The Correlation between the Application of Computer Multimedia Integrated Environmental Education and Environmental Sensitivity and Behavior

Zhi-Yong Zhuang [1], **Wei Qiao** [2*]

[1] School of Physical Education, Huaqiao University, Quanzhou 362021, CHINA

[2] Department of Physical Education, Xiamen Institute of Technology, Xiamen, 361021, CHINA

* Corresponding author: 57968290@qq.com

Abstract
Along with industrial development, people accelerate the exploitation of natural resources for the economic prosperity. Behind the economic growth, serious environmental pollution and ecological unbalance are the cost. The enhancement of correct environmental protection knowledge of the government and the public to form the consensus and the acceleration of the achievement of environmental protection rely on the promotion of environmental education. Since the practice of information education, it is expanded to the comprehensively diverse computer multimedia networks. The utilization of computer multimedia as the teaching materials would be appropriate for the practice of environmental education. With experimental design, 206 college students in Fujian Province, as the research objects, are preceded environmental education with computer multimedia. The 16-week experimental instruction is preceded for 3 hours per week (total 48 hours). The research results show 1.positive and significant effects of environmental education on environmental sensitivity, 2.positive effects of environmental sensitivity on environmental behavior, and 3.positive and remarkable effects of environmental education on environmental behavior. According to the results to propose suggestion, it is expected to instruct students with correct environmental knowledge through computer multimedia integrated environmental education to cultivate the environmental sensitivity and enhance the environmental behavior.
Keywords: computer multimedia, environmental education, environmental sensitivity, environmental behavior

INTRODUCTION

Global warming has become the most important issue in the century. Along with industrial development, increasing greenhouse gas results in rising temperature globally and threatens the living environment of humans. The concept of "energy saving and carbon reduction" therefore becomes the primary policy in various countries. After industrial revolution, people accelerate the exploitation of natural resources for the economic prosperity. The advance industry and business destroy the natural environment. Behind the economic growth, people have to pay for serious environmental pollution and ecological unbalance with continuous problems of contaminated air, river pollution, noise deafening, soil poisoning, garbage war, and extinction of rare animals and plants. With the insistence on conquering the nature to develop the land, people are aroused the emphasis on the protection of living environment and natural ecology after economic prosperity, worsening environmental quality, and ruthless counterattack of the nature. Nevertheless, garbage discard, toxic item dumping, deforestation, water and soil destroy, and picking and hunting of plants and animals are still happening everywhere. During the environmental movement, the enhancement of correct environmental protection knowledge of the government and the public to form the consensus and accelerate the achievement of environmental protection rely on the promotion of environmental education.

Information education is a development key in future education. Since the practice of information education, the teaching and learning ecology in schools are changing. After being made public of the Internet, the entire education environment is largely changed, and knowledge sources are expanded from books, teachers, and schools to comprehensive and diverse computer multimedia network world. In this case, education is the method to fundamentally solve environmental problems, enhance students' knowledge

of environmental problems and environmental problem solving ability, change individual behaviors and concepts, and cultivate correct attitudes so as to arouse the public maintaining the natural ecological environment. Computer multimedia assisted teaching covers texts, graphs, images, music, meticulous layout, and vivid interpretation to break through the entire teaching activity. The utilization of computer multimedia assisted materials as the teaching materials for environmental education would be appropriate. By applying computer multimedia integrated environmental education to the empirical study on environmental sensitivity and behavior, it is expected to instruct students with correct environmental knowledge through computer multimedia integrated environmental education in order to cultivate students' environmental sensitivity and promote students' environmental behavior.

