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RELATIONSHIPS BETWEEN THE KNOWLEDGE, ATTITUDES, AND BEHAVIOUR DIMENSIONS OF ENVIRONMENTAL LITERACY: A STRUCTURAL EQUATION MODELING APPROACH USING SMARTPLS

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ABSTRACT

The purpose of this study was to assess environmental literacy which includes the dimensions of environmental knowledge, attitudes, and behaviour among Malaysian Form 4 secondary school students. This study was also aimed to ascertain differences in environmental literacy based on students' gender and school location. The relationships and the contribution of environmental knowledge and environmental attitudes to environmental behaviours were also studied. The ultimate goal of this study was to propose a structural model which explains the direct and indirect effects of the three dimensions of environmental literacy by using SmartPLS. This study involved administering the Environmental Literacy Survey (ELS), a version of the Green's (1999) modified Wisconsin Environmental Survey. This study offers a snapshot of environmental literacy among Form 4 secondary school students as well as an insight on the direct and indirect effects among the knowledge, attitudes, and behaviour dimensions of environmental literacy.

Keywords: Environmental literacy; Environmental knowledge; Environmental attitudes; Environmental behaviour; Structural Equation Modeling; Environmental education

Background of the Study

The lack of public awareness about the environment has been a topic of international concern dating way back to 1972 in the United Nations Conference in Stockholm. 20 years later, this commitment to raising public environmental awareness was renewed in 1992 at the Earth Summit in Rio de Janeiro which manifested in Chapter 36 of Agenda 21. In reference to Tbilisi Declaration in 1977 and then the subsequent reaffirmation in 1997 international commitment to international environmental education. Therefore, the study in the area of environmental literacy is the core emergence of this international commitment to raise environmental awareness in citizens around the world. Environmental literacy is not just knowledge of environmental and ecological concepts but it in-cooperates a set of skills profound to carry out sustainable behaviours, attitude and concern for the environment which then result into profound motivation to perform environmental behaviours. Hence, by including environmental knowledge, attitudes as well as behaviours that are related to environmental sustainability, environmental literacy paved its way further than the basic literacy.

It is undeniable that school plays an important role in assisting for sustainable environmental development. One of the vital tool for it is the implantation of Environmental Education (EE) in school. The implementation of EE in schools is geared towards producing a society that is sensitive towards issues pertaining to environmental issues and possess appropriate knowledge, skills, values, and able to then contribute to the solutions of problems in regard to environment. According to Disinger and Roth (1992), EE main focus is environmental literacy. Though many struggle with the definition for environmental literacy, a general definitions have

been identified by Marcinkowski and Rehrig (1995) and Simmons (1998). Environmental and ecological knowledge, clear positions on environmental issues, cognitive skills to analyze environmental problems, and behaviour patterns are some of those identified to have the power to limit environmental impacts by individuals or protecting the environment by contributing to a greater and wider societal efforts. EE is very different from other discipline in the education field because it aspires or have the power to influence the behaviour of students studying it (Hungerford & Volk, 1998). Thus the parallel or similar interpretation of behavioural component reflected in most definitions of environmental literacy.

Problem Statement

Environment Education (EE) has attracted numerous researchers to explore the status, delivery, and effects of EE for the past 20 years or so by administering a number of national surveys. Often times, these studies have addressed the need in K-12 curriculum in public schools. What researchers did was to assess the level of environmental literacy (environmental knowledge or environmental attitude) of students in both primary and secondary schools via a number of national surveys (e.g., Barraza & Walford, 2002; Makki, Abd-El-Khalick, & Boujaoude, 2003; Tuncer, Ertepinar, Tekkaya, & Sungur, 2005). Hungerford and Volk (1998) have pointed out in their study that surveys questionnaires have limitations as the narrowly focuses on environmental knowledge or specific dimensions of environmental affect. Hence, researchers tackle this pointers by developing a much broader models for environmental literacy. However, Chu et al (2007) and Kulemeier, van der Bergh and Lagerwij (1999) have pointed out the fact that only few efforts have been made thus far to assess students over this wider range of environmental literacy components.

EE is not taught as a single subject in Malaysia. However, the core concepts and components of EE are integrated across curriculum in every single subject and at every level of education in schools. EE is not confined to just academic subjects but it is also embedded in the extra co-curricular activities in schools, outdoor activities as well other school projects with the community. The aim of the education system in regard to EE is aligned with the goals of EE itself. Students in schools are expected to nurture and develop their awareness and understanding of what is happening around them as well as how human activities can impact the natural environment they are living in. Thus, appreciating the complexities of the interactions between man and environment. Therefore, the need for us to know the level of environmental literacy among secondary school students is crucial for us to better understand the effectiveness of EE programs in schools. Besides, with such data, we will be able to draw some conclusions in regard to the level of mission and vision accomplishment of EE programs, fundamental changes to be made if any or to continue on as it is (McBeth, Hungerford, Marcinkowski, Volk, & Meyers, 2008). The growing societal interest and the possible investment in EE are great indicators of how important EE is in schools and education as a whole. Hence, the lack of comprehensive researches in Malaysian schools to assess environmental literacy and focusing on the direct and indirect effects among the variables forming environmental literacy calls for attention. Thus, conducting a study on secondary school students' environmental literacy is crucial as we will be able to gain better insights of how environmental knowledge, environmental attitudes and environmental behaviours dimensions are reflected in the minds of the students after undergoing a substantial number of years with EE programs.

