Eurasia Journal of Mathematics, Science & Technology Education, 2016, **12**(5), 1221-1229
doi: 10.12973/eurasia.2016.1508a

Design and Implementation of Marine Information System, and Analysis of Learner's Intention Toward

Yu-Jen Pan
Ta Hwa University, TAIWAN
Jui-Chung Kao & Te-Cheng Yu
National Kaohsiung Marine University, TAIWAN

•*Received 29 June 2015*•*Revised 8 August 2015* •*Accepted 25 August 2015*

The goal of this study is to conduct further research and discussion on applying the internet on marine education, utilizing existing technologies such as cloud service, social network, data collection analysis, etc. to construct a marine environment education information system. The content to be explored includes marine education information system design, the establishment of marine environment knowledge exchanging mechanism and learner's intention toward use. We take students from one national university of science and technology as objects, figuring out the behavioral intention of college students toward applying marine education information system in teaching. The survey and analysis showed if users consider the system is easy to use, and the system function is clear and comprehensible, they will have higher efficiency of learning.

Keywords: marine education, information system, intention analysis

INTRODUCTION

In recent centuries, the economic development of costal countries worldwide is associated with trading. Amongst the diverse channels of trade, the emergence of marine trade can be traced back to the age of sail. After 20th century, the dependence of countries on marine trade had greatly increased. It is obvious that marine trade plays an important role in global economic development. Marine education issue is not limited to marine science and environment. It also involves other fields such as art, history, culture, economics, recreation, law and politics, etc. Hence, marine education has been suggested to be incorporated to the curriculum and teaching of all schools since 2011.

Owing to marine education is related to a lot of fields and the negligence of the government and education units, the involvement of marine education is facing

Correspondence: Yu-Jen Pan,
Department of Digital Content and Technology, Ta Hwa University, 307, Hsinchu County, Taiwan.
E-mail: yjpan@tust.edu.tw

State of the literature

- Marine education issue involves marine science, environment, history, culture and politics, etc. In Taiwan, marine education has been suggested to be incorporated to the curriculum and teaching of all schools since 2011.
- Teaching materials introducing the concept of marine are increasing, however, materials relevant to the implementation of marine education are still insufficient.
- Marine knowledge is an understanding towards how marine affects you and how you affect marine.

Contribution of this paper to the literature

- This study be explored includes marine education information system design, the establishment of marine environment knowledge exchanging mechanism and learner's intention toward use.
- This study integrates the existing marine resource protection with the marine education policy of government, combining information technology to figure out the available resource and applicable ways to promote marine education via the internet.
- The feasibility of marine knowledge education platform is considered very high and further has positive influence on their intention to use the system.

some difficulties and problems. Along with the development of marine trade, recently, the occurrence of marine and marine environment protection cases is increasing year by year. In addition, General Coast Guard Administration, Executive Yuan maintains the order of local maritime space and coastline in Taiwan and resource protection to ensure nation safety and the well-being of the people. It executes maritime laws and is responsible for marine related affairs such as life rescue, disaster rescue, admiralty dispute, trespassed fishing enforcement, three-nautical-mile trawl, marine ecosystem destruction, marine pollution, fish protection and the management of marine and marine environment protection cases. In recent years, countries around the world have extended their power towards the ocean on the aspect of technology to enhance the understanding toward marine ecosystem and environment to reinforce the efficiency for marine affair management and accelerate the formation and development of newly-emerged marine industries, obtaining power in the development of marine economy and national power and breaking new ground, making 21st century a new era of "Blue Revolution" (Ministry of Education 2007).