LITERATURE REVIEW
Computer Multimedia

Ho et al. (2015) described the application of computer multimedia assisted materials to teaching activity as using various multimedia projection systems in multimedia audiovisual classrooms to provide more modernized multimedia curricula and adopting richer teaching data than blackboards, chalk, and textbooks to education in the new era. Moghimehfar and Halpenny (2016) explained computer multimedia integrated teaching as integrating information technology into curricula, teaching materials, and instruction so that information technology became the necessary teaching and learning tool for teachers and students and the use of information technology became a part of daily teaching activity in classrooms. Grønhøj and Thøgersen (2017) mentioned that computer multimedia integrated teaching did not simply refer to teachers being able to use computers; more precisely, teachers were able to use computers for more effectively achieving the teaching objectives. Shang et al. (2017) indicated that "information technology" in information multimedia integrated teaching referred to computer multimedia or network technology with the functions of digitalization, multiple stimulation of audio-visual sound and light, ease of access, rapid processing, and convenience for communication; and, "implementation of integration" was the application of teaching and learning integration, i.e. being the teaching tool.

Environmental Education

Koh et al. (2015) indicated that environmental education was originated from the US conservation

education in the 19th century. The destruction of natural ecology and the worsening environmental quality induced the conservation movement in the US. With the effort of Muir, the concept of natural protection was implanted in human minds to discard the deviation concept of exploiting and utilizing the nature. Education was emphasized in conservation movement. Simsekli (2015) mentioned that conservation professionals had to deliver the philosophy and objective to the public in order to win the public support for the conservation program. Ali et al. (2018) indicated that environmental education aimed to cultivate and enhance individual or group awareness, knowledge, attitudes, skills, evaluation ability, and participation related to environment. Williams (2015) explained that environmental education did not simply aim to acquire environmental knowledge, but more importantly, to perfect students' attitudes towards the environment and practice of responsible environmental behaviors in daily life. Esin et al. (2015) pointed out the philosophy of environmental education including integrity, lifelong education, interdisciplinary integration, active participation in problem solving, balance between world view and local view, sustainable development, and international cooperation. Botetzagias et al. (2015) stated that environmental education was the process of concept cognition and value clarification to develop necessary skills and attitudes for the mutual relationship between humans, culture and the creature, physical environment. Rachel et al. (2015) mentioned that environmental education also required the application of environmental quality decision-making and self-oriented behavior norms. The environmental education contents contained environmental awareness and sensitivity, environmental concept knowledge, environmental value and attitudes, environmental movement skills, and environmental movement experiences.

Referring to Wang (2016), the following dimensions are used for discussing environmental education in this study.

(1) Intellectual concept: referring to the environment and the surrounding natural ecology, geomorphologic characteristics, environmental ecology loop, pollution concept, environmental maintenance, and limited environmental resources.

(2) Affective concept: referring to concerns about environment, appreciation of the beauty of natural ecology, correct environmental ethics and value, and integration of environmental humanities and art.

(3) Skill concept: referring to prevention and control of environmental pollution, purification of water, environmental resource development and management, environmental resource conservation, and environment maintenance behavior.

Environmental Sensitivity

Wu and Lai (2015) defined environmental sensitivity as the empathic perception of an ecological system (composed of humans or other creatures) to the environment, i.e. the reaction to the serious impact and hazard of bad environmental changes (pollution, disasters, and artificial development) on the security, survival, and reproduction in the ecological habitat environment. De Leeuw et al. (2015) regarded environmental sensitivity as individuals empathetically inspecting the emotional character of environment, i.e. individual discovery, exploration, appreciation, respect, and concern about the environment. Vanesa et al. (2018) defined environmental sensitivity as the emotional character allowing an individual treating the environment from the viewpoint of empathy that environmental sensitivity was the sympathy for the environment. Joanne and Erminia (2015) pointed out environmental sensitivity as the opinion about the relevance of environmental problems to individuals. The cultivation of environmental sensitivity required long-term and profound natural experience or the guidance of role model in life. A person concerning more about the environment would present the motivation to solve environmental problems; therefore, environmental sensitivity was the environmental point of view induced from individual empathy. Pienaar et al. (2015) referred environmental sensitivity to people cultivating the cognition of various environmental destruction and pollution, through the training of sensory perception (e.g. observation, measurement, deduction, prediction, analysis, and interpretation), and the appreciation, concern, and sensitivity to the beauty of natural environment and artificial environment.