Objectives of the Study

This study attempts to achieve the following objectives:-

i) To assess environmental knowledge, environmental attitudes, and environmental behaviours among secondary school students;
ii) To ascertain if there is any significant difference in environmental literacy between male and female secondary school students;
iii) To ascertain if there is any significant difference in environmental literacy between urban and rural secondary school students;
iv) To investigate the extent of the relationships between environmental knowledge, environmental attitudes, and environmental behaviours among secondary school students;
v) To investigate the contribution of environmental knowledge and environmental attitudes to environmental behaviours among secondary school students;
vi) To propose a direct and indirect effect structural model to predict secondary school students' environmental behaviours based on their environmental knowledge and environmental attitudes.

Research Questions

This study attempts to answer the following questions:-

i) What is the level of environmental knowledge, environmental attitudes, and environmental behaviours among secondary school students?
ii) Is there a significant difference in secondary school students' environmental literacy based on gender?
iii) Is there a significant difference in secondary school students' environmental literacy based on school location?
iv) What is the extent of the relationships between environmental knowledge, environmental attitudes, and environmental behaviours among secondary school students?
v) Do secondary school students' environmental knowledge and environmental attitudes contribute to their environmental behaviours?

Research Hypotheses

Five null hypotheses formed to be tested in this study are:

i) There is no significant difference in secondary school students' environmental literacy based on gender.
ii) There is no significant difference in secondary school students' environmental literacy based on school location.
iii) There is no significant linear relationship between environmental knowledge, environmental attitudes, and environmental behaviours among secondary school students.
iv) Secondary school students' environmental knowledge and environmental attitudes do not contribute to their environmental behaviours.
v) All the path coefficients for environmental knowledge and environmental attitudes are equal to zero when environmental behaviour is the endogenous variable.

Research Design

This study is in the base of quantitative research and is a non- experimental research design. As the researcher has no direct control of the independent variables as the emergence of their underlying traits have already occurred or it can be because they are not manipulable, it is hence named as non-experimental research as the researcher conduct a systematic empirical enquiry on the related variables. Johnson and Christensen (2000) outlined that the inferences or conclusions in regard to the relations among these variables, without direct intervention, from concomitant variation of independent and dependent variables. This study used a sample survey method to gather and collect data. The Environmental Literacy Survey (ELS) instrument, a version of the Green's (1999) modified Wisconsin Environmental Survey (WES) was used in this research to measure secondary school students' level of environmental knowledge, environmental attitudes and environmental behaviours which are subsets to environmental literacy.

Research Samples and Sampling Methods

A group of Form 4 students were selected, by using cluster random sampling technique, from urban and rural secondary schools in Sabah, Malaysia. The distribution of Form 4 students according to gender and school location is illustrated in Table 1:

TABLE 1: Distribution of Form 4 Students according to Gender and School Location

	n	*%*
Gender		
Male	57	43.8
Female	73	56.2
	130	100.0
School Location		
Urban	67	51.5
Rural	63	48.5
	130	100.0

Instrumentation

In order to measure students' environmental literacy levels, the original Environmental Literacy Survey (ELS) was not used. Instead, in this study, the ELS survey used was adapted from the Green's (1999) modified Wisconsin Environmental Survey (WES). The original instrument was adapted from the Wisconsin High School Student Environmental Survey, developed by the Wisconsin Center for Environmental Education. The ELS consists of affective domain, behavioural domain and cognitive domain. These three dimensions that are scored separately are then summed up to indicate the respondents' environmental literacy level. Respondents (high school students) took approximately 30 minutes to complete this survey.

The instrument that the ELS was based on has been tested extensively for validity both for construction and content by the Wisconsin Center for Environmental Education. The content was based on the Environmental Literacy Framework that was developed by the Wisconsin Center for Environmental Education, which is very similar to the National Association for

Environmental Education Guidelines. Pilot test were conducted to test individual item reliability. A large state-wide sample was then administered after which final modifications were made to the survey (Green, 1999).

The reliability of each subscale of the Wisconsin High School Student Environmental Survey was calculated based on the 1994 administration of the instrument by the Wisconsin Center for Environmental Education (Peri, 1996). The coefficient alpha for the Environmental Attitudes (affective subscale) equals .91; Environmental Behaviour (behaviour subscale) equals .88; and Environmental Knowledge (cognitive subscale) equals .84. These numbers indicated that each dimension of the ELS was reliable (Green, 1999). In the context of this study, the Cronbach's alpha reliability of the ELS instrument is reported as in Table 2.

TABLE 2: Cronbach's Alpha Reliability of the Environmental Literacy Survey Instrument

Dimension	Item No.	Cronbach's Alpha Reliability Coefficients
Environmental Knowledge (Cognitive)	C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15	.42
Environmental Attitudes (Affective)	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15	.46
Environmental Behaviours (Behaviour)	B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12, B13, B14, B15	.76
Overall		.61

The Cronbach's Alpha Reliability Coefficients show .42 for environmental knowledge. This low score is probably caused by unfamiliar context. Students find that some questions in the questionnaire were something they are not familiar with. As for environmental attitude, .46 score shows a low value too. As researches indicated a consistent positive relationship between Environmental Knowledge and Environmental Attitude though the strength of the relationship is not very strong. Hence, that explains why both value for Environmental Knowledge and Environmental Attitude is quite low.