To sustainably use the marine environment and its resource, we have to rely on the power of education to cultivate people with human and science marine literacy (C.Y. Huang 1999). Teaching materials introducing the concept of marine are increasing, however, materials relevant to the implementation of marine education are still insufficient, and there is an imbalance between science and humanity in the materials (S.L. Fan 2000, Y.Y. Liu 2007). Curriculum and teaching towards marine education published by education institutes or textbook publishers are far less than that towards other subjects. The available resource for related institutes to promote marine education is limited and rarely involved in textbooks (C.H. Li 2006). Furthermore, the cognition and sense towards environment of people are important factors affecting environmental policy and management (H. Weidner, M. Janicke 1997). Ocean Literacy (2008) proposed "marine knowledge is an understanding towards how marine affects you and how you affect marine." The actions and attitude people participating in marine and coast activities would bring risk or hazard to marine. And the source people obtain information related to marine and coast environment would affect their views and behaviors toward the environment (B.S. Steel et al. 2005). Knowledge refers to "being familiar with the fact or status for certain thing through the experience or imagination, and it is also the information or understanding obtained by an individual" (Lin, 2009). From the above-mentioned definition, "marine environment knowledge" is "individual's understanding for marine environment through the experience or imagination", and individual's knowledge toward marine environment directly affects their attitude towards marine environment.

The government formulated "Marine Education Policy White Paper" in 2007. This is the first policy white paper formulated for marine education, aiming at enhancing

the marine literacy of students in all schools and the public to cultivate talents for industries, establishing a platform taking promoting marine education as one of its directions. It is strategized to facilitate the exchange, sharing and application of resource and information related to marine education. We wish to establish a platform to exchange marine education information and the resource and resulting information of all sorts of database, including industries, school system, government institutes and non-profit organizations. This study integrates the existing marine resource protection with the marine education policy of government, combining information technology to figure out the available resource and applicable ways to promote marine education via the internet. We combine existing technologies such as cloud technology, internet, geographical information and social network to develop an information system which is effective for the learning, sharing and management of the marine education information system.

BACKGROUND

Computer-Based Training (CBT) has become a trend for teaching. Hartman et al. (1995) compared the effect of traditional teaching and network teaching on composition learning by experiments. The results showed in web-based interactive teaching group, the interaction between teachers and students is significantly higher than that in traditional teaching group. Network distant education learner should equip themselves with active learning spirits to achieve the goal of self-learning and self-monitoring and then the responsibility of learning, and finally, obtain the ability to collect and comprehend the information; although traditional education also requires voluntary and active learning, in comparison with distance education, learners need to have more motivation for actual operation and active learning participation. The role of the Internet and distance course teachers is to equip themselves with related technological literacy and well utilize networking technology to enhance the teaching effectiveness. Their roles are more like the mediator, guide, edifier and resource consultant of knowledge. From the above exploration for comparing and corresponding to the difference, we realize that learners should be active, acquire knowledge voluntarily and learn to access and utilize resources; teachers should properly utilize technologies to learn to be a better guide, edifier, resource consultant, etc. That makes the role more difficult and challenging to play than that of traditional teachers. Nevertheless, there have been a variety of mature related networking technologies. In addition to develop hardware facilities, it is also important for teachers to play the role appropriately, making technology a fuel not a barrier.

Taiwan is surrounded by sea with coastline at length of 1,140 km, and therefore, is closely associated with the ocean. The marine environment in Taiwan has a lot of features; although coastline ecosystem varies with geographical environment, the common feature between these systems surrounded by the ocean is the complex and abundant creatures. At present, the marine environment is facing problems such as pollution, illegal fishing, overfishing by diving, coral community destruction, etc. Marine environment is associated with our living quality. Thus, we should actively promote and implement marine environmental education, developing a correct concept for marine environment protection; for implementation, on one hand, educating people the truth, goodness and beauty of the marine environment, on the other hand, teaching people how to face marine environmental problems (R.G. Zhan 1999). Marine environment is like other environments, therefore, when promoting marine environmental education, it is better to let students experience on the field. However, when teaching is limited by some factors and unable to let students experience on the field, multimedia network education system will play the role of mediator through network teaching.

Technology Acceptance Model (TAM) is a theory developed by Davis et al. (1989) being used to explain the determinant factors of information technology acceptance, especially for technology using behavior. This theory is based on theory of reasoned action. This model is widely applied to predict and explain the acceptance of personal information system. TAM considers attitude as an important factor affecting users' behavior. And attitude is affected by the two variables: perceived usefulness and perceived ease of use; perceived usefulness positively affects perceived ease of use; perceived usefulness and perceived ease of use are affected by external variables.