Referring to Thu and Kato (2016), the following dimensions are used for measuring environmental attitudes in this study.

(1) Cognition: referring to the knowledge and perception combined with humans' direct experience in the attitude target and relevant information.

(2) Emotion: referring to humans' positive or negative responses to the attitude target, i.e. individual emotional feelings about the environment, which might be like or dislike, good or bad.

Environmental Behavior

Huang (2016) defined environmental behavior as individual or group behaviors for solving certain environmental problems. Rocío et al. (2017) referred environmental behavior to individual responsible environmental behavior to adopt actions beneficial to environment improvement or environmental quality enhancement or maintenance and practice in life in order to achieve the sustainable development. Echazarra et al. (2016) pointed out environmental behavior as the basic model of the interaction between human behavior and environment or the reaction to the environment. Conke (2018) explained that, in the environmental belief and behavior based value, individuals being willing to donate something exceeding the profit value, i.e. the value of self-transcendence, responsibility for the society, altruism, and biosphere, to enhance the responsible environmental behavior. Juanita & Sergio (2016) indicated that consumers, in order to protect the environment, had to adopt environment-friendly behaviors to maintain natural resources and protect the environment from being destroyed, such as recycle and energy saving & carbon deduction. Alpízar & Gsottbauer (2015) pointed out environmental behavior as individual or group behaviors for solving certain environmental problems. Environmental citizenship, after presenting environmental knowledge, environmental attitudes, and environmental skills, had to adopt actions and participate in solving various environmental problems. Quinn et al. (2016) defined environmental behavior as individual or group behaviors intending to sovle certain environmental problems, i.e. the route of individuals or groups preventing or solving environmental problems and issues.

Referring to Sadi and Lee (2018), the following dimensions are proposed in this study for environmental behavior.

(1) Ecological management: Adopting actions to the environment in daily life to directly achieve the objective of environmental protection, e.g. recycle, saving water and electricity, and reducing garbage.

(2) Economic behavior: Individuals or groups adopt economic support or boycott to achieve the objective of environmental protection, e.g. avoiding the purchase of products which would result in pollution and boycotting businesses which do not emphasize environmental protection.

(3) Persuasion action: Individuals or groups persuade others to support environmental protection,

e.g. informing others what actions could solve environmental problems and advising others to stop environmental destruction.

Research Hypothesis

Koh et al. (2015) pointed out notable correlations between pupils' marine environmental education and environmental sensitivity. Ali et al. (2018) discovered that college students with higher scores on the environmental education scale acquired higher scores on the scale of environmental sensitivity to energy problems. In the 10-day environmental science education of high-school students, Williams (2015) found out more positive attitudes towards environmental sensitivity of students with higher environmental knowledge. After students received the environment related courses or programs for 4-8 weeks, Vanesa et al. (2018) found out the positive correlation between environmental knowledge and environmental sensitivity. Wang (2016) measured the concerns of junior high school teachers about environmental sensitivity and the environment with 10 major domestic environmental events and revealed the positive correlation between environmental sensitivity and environmental education. It is therefore assumed in this study that

H1: Environmental education shows positive and significant effects on environmental sensitivity.

Wu and Lai (2015) pointed out environmental sensitivity as the opinion about the seriousness of environmental problems and the relevance to individuals. Pienaar et al. (2015) discovered that students with high environmental sensitivity presented more environmental actions. Rocío et al. (2017) also mentioned that students participating in more environmental activities showed higher environmental sensitivity; in other words, students participating in more environmental activities would more easily pay attention to environmental problems in daily life that the sensitivity was higher. Thu and Kato (2016) pointed out the remarkably positive correlation between environmental sensitivity and environmental behavior of high-graders in elementary schools; pupils with higher environmental sensitivity presented more positive environmental behavior. Students or teachers, at any stages, tending to positive environmental sensitivity, participating in more environmental activities, and more easily paying attention to environmental problems in daily life revealed higher environmental sensitivity. Accordingly, the following hypothesis is proposed in this study.