Data Collection Procedures

In order to administer the ELS instrument, a few steps were taken. Firstly, a formal approval from the school was sought and obtained once the researcher has identified the samples. Once the approval was given, the researcher administered the instrument by herself. Form 4 secondary school students were gathered in their respective classrooms (intact classes) and informed about the nature of the survey before the survey was administered concurrently. In this study, students were instructed to indicate the extent to which they agree or disagree with each statement in Section A (e.g. *I'm not interested in reading about nature or the environment*); how frequently they do each of the actions mentioned in Section B (e.g. *I send letters to the newspaper about environmental problems or issues*), and choose the best answer for each of the multiple-choice

items in Section C (e.g. *The process of photosynthesis in green plants changes light energy into chemical energy.*)

Data Analysis Procedures

The modified version of Wisconsin Environmental Survey was further modified to comprise only 15 multiple-choice questions in regard to the Environmental Knowledge dimensions of the ELS. The 15 items are a combination of basic ecological concepts, problems in regard to the environment and action strategies to overcome the problems. Researchers assigned correct responses with a score of four (4) and zero (0) for incorrect responses. With 15 items, the lowest possible score for Environmental Knowledge domain is zero and sixty for highest possible score.
As for the Environmental Attitudes dimensions of the ELS, the further modified 15 items were measured using a 5 point Likert scale. The scale range from Strong Disagree to Strongly Agree and the responses are awarded zero for least desirable environmental attitudes and four for the most preferred environmental attitudes. Therefore, the lowest possible score for this sub scale will be zero (0) and a total of sixty (60) for the highest possible score.

Another sub domain measured in this questionnaire is the behavioural subscale. The further modified 15 items under the Environmental Behaviour domain are also measured using the 5 point Likert scale items. The scale range from Never to Almost Always subscales of each of the items. Zero (0) is given to behaviour that does not demonstrate environmental behaviour while four (4) is awarded to most demonstrated environmental behaviour by the respondents. Again, the highest possible score for all the 15 items in this sub domain will be sixty (60) and zero (0) for the lowest possible cumulative scores in this domain. Hence, the total scores for all the three domains will range from 0 to 180.

Next, to ensure the data used is normal, a few steps were taken. Graphical measures such as histogram, stem-and-leaf plot, normal Q-Q plot, and detrended normal Q-Q plot were taken to ensure a normally distributed sample for each of the variable used. Hair, Anderson, Tatham, & Black (1998) and Miles and Shevlin (2001) mentioned the used of skewness and kurtosis in identifying deviations from a normally distributed data. Once all the assumptions for using parametric techniques were met, independent sample *t*-test was used to determine if there is a significant difference in secondary school students' environmental literacy based on gender and school location at a predetermined significance level, alpha = .05.
Pearson's product moment correlation was used to identify possible significant linear relationships among the knowledge, attitudes, and behaviours dimensions of environmental literacy. Pearson's product-moment correlation coefficients (*r*) were calculated to show the strength of the linear relationships among the variables studied. A Stepwise multiple regression analysis was conducted to investigate the contribution of environmental knowledge and environmental attitudes to environmental behaviours when all other independent variables were hold constant. Stepwise variables selection method was used in order to get a parsimonious model which explain most of the variances in the dependent variable by using the least number of independent variables. Assumptions namely normality, homoscedasticity, linearity, and independence were met prior to multiple regression analysis. Besides that, distance statistics (leverage measure and Cook's distance) and influence statistics (DfBeta and DfFit) were used to identify outliers and influential observations in the dataset. To detect multicollinearity among the independent variables used in this study, correlation matrices, Tolerance (T) and Variance Inflation Factor (VIF) were also used (Hair et al., 1998).

Structural Equation Modeling (SEM) is a multivariate technique combining aspects of multiple regression (examining dependence relationships) and factor analysis (representing unmeasured concepts -factors- with multiple variables) to estimate a series of interrelated dependence relationships simultaneously (Hair et al., 1998). Partial Least Squares (PLS) regression analysis, developed in the late seventies (Wold, 1975, Wold et al., 1984), is a statistical tool that has been specifically designed to deal with multiple regression problems where the number of observations is limited, missing data are numerous and the correlations between the predictor variables are high. These characteristics of PLS regression have been demonstrated both with real data and in simulations (Garthwaite, 1994; Tenenhaus, 1998). In this study, SmartPLS path analysis technique was used to identify the direct and indirect relationships among secondary school students' environmental behaviours, environmental knowledge, and environmental attitudes. With PLS-SEM, all the previous data analysing approaches was done in one go using SmartPLS.