RESEARCH METHODS

This project is based on the application of information technology on marine information education, developing a marine knowledge information system which is effective for learning, sharing and management. We conduct the design based on Service-Oriented Architecture (SOA) method to achieve the goal of delivering the data and integrating the operation. Service-oriented architecture is a system design method being developed along with the emergence of the Internet. It is a software model consisted of users' requirements. Its composite elements include three parts: software components, service and process. It is service-oriented. Through the object-oriented functions, the software components of the system are provided as the form of services. The related processing step of "process" defined service is adopted to design and construct the entire system. The information system of this study is based on relational database and cloud geographical information system, combining information serving technology of the Internet, developing the system on the network to form an effective system which enables information sharing and real-time update; the information of the entire system will be presented in a list and the geographical information system (Google Map/Earth).

General Coast Guard Administration is the execution unit to maintain domestic marine order and environment. Related maritime cases are comprehensively recorded and estimated statistically, and therefore, data from General Coast Guard Administration can make the information system complete. Thus, this study is based on distributed heterogeneous system, integrating the data from General Coast Guard Administration to construct marine knowledge education system. Considering the flexibility of system integration and expandability of functions in the future, we proposed a data transmission and operation integration platform based on SOA to ensure the existing data to exchange the necessary data and assist the execution of the adjusting system, enabling the cooperation of cross-platform communication and achieving resource sharing of marine education. The system architecture is

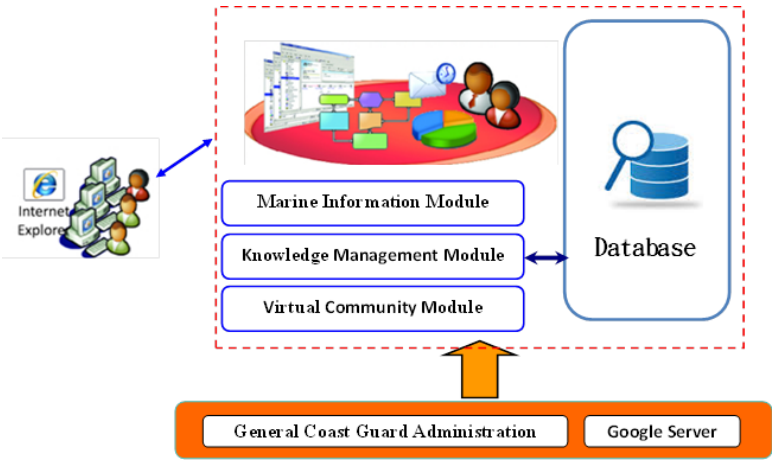

Figure 1. System Framework

shown in Figure 1. The bottom is the data resource necessary for constructing the platform. After organizing and analyzing the data, they will be stored in the relational database on the right. The data in the database is classified into seven categories.

It increases the convenience for the management and maintenance of the future system and the information presentation of the user interface. We design three function modules for this platform: first is the marine information module which includes database management system, marine information and user system, second is the knowledge management module is manager system and third, the virtual community module which is the community network system. The goal of the three designed function modules is to enable real-time interaction and feedback between users or user and manager (experienced users). Therefore, users can exchange opinions toward related information provided by the marine knowledge module when they have any ideas or suggestions through the virtual community module established by social network technology with other users or managers. Furthermore, managers will put new marine policy, education, environment or events in the community module to timely accelerate the understanding of users towards the marine, helping users to build correct values towards the ocean.

This study uses cloud computing application Maps API/Earth API provided by Google to develop our geographical information system. Google (earth) is a virtual 3D globe developed by Google building satellite pictures, aerial photography and GIS on an earth 3D model. Google Map is a high-performance cloud service platform based on the application of the Internet; it not only provides global image and vector data, but also innovative street view service. We plan to integrate the information provided by General Coast Guard Administration and combine the popular AJAX and other webpage technologies to develop the system. Figure 2 is the illustration of marine education geographical information system.