H2: Environmental sensitivity appears positive effects on environmental behavior.

Huang (2016) pointed out the notably positive correlation between environmental education and environmental behavior, i.e. significant effects of environmental education knowledge on environmental behavior. Juanita and Sergio (2016) found out the remarkable correlation between environmental behavior and environmental education, but insignificant relationship with other variables. Conke (2018) pointed out the knowledge and skill to adopt environmental education as the factors in environmental behavior, and action intention was also an important factor in teachers' environmental behavior. In the discussion of elementary pupils' environmental behavior, Sadi and Lee (2018) found out the notable correlation between environmental education knowledge and environmental behavior; besides, the group with high environmental knowledge presented more environmental behavior than the group with low environmental knowledge on "overall environmental behavior", "ecological management", and "consumption action". The following hypothesis is therefore proposed in this study.

H3: Environmental education reveals positive and remarkable effects on environmental behavior.

SAMPLE AND MEASUREMENT INDICATOR

Research Sample and Object

Total 206 college students in Fujian Province, as the research objects, are preceded the experimental research with 16-week computer multimedia environmental education for 3 hours per week (total 48 hours).

Analysis Method

SPSS factor analysis is applied to test the reliability and validity and SEM is used for understanding the relationship among environmental education, environmental sensitivity, and environmental behavior in this study.

Test of Reliability and Validity

With factor analysis, the environmental education scale is extracted three factors, the environmental sensitivity scale is extracted two factors, and the environmental behavior scale is extracted three factors.

variable	factor dimension	eigenvalue	α	cumulative variance explained
environmental education	intellectual concept	3.143	0.89	80.178
	affective concept	2.756	0.83	
	skill concept	2.411	0.87	
environmental sensitivity	cognition	3.262	0.92	86.522
	emotion	2.755	0.91	
environmental behavior	ecological management	2.214	0.86	81.433
	economic behavior	1.688	0.81	
	persuasion action	1.946	0.84	

EMPIRICAL RESULT ANALYSIS
Structural Model Analysis

Structural model analysis contains model fit analysis and overall model explanation power. Referring to researchers' opinions, 7 numerical indices are used for testing the overall model fit, including chi-square (χ^2) test, χ^2-degree-of-freedom ratio, fit indices, adjusted fit indices, root mean square error, compared goodness-of-fit indices, compared hypothesis model, and chi-square difference of independent models. The overall result analyses are organized in **Table 1**.

Table 1. Research model fit analysis

fit index	allowable range	this research model	model fit judgment
χ^2 (Chi-square)	the smaller the better	18.62	
χ^2 -degree-of-freedom ratio	<3	1.59	conformed
GFI	>.9	0.96	conformed
AGFI	>.8	0.85	conformed
RMSEA	<.08	0.06	conformed
CFI	>.9	0.93	conformed
NFI	>.9	0.91	conformed

Overall view, the χ^2-degree-of-freedom ratio is used for testing the model fit, which is the smaller the better. The χ^2-degree-of-freedom ratio of this research model appears ＜3 (1.59). GFI and AGFI are better close to 1, and there is not an absolute standard to judge the model fit; GFI＞.9 and AGFI＞.8 are acceptable. GFI and AGFI in this study shows .96 and .85, respectively. RMSEA in .05-.08 reveals good model and reasonable fit. RMSEA of this research model appears .06. The allowance standard of CFI is ＞.9, and CFI in this study shows .93. NFI should be larger than .9, and NFI in this study presents .91. Overall speaking, the fit indices conform to the standards, revealing the acceptable

research results. The sample data in this study therefore could be used for explaining the real observation data.