Research Findings and Discussion

Secondary School Students' Environmental Literacy

TABLE 3: Mean and Standard Deviation of Secondary School Students' Environmental Literacy

Dimension	*n*	Number of Items	Maximum Possible Scores	*M*	*SD*
Environmental Knowledge	130	15	60	25.48	9.46
Environmental Attitudes	130	15	60	43.08	4.46
Environmental Behaviours	130	15	60	40.78	8.23
Overall EL	130	45	180	109.35	14.47

The mean and standard deviation of secondary school students' environmental literacy in descending order were reported in Table 3 as follows: Environmental Attitudes (M = 43.08, SD = 4.46), Environmental Behaviours (M = 40.78, SD = 8.23), and Environmental Knowledge (M = 25.48, SD = 9.46). The results of this study were similar to other studies (Kibert, 2000; Connell et al., 1999; Diekmann & Preisendorfer, 1998; Kuhlemeier et al., 1999; Scott & Willits, 1994) which showed that environmental attitudes are the highest, followed by environmental behaviours whereas environmental knowledge is the lowest. Unexpectedly, Form 4 students in this study did not exhibit impressive scores for the knowledge dimension of environmental literacy. This result is striking because knowledge is the environmental-literacy category most emphasized in the curriculum. The poor results with respect to several key environmental topics may reflect the fact that the actual time spent on EE in schools is far below that recommended by the Malaysian Ministry of Education. The environmental attitudes and environmental behaviours of secondary school students in the present study were, in general, high. These findings are consistent with research conducted among students in the Netherlands (Kuhlemeier et al., 1999) and Turkey (Tuncer et al., 2005). Secondary school students' responses on the environmental knowledge, attitudes, and behaviours items are shown in Table 4, 5, and 6, respectively.

TABLE 4: Secondary School Students' Responses on the Environmental Knowledge Items

No	Environmental Knowledge Items	Correct (%)	Incorrect (%)
C1	A food web consists of Answer: many *interconnected food chains.*	**44.6**	55.4
C2	All of the same individual organisms that live on the ground in a particular forest share the same Answer: *habitat*	55.4	44.6
C3	Wolves eat deer. Does this interaction have any beneficial effects on the deer population as a whole? Answers: *Yes, the wolves help keep the deer population size controlled.* *Yes, the wolves help keep the population strong since the fastest, most alert deer survive.*	**30.8**	69.2
C4	Based upon major ecological principles, we should conclude that Answer: *the human species will last as long as there is a balanced ecosystem that will support human life.*	51.5	48.5
C5	The process of photosynthesis in green plants Answer: *changes light energy into chemical energy.*	**33.1**	66.9
C6	Which of the following terms is used to describe all of the natural living and non-living interacting features of a given area? Answer: *Ecosystem*	60.8	39.2
C7	A particular aquatic ecosystem is contaminated by a chemical which tends to remain stored in body fat. The highest concentration of this chemical would most likely be found in which group of organisms in the ecosystem? Answer: *Minnows*	**20.0**	80.0
C8	Which of the following phrases refers to the potential ability of a system to support population growth without harming the environment? Answer: *Carrying capacity*	**20.8**	79.2
C9	Some insecticides that were once effective in killing insects no longer work very well. This is because Answer: *insects with natural resistance survived and multiplied*	56.2	43.8
C10	Which of the following contributes to air pollution at the surface of the earth, and acts as a shield against ultraviolet rays in upper atmosphere? Answer: *Ozone*	66.9	33.1
C11	The main source(s) of emissions that have been identified as contributing to acid deposition (acid rain) in the United States are Answer: *automobiles and coal burning power plants.*	50.0	50.0
C12	The rate of species' extinction is higher now than at any time since the period of the dinosaurs' extinction. The main cause of this rapid decline in biodiversity is Answer: *changes in the Earth's atmosphere due to human activities.*	**38.5**	61.5
C13	A major nuclear accident occurred in 1986 at the _____ nuclear power plant. Answer: *Chernobyl*	**34.6**	65.4
C14	Which of the following is most likely to help endangered species? Answer: *Maintain large protected natural areas where they live.*	**40.8**	59.2
C15	In the long term, which of the following would be the best way to lessen the problem of solid waste? Answer: *Reuse materials for other purposes rather than throwing them out*	**33.1**	66.9

TABLE 5: Secondary School Students' Responses on the Environmental Attitudes Items

No.	Statement	Responses			
		SD (%)	D (%)	A (%)	SA (%)
A1*	When I am outside, I usually don't notice the natural things around me like flowers, trees, and clouds.	**40.8**	40.0	13.8	5.4
A2*	I'm not interested in reading about nature or the environment.	16.9	**51.5**	24.6	6.9
A3*	I think most of the concern about environmental problems has been exaggerated.	18.5	**37.7**	36.2	7.7
A4*	A community's pollution regulations should not interfere with industrial growth and development.	26.2	**36.2**	29.2	8.5
A5	More controls should be placed on industry and agriculture to protect the quality of the environment, even if it means that thing I purchase will cost more.	5.4	14.6	**49.2**	30.8
A6*	I am not concerned about the fact that the world's deserts are increasing in size.	32.3	**44.6**	16.9	6.2
A7*	There are already enough laws to protect the environment.	34.6	**41.5**	10.0	13.8
A8*	I don't think that recycling is worth all the trouble it takes.	20.8	30.0	**42.3**	6.9
A9	More land should be set aside for wildlife habitats.	4.6	22.3	**38.5**	34.6
A10	I am concerned about how much waste is produced in this country.	2.3	16.2	**44.6**	36.9
A11	Laws should be passed and enforced that protect the quality of life in the future even if it means that individual freedoms are limited.	6.2	33.1	**39.2**	21.5
A12*	I am not concerned about the rate of species extinction in the world.	**37.7**	32.3	22.3	7.7
A13	I am concerned about environmental health hazards such as those caused by air or water pollution.	4.6	10.8	**47.7**	36.9
A14	I believe that I can contribute to the solution of environmental issues by my actions.	10,0	27.7	**45.4**	16.9
A15*	It's too hard to change my friends' minds about doing things to help the environment (for example: recycling).	6.9	25.4	**43.8**	23.8