We will take TAM as theoretical basis to explore the behavioral intention model of college students applying marine education information system to teaching. We will conduct the discussion by the following four parts (Figure 3): first, we will explore the relationship between "attitude toward use" and "behavioral intention"; then the relationship between "behavioral intention", "attitude toward use" and "perceived usefulness"; finally, the relationship between "attitude toward use", "perceived usefulness" and "perceived ease of use." Therefore, this study assumes:

H1: The attitude toward use of college students would positively influence the behavioral intention

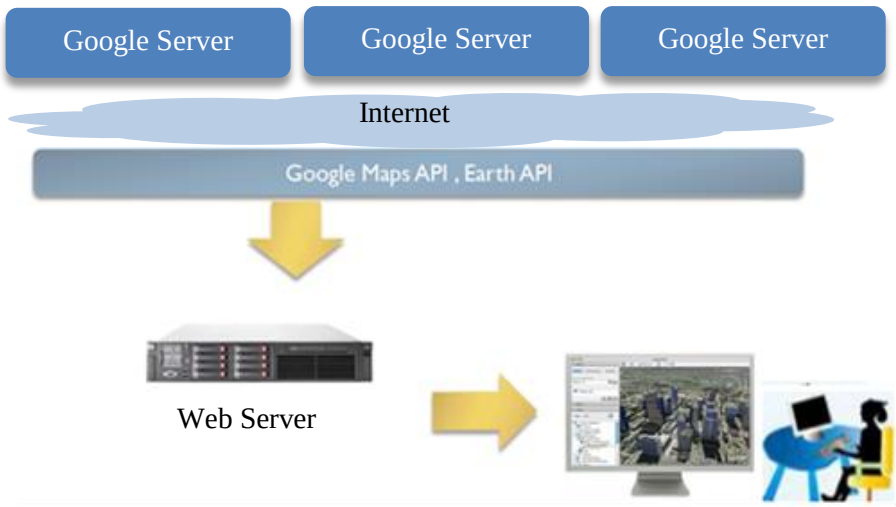

Figure 2. Illustration of marine education geographical information system

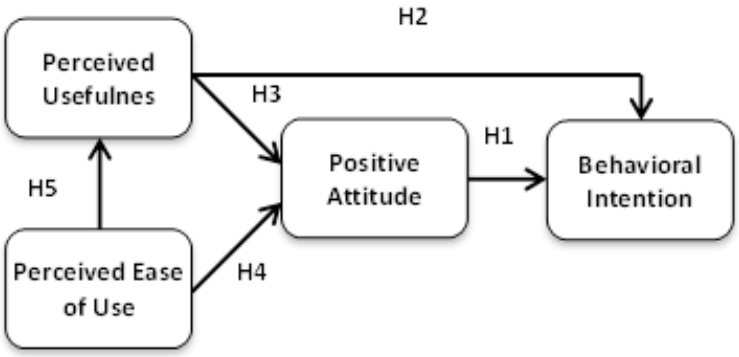

Figure 3. Research framework

H2: The perceived usefulness of college students would positively influence behavioral intention

H3: The perceived usefulness of college students would positively influence the attitude toward using

H4: The perceived ease of use of college students would positively influence the attitude toward using

H5: The perceived ease of use of college students would positively influence perceived usefulness

SYSTEM FUNCTION AND CORRELATION ANALYSIS

We successfully design four major functions for the web function and operation as following: (a) Marine affair information which provides the basic and advanced search function of domestic marine affair information; (b) Marine knowledge sharing, providing related marine information; (c) Community discussion which combines social services including Facebook, Google+, etc. to provide social discussion and sharing; (d) Backend management module which enables the website manager to maintain and edit the web content. Marine knowledge sharing provides managers with online post publishing function. Through the power of the community, they can promote marine education and share the comment of using marine education teaching resource. For publishing posts, there are columns for post title, the name of the poster, e-mail address, date, article content to be filled out. Each post is integrated with community service function, enabling users to share related messages with others through social network technology and conduct further discussion.

The study adopts the questionnaire to collect the perceived usefulness, perceived ease of use, attitude toward use and behavioral intention of users towards marine education information system; all items were measured on a five-point Likert scale, ranging from strongly disagree (5) agree (4) through neutral (3) to disagree (2) and strongly agree (1). We adopt SPSS Statistics 18.0 as the data analysis tool.