From previous overall model fit indices, the model structured in this study shows favorable goodness-of-fit with observation data, revealing that the theoretical model could fully explain the observation data. In this case, the correlation coefficient and coefficient estimated value of environmental education to environmental sensitivity and environmental behavior could be further understood after the model fit test.

The research data results are organized in **Table 2**. The complete model analysis results reveal that three factors of environmental education (intellectual concept, affective concept, skill concept) could significantly explain environmental education ($t>1.96$, $p<0.05$), two factors of environmental sensitivity (cognition, emotion) could remarkably explain environmental sensitivity ($t>1.96$, $p<0.05$), and three factors of environmental behavior (ecological management, economic behavior, persuasion action) could notable explain environmental behavior ($t>1.96$, $p<0.05$). Apparently, the overall model presents good preliminary fit.

Table 2. Overall linear structural model analysis result

evaluation item	parameter/evaluation standard		result
basic fitness	environmental education	intellectual concept	0.70★
		affective concept	0.68★
		skill concept	0.65★
	environmental sensitivity	cognition	0.76★★
		emotion	0.75★★
	environmental behavior	ecological management	0.71★★
		economic behavior	0.67★
		persuasion action	0.73★★
internal fit	environmental education→ environmental sensitivity		0.82★★
	environmental sensitivity→ environmental behavior		0.87★★
	environmental education→ environmental behavior		0.86★★

Note: ★ stands for $p<0.05$, ★★ for $p<0.01$, and ★★★ for $p<0.001$

In regard to internal fit, environmental education shows positive and significant correlations with environmental sensitivity (0.82, $p<0.01$), environmental sensitivity reveals positive and remarkable correlations with environmental behavior (0.87, $p<0.01$), and environmental education appears positive and notable correlations with environmental behavior (0.86, $p<0.01$) that H1, H2, and H3 are supported.

CONCLUSION

The research results reveal that environmental education could be matched with computer multimedia. Using computer multimedia resources for supporting environmental education could enrich the presentation of traditional materials, induce students' learning motivation, provide diverse learning information, and induce students' imagination and creativity. Learning methods in the future should not be passively taught environmental knowledge by teachers; more importantly, students should combine environmental knowledge with life, timely develop keen observation, and discover environmental problems. A lot of environmental information for students comes from mass media, and lots of mass media would report and introduce environmental information; however, the mass public does not emphasize and fully apply such information. Well utilizing the power of mass media could enhance the public environmental knowledge. For this reason, computer multimedia could be preceded in schools for the promotion of environmental education, and it is better to synchronously precede environmental sensitivity, environmental knowledge, and environmental behavior. In this case, students could enhance the environmental sensitivity or knowledge as well as the environmental behavior. The process to encourage students engaging in environmental behavior would relatively enhance the environmental sensitivity and environmental knowledge. Such benign environment learning processes could help the environment.

SUGGESTION

From the research results and findings, the following practical suggestions are further proposed in this study.

1. Computer multimedia has become the fastest channel for information circulation. Educators should well apply computer multimedia, e.g. designing online games with energy saving and carbon reduction and playing energy education films, to enhance students' environmental sensitivity and behavior. Besides, students should be encouraged to read environment related books to enhance the environmental cognition and further promote the environmental behavior.

2. Relevant governmental units are suggested to continuously collaborate with schools to conduct environmental education activities and encourage students' participation. Environmental activities held in schools are the major source for students participating in environmental activities. Unfortunately, schools are often limited to funds. Environmental education could be really implemented when cooperating with clubs and institutions and applying various social resources to conduct more diverse environmental activities.

3. Since relevant data could be searched through computer multimedia, students could be guided to discuss environmental problems and cultivated the data collection and analysis ability. It is therefore suggested that teachers could apply computer multimedia to open environmental issues for students searching relevant data on the Internet, learning some environment related scientific competence, and promoting the environmental sensitivity.

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