*negatively-worded items

TABLE 6: Secondary School Students' Responses on the Environmental Behaviours Items

No.	Statement	Responses				
		Never (%)	Almost never (%)	Sometimes (%)	Often (%)	Almost always (%)
B1	I turn off lights and appliances when they are not being used to conserve electricity.	4.6	3.1	25.4	29.2	**37.7**
B2	I talk to people that I notice doing something that harms the environment in an effort to persuade that person to stop the activity. (For example, try to talk to a friend into recycling a soda can instead of throwing them in the trash).	11.5	23.1	**47.7**	8.5	9.2
B3	I walk, take public transportation, or ride a bike instead of using a car in order to help protect the environment.	17.7	24.6	**33.1**	14.6	10.0
B4	I make an effort to reduce the amount of goods I consume.	10.8	18.5	**43.1**	20.0	7.7
B5	I set a positive environmental example for my friends to follow.	9.2	16.9	**45.4**	20.0	8.5
B6	I support candidate for political offices who are concerned about environmental problems and issues.	10.8	16.2	**31.5**	21.5	20.0

B7	If I see an aluminium can on the ground when I'm out walking, I pick it up and take it with me.	30.0	15.4	**34.6**	12.3	7.7
B8	I recycle paper, glass and/or metal waste products at home or at school.	11.5	16.2	**31.5**	24.6	16.2
B9	I avoid purchasing products that have a negative impact on the environment.	19.2	13.8	**36.2**	22.3	8.5
B10	I talk to my family and friends about what they can do to help solve environmental problems	25.4	19.2	**36.9**	11.5	6.9
B11	I write or call politicians to express my views about environmental issues.	**53.1**	26.9	12.3	3.1	4.6
B12	I make a point of reading newspaper and magazine articles about the environment.	19.2	23.1	**32.3**	13.1	12.3
B13	I purchase one product over another product because it is packaged in reusable, returnable or recyclable containers or packages.	12.3	16.2	**35.4**	23.1	13.1
B14	I send letters to the newspaper about environmental problems or issues.	**65.4**	15.4	12.3	5.4	1.5
B15	I have reported environmental problems or violations that I have noticed to the proper authorities.	**56.2**	23.8	13.8	4.6	1.5

Mean Differences in Secondary School Students' Environmental Literacy based on Gender

TABLE 7: Mean Differences in Secondary School Students' Environmental Literacy based on Gender

Dimension	Gender	*n*	*M*	*SD*	Mean Difference	*t*	*df*	*p*	*Effect Size*
Environmental Knowledge	Male	57	26.39	9.91	1.62	.97	128	.34	.17
	Female	73	24.77	9.11					
Environmental Attitudes	Male	57	43.51	4.52	.76	.96	128	.34	.17
	Female	73	42.75	4.42					
Environmental Behaviours	Male	57	42.37	7.51	2.82	1.96	128	.05	.34
	Female	73	39.55	8.60					
Environmental Literacy	Male	57	112.26	14.44	5.20	2.06	128	.04*	.36
	Female	73	107.07	14.18					

The first null hypothesis was tested by using the independent sample *t*-test at a specified significance level, alpha = .05. As shown in Table 7, independent sample *t*-test results showed that there were no significant differences in secondary school students' environmental knowledge, environment attitudes and environmental behaviours based on gender. However, there was a significant difference in environmental literacy between male and female secondary school students (t = 2.06, df = 128, p < .05, ES = .36). Generally, male secondary school students demonstrated higher environmental knowledge, more positive environmental attitudes, more actively engaged in environmental behaviours as compared to their female counterparts. However, the differences were not statistically significant.

The results of this study showed some contradictions with Kibert's (2000) study. In Kibert's (2000) study, gender differences in environmental attitudes have been detected with females generally demonstrating more positive attitudes than males. At the alpha = .05, there was

also a significant difference in environmental behaviours with females scoring higher than males. In contrast, males have been shown to have more environmental knowledge than females. Kibert's (2000) study supported the studies presented in the literature review. Gifford et al. (1982/83) found in their study of undergraduates that males scored higher in environmental knowledge than females and that more females than males reported they would do something about environmental problems. Likewise, Hausbeck et al. (1992) reported that females expressed more positive environmental attitudes than males, and males had slightly more environmental knowledge than females. Scott and Willits (1994) found that females were more likely to exhibit environmentally protective consumer behaviours, but men were more likely to participate in environmental political action. To summarize, in prior studies that studied male and female differences in the components of environmental literacy, it was found that females generally demonstrated more concern and positive attitudes than males towards the environment whereas males typically performed higher on the knowledge component (Eagles & Demare, 1999; Dietz, 1998; Gifford et al. 1982/83; Hausbeck et al. 1992; Scott & Willits, 1994).