This study conducts analysis on the average of variables by Pearson correlation analysis to measure the direction and strength of "linear relationship" between independent variables and dependent variables. Pearson correlation coefficient ranges from +1 to -1. The more the value approaches +1 and -1, the stronger the correlation between the variables will be. When the value approaches zero or equals to zero, it indicates there is no correlation between two variables. The correlation coefficient and correlation degree between two variables can be divided into:

(a) Highly correlated: r value is above 0.7 (including 0.7);

(b) Moderately correlated: r value is above 0.3 (including 0.3) to below 0.7 (excluding 0.7);

Table 1. Correlation matrix of each research variable

Research Dimension	Perceived Usefulness	Perceived Ease of Use	Attitude toward Use	Behavioral Intention
Perceived usefulness	1			
Perceived ease of use	0.660**	1		
Attitude toward use	0.762**	0.634**	1	
Behavioral intention	0.759**	0.544**	0.766**	1

*Note : * indicating p<0.05 ** indicating p<0.01 *** indicating p<0.001*

Table 2. Regression analysis of attitude toward use and perceived usefulness to behavioral intention

Independent Variable	Unstandardized Coefficient		Standardized Coefficient Beta Distribution	t Value	p Value
	Estimated Value of B	Standard Value			
Constant	2.967	1.087		2.730	0.007
Perceived usefulness	0.499***	0.083	0.417	6.030	0
Attitude toward use	0.469***	0.072	0.488	6.470	0

*Adjusted R Square = 0.656 F = 163.617 P = 0.000****
Dependent variable: behavioral intention
*Note : *indicating p<0.05 ** indicating p<0.01 *** indicating p<0.001*

(c) Modestly correlated: r value is below 0.3

From Table 1 it is known that when significant level between constructs is 0.01, it reaches significant relationship. The correlation coefficients for "perceived usefulness" and "attitude toward use", "perceived usefulness" and "behavioral intention" and "attitude toward use" and "behavioral intention" are 0.762, 0.759 and 0.766, respectively, which are "highly positively correlated"; the correlation coefficient between other variables range from 0.544 to 0.660, belonging to "moderately correlated." There is a positive correlation between all constructs, and therefore, a regression analysis can be conducted.

VALIDATING RESEARCH HYPOTHESES

Effect analysis of perceived usefulness and attitude toward use on behavioral intention

Two hypotheses for "behavioral intention" of the marine education information system are as following:

H1: "attitude toward use" has significantly positive influence on "behavioral intention".

H2: "perceived usefulness" has significantly positive influence on "behavioral intention".

To explore the extent which the attitude toward use and the perceived usefulness influencing the behavioral intention, this study takes perceived usefulness and attitude toward use as independent variable and behavioral intention as dependent variable. As shown in Table 2, from the regression analysis results, the overall explaining power of the regression estimation toward users' attitude is 65.6%, F value is 163.617 and P<0.001, indicating the regression effect of 65.6% is statistically significant.

Effect analysis of perceived usefulness and perceived ease of use on attitude toward use

There are two hypotheses for "attitude toward use" of the marine education information system as following:

H3: "perceived usefulness" has significantly positive influence on "attitude toward use".

H4: "perceived ease of use" has significantly positive influence on "attitude toward use".

To explore the influence of perceived ease of use and perceived usefulness on behavioral intention, this study takes perceived usefulness and perceived ease of use as independent variables and attitude toward use as dependent variable. As shown in Table 3, from the regression analysis results, the overall explaining power of the regression estimation toward users' attitude is 60.6%, F value is 132.459 and P<0.001, indicating the regression effect of 60.6% is statistically significant.

Effect Analysis of perceived ease of use to perceived usefulness

There is a hypothesis for "perceived usefulness" of the marine education information system as following:

H5: "perceived ease of use" has significantly positive influence on "perceived usefulness".

To explore the extent the perceived ease of use influencing the perceived usefulness, this study takes perceived ease of use as independent variable and perceived usefulness as dependent variable. As shown in Table 4, from the regression analysis results, the overall explaining power of the regression estimation toward users' attitude is 43.2%, F value is 130.986 and P<0.001, indicating the regression effect of 43.2% is statistically significant.