Mean Differences in Secondary School Students' Environmental Literacy based on School Location

TABLE 8: Mean Differences in Secondary School Students' Environmental Literacy based on School Location

Dimensions	School location	*n*	*M*	*SD*	Mean Difference	*t*	*df*	*p*	*ES*
Environmental Knowledge	Urban	67	25.37	8.93	-.21	-.13	128	.90	.02
	Rural	63	25.59	10.07					
Environmental Attitudes	Urban	67	43.90	4.36	1.67	2.17	128	.03*	.38
	Rural	63	42.22	4.44					
Environmental Behaviours	Urban	67	40.49	8.6	-.60	-.42	128	.68	.07
	Rural	63	41.10	7.87					
Environmental Literacy	Urban	67	109.76	14.79	.86	.34	128	.74	.06
	Rural	63	108.90	14.23					

The second null hypothesis was also tested by using the independent sample *t*-test at a specified significance level, alpha = .05. As shown in Table 8, independent sample *t*-test results showed that there were no significant differences in secondary school students' environmental knowledge, environmental behaviours, and environmental literacy based on school location except for environmental attitudes. Generally, rural secondary school students demonstrated more environmental knowledge, more actively engaged in environmental behaviours as compared to their urban school counterparts whereas urban secondary school students showed more positive environmental attitudes ($t = 2.17$, $df = 128$, $p < .05$, $ES = .38$) and more environmentally-literate than their rural school counterparts. However, the difference in environmental literacy was not statistically significant. This is probably due to many other reasons like teacher factors, the similar environmental context on the whole and etc. The rural and urban schools are probably not too far divided to have shown such a non-significant relationship.

Relationships among Environmental Knowledge, Environmental Attitudes, and Environmental Behaviours amongst Secondary School Students

The third null hypothesis was tested by using the Pearson's product-moment correlation at a specified significance level, $p = .05$. Correlation analysis results in Table 9 showed that there were low to moderate, positive correlation among environmental knowledge, environmental attitudes, and environmental behaviours. Thus, these findings had rejected the third null hypothesis successfully. On the other hand, all the three dimensions of environmental literacy were moderately, positively, and significantly correlated with environmental literacy.

TABLE 9: Pearson's Product Moment Correlations among Environmental Knowledge, Environmental Attitudes, and Environmental Behaviours

	EK	EA	EB	EL
Environmental Attitudes, EA	.130 *p*=.141	-		
Environmental Behaviours, EB	.031 *p*=.728	.224* *p*=.010	-	
Environmental Literacy, EL	.712** *p*<.0005	.521** *p*<.0005	.658** *p*<.0005	-

* $p < .05$; ** $p < .01$

These findings were consistent with previous research findings. A key debate in the EE literature revolves around the relations between knowledge, attitudes, and behaviour (e.g., Kibert, 2000; Courtenay-Hall & Rogers, 2002; Hungerford & Volk, 1998; Kaiser et al., 1999; Kollmuss & Agyeman, 2002; Kuhlemeier et al., 1999; Makki et al., 2003; Marcinkowski, 1998b; Olli et al., 2001; Said et al., 2007; Scott & Willits, 1994; Simmons, 1998; Ungar, 1994).

In Kibert's (2000) study, the initial correlations showed an insignificant relationship between knowledge and behaviour. Knowledge and attitude had a weak correlation. Attitude and behaviour components demonstrated a moderate correlation. According to Kibert (2000), for both 6th and 12th graders, the overall environmental-behaviour scores were unrelated to environmental-knowledge scores and, in fact, were negatively related to knowledge in a multivariate regression that included attitudes. Behaviour was strongly related to attitudes in the 6th grade and moderately related in the 12th grade. With the exception of one question in the 6th grade, Kibert found no single knowledge question to be related to behaviour scores. The lack of high correlation between knowledge and behaviour has been discovered and considered in other contexts (Kuhlemeier et al., 1999; Makki et al., 2003; Scott & Willits, 1994). These findings supported the results from other environmental literacy studies recounted in the literature review. Attitudes and knowledge have historically been found to have weak to moderate correlations. Behaviour and attitudes have weak to moderate correlations dependent on what types of attitude (self-efficacy, locus of control, and consciousness) and behaviour (self-reported or observed) are being related. Knowledge and behaviour have been reported to have no or weak correlations. This is generally thought to be because the affect of knowledge is attenuated by attitudes, situational factors and subjective norms.

As indicated by the theoretical models of behaviour change, knowledge and behaviour are not expected to have a strong correlation. In the Kuhlemeier et al. (1999) study of environmental knowledge, attitudes and behaviours in ninth graders in Holland, they found a weak correlation (r = .20) between knowledge and behaviour. In the Hines et al. (1987) study, they also examined the relationship of knowledge and behaviour and found an overall correlation of r = .299 from the 17 studies that reported this data. Those studies that drew from a population of individuals in environmental organizations had a correlation of r = .691 as compared with members of the general public (r = .268) or children (r = .192). These studies support Azjen's (1988, p.134) notion that knowledge is a pre-condition for behaviour: "At the most basic level of explanation, behaviour is assumed to be a function of salient information, or beliefs, relevant to the behaviour." Kaiser et al. (1999, p.4) remark that "factual knowledge should not be related with ecological behaviour strongly because its influence is attenuated both by environmental attitude and intention." Attitudes are moderate predictors of behaviour and in order to have a positive environmental attitude, an individual must first have the relevant knowledge to hold that attitude.

As Kaiser et al. (1999, p.4) remark, "factual knowledge about the environment is a precondition of one's environmental attitude." The relationship between knowledge and attitude is a complex one and is not fully understood (Zimmerman, 1996). In Petrzelka and Korsching's (1996) study of environmental attitudes and behaviour toward sustainable agriculture, they found that changing the knowledge and beliefs of farmers about sustainable agriculture also changed their attitudes. In the Kuhlemeier et al. (1999) study of environmental literacy in Dutch ninth grade students, they found a weak correlation between knowledge and attitude. In Bradley et al.'s (1999) study of knowledge and environmental attitude in high school students, they found that after an environmental science course, students had higher environmental knowledge and attitudes between the pre- and post-tests. In both the pre- and post-tests, students with higher knowledge scores also had higher attitude scores when compared with students who had lower environmental knowledge scores. Similarly, Mangas and Martinez's (1997) study regarding university students enrolled in an elective environmental education course showed that students' environmental knowledge increased at the end of the course and was accompanied by an increase in environmental attitudes.

Hines et al. (1987) found that attitude and behaviour had an overall moderate correlation of r = .347. This finding is substantiated by Kaiser et al. (1999, p.4) who found that, "the usual findings reveal either a moderate relationship between environmental attitude and ecological behaviour or a weak relationship." In the Kuhlemeier et al. (1999) study of environmental literacy among Dutch ninth graders, they found a moderate correlation (r = .36) between attitude and behaviours. Counter-intuitively, Hines et al. (1987) found that when the behaviour was actually observed rather than self-reported, the attitude-behaviour correlation went up to r = .427. Other studies have assumed that self-reported behaviour is usually over-reported. The results from the Hines et al. (1987) study may have been enhanced because the attitudes and behaviours that were correlated were specifically related. Conversely, Scott and Willits (1994), in their study of Pennsylvanians' environmental attitudes and behaviours, found that attitudes were predictive of behaviours but the correlation were weak at r = .21.

The Contribution of Environmental Knowledge and Environmental Attitudes on Environmental Behaviours

The fourth null hypothesis was tested by using stepwise multiple regression analysis technique. Results (Table 10) showed that environmental attitudes significantly contributed to secondary

school students' environmental behaviours [$F(1,128) = 6.79$, $p = .010$]. Based on the R^2 value, environmental attitudes can only explain 5.0% of the variances in secondary school students' environmental behaviours. Thus, this finding had rejected the fourth null hypothesis successfully. According to Kibert (2000), although knowledge by itself was not significantly related to behaviour, when both knowledge and attitudes were included as independent variables in a regression with behaviour as a response, Kibert found that both had a significant effect on behaviour for both 6th and 12th grades, suggesting that there is an interaction effect between knowledge and attitudes that influences behavioural outcomes. In both cases, attitude had a strong positive relation to behaviour, and, more surprisingly, knowledge had a weak negative relation to behaviour. In other words, with control for attitude, environmental knowledge was correlated with somewhat decreased environmental behaviour.

TABLE 10: Multiple Regression Analysis Results for Environmental Knowledge and Environmental Attitudes on Environmental Behaviours (n = 130)

Predictor variables	*B*	*SE*	*B*	*t*	*p*
Constant	22.95	6.88		3.33	.001
Environmental Attitudes	.41	.16	.22	2.61**	.010

** $p < .01$
Multiple $R = .22$; $R^2 = .05$; Adjusted $R^2 = .04$; SEE = 8.05; F (1, 128) = 6.79; $p = .010$

SmartPLS Path Analysis Results

Like Covariance-Based Structural Equation Modeling (CBSEM), PLS is a latent variable modeling technique that incorporates multiple dependent constructs and explicitly recognizes measurement error (Karim, 2009). In general, two applications of PLS are possible. It can either be used for theory confirmation or theory development. In the latter case, PLS is used to develop propositions by exploring the relationships between variables (Chin, 1998). Furthermore, PLS is able to handle both reflective and formative constructs, and it is one of the reasons why researchers chose PLS as the statistical means for testing structural equation models (Urbach & Ahleman, 2010). In this study, the fifth null hypothesis was tested using the path analysis technique with SmartPLS.

TABLE 11: Results of Measurement Model

	AVE	Composite Reliability	R Square	Cronbach's Alpha	Communality	Redundancy
Attitude	.358	0.690	0.077	0.412	0.358	0.027
Behaviour	.392	0.817	0.235	0.747	0.392	0.080
Knowledge					0.082	