CONCLUSIONS

This study incorporated the content of "Marine Education Policy White Paper", combining information technology, through the understanding of applicable resource and feasibility of marine education promoted on the Internet, integrating cloud geographical information, Internet and social community service to build a teaching environment of marine education information system and test them on teaching courses of related faculties in college schools.

The survey and analysis showed when users consider the system is easy to use, and the function is clear and comprehensible, users will consider it can increase the

Table 3. Regression analysis of perceived ease of use and perceived usefulness to attitude toward use

Independent Variable	Unstandardized Coefficient		Standardized Coefficient Beta Distribution	t Value	p Value
	Estimated Value of B	Standard Value			
Constant	4.286	1.125		3.811	0
Perceived Usefulness	0.694***	0.073	0.608	9.517	0
Perceived ease of use	0.230***	0.063	0.233	3.646	0

*Adjusted R Square = 0.606 F = 132.459 P = 0.000****
Dependent variable: attitude toward use
*Note : * Indicating p<0.05 ** Indicating p<0.01 *** Indicating p<0.001*

Table 4. Regression analysis of perceived ease of use to perceived usefulness

Independent Variable	Unstandardized Coefficients		Standardized Coefficient Beta Distribution	t Value	p Value
	Estimated Value of B	Standard Value			
(Constant)	6.031	1.089		3.811	0
Perceived ease of use	0.570***	0.050	0.660	11.445	0

*Adjusted R Square = 0.432 F = 130.986 P = 0.000****
Dependent variable: perceived usefulness
*Note:*indicating p<0.05 ** indicating p<0.01 *** indicating p<0.001*

efficiency of learning. Overall, the feasibility of marine knowledge education platform is considered very high and further, has positive influence on their intention to use the system.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the financial support provided to this study by the Ministry of Science and Technology in Taiwan under Grant No. 102-2511-S-233-001.

REFERENCES

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science*, 35(8), 982-1003.

Fan, S. L., (2000). A study on the Construction of Conceptual Hierarchy for Marine Environmental Education and an Analysis of Textbook Contents of Elementary and Secondary Schools in Taiwan. Master's thesis, National Sun Yat-sen University Department's Marine Environment and Engineering.

Hartman, K., Neuwirth, C. M., Kiesler, S., Sproull, L., Cochran, C., Palmquist, M., & Zubrow, D., (1991). Patterns of social interaction and learning to write: some effects of network technologies. *Written Communication,* 8(1), 79-113.

Huang, C. Y., (1999). Envisioning for the Marine Education of Kaohsiung: Discussed from the View Point of Environmental Education, Science Education and Agenda 21, *Research and Development in Science Education Quarterly,* 15, 39-48.

Li, C. H., (2006). The present and future of marine education in Taiwan. *Bimonthly Journal of Educational Resources and Research,* 69, 103-110.

Lin, C. T., (2009). A Study of Medical and Non-Medical College Students' Knowledge and Attitudes toward Older People in a University in Southern Taiwan, Master's thesis, National Cheng Kung University's Institute of Gerontology.

Liu, Y. Y., (2007). A Content Analysis on the Marine Education in the Textbooks of Social Studies in Junior High School, Master's thesis, National Taiwan Ocean University's Institute of education.

Ministry of Education. (2007). *Marine educational policy white paper*. Taipei: Ministry of Education.

Ocean Literacy. (2008). Retrieved from http://oceanliteracy.wp2.coexploration.org/ Retrieved 03/25, 2011.

Steel, B. S., Smith, C., Opsommer, L., Curial, S., & Warner-Steel, R., (2005). Public ocean literacy in the United States. *Ocean & Coastal Management*, 48, 97-114.

Weidner, H., & Janicke, M., (1997). *The political systems capacity for environmental policy,* New York, Springer.

Zhan, R. G., (1999 May). Taiwan marine environmental education and ecological environment education quarterly. *Environmental Education Quarterly,* 39. Retrieved from http://www.ntnu.edu.tw/eec/eeq/39/eeq39.htm