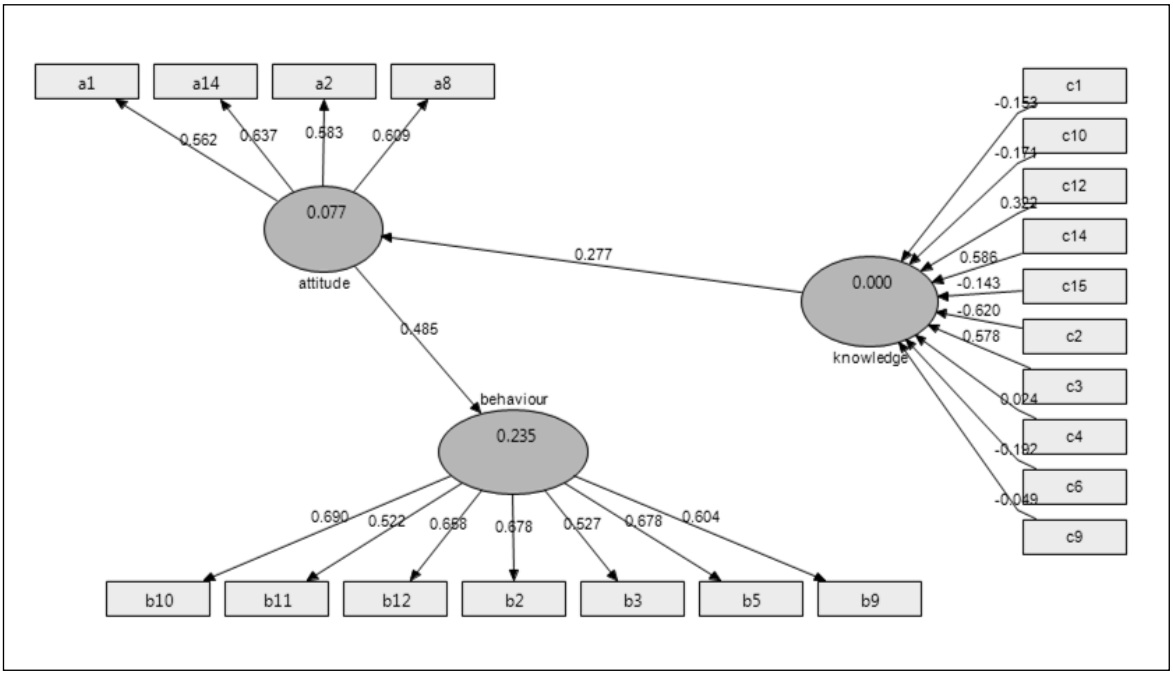
Composite reliability should be 0.7 or higher to indicate adequate convergence or internal consistency (Gefen et al., 2000). In this study, the composite reliability is considered adequate. This suggests that a high internal reliability of the data existed. Along with the coefficients of composite reliability, the coefficients of average variance extracted are also displayed. The average variance extracted indicates what percentage of the variance of the construct is explained by any individual item. The great majority of the constructs have average variance extracted higher than the benchmark of 0.5 recommended. Average Variance Extracted (AVE) should exceed 0.5 to suggest adequate convergent validity (Bagozzi & Yi, 1988; Fornell & Larcker, 1981). However, in this study, the AVE value is lower than 0.5 possibly due to the small sample size and high probability of inadequate data of the desired quality. This analysis suggest data to be recollected and re-analysed.

Path diagram of the influence of environmental knowledge and environmental attitudes on secondary school students' environmental behaviours portrayed that environmental attitudes (Attitudes) ($\gamma = .48$, $p < .05$) was positively related to environmental behaviours (Behaviours). On the other hand, environmental knowledge (Knowledge) ($\gamma = .28$, $p > .05$) was not significantly related to attitude and behaviour ($\gamma = .13$, $p > .05$).

TABLE 12: Path Coefficient and Hypothesis Testing

Hypothesis	Relationships	Coefficient	T value	Supported
H1	attitude -> behaviour	0.48*	7.23	Supported
H2	knowledge -> attitude	0.28	0.70	Not supported
H3	knowledge -> behaviour	0.13	0.66	Not supported

Path Diagram of the Influence of Environmental Knowledge and Environmental Attitudes on Secondary School Students' Environmental Behaviours



Conclusion

Environmental literacy among secondary school students in the state of Sabah, Malaysia is somewhat to a certain degree is captured in this study. A large gap in environmental knowledge and a significant drop in environmental behaviours and attitudes among secondary school students is revealed in this study. The results indicates that the intended objectives of environmental education in Malaysia have not been achieved. Identifying possible ways to improve environmental education in the Malaysian secondary schools is crucial. More studies are also necessary as to understand how the various components of environmental literacy in reality interact, especially in different subpopulations, so that an effective course of action for environmental literacy programmes can be established successfully. Secondary school students will deliberately engage in responsible environmental behaviours if their existing tendencies for environmental literacy is built to naturally increase. Upgrading EE programmes in the Malaysian schools should be a central part of future environmental policy efforts at both the national and local levels given the increasing severity of these problems and the public's role in solving them. This will surely require additional research about openness to new EE initiatives and curricula and existing and experimental pedagogical techniques in the field.

Previous researchers have found that environmental knowledge, attitudes, and behaviour vary across cultures and societies (Barraza & Walford, 2002; Deng et al., 2006; Hershey & Hill, 1977-1978; Johnson et al., 2004; Milfont & Gouveia, 2006; Olli et al., 2001; Van Petegem & Blieck, 2006) and that some attitude scales are highly affected by respondent characteristics such as gender, residence, education, income, age, and political orientation (Tarrant & Cordell, 1997). Researchers should further attempt to broaden the notion of environmental literacy, especially in a multicultural society such as Malaysia, to reduce cultural bias in surveys as much as possible. Although it is expected that a culturally sensitive approach will be reflected in EE programmes, the refinement process should be done in light of the finding of Cheak, Volk, and Hungerford (2002) that similar EE techniques work in cross-cultural situations with emphasis on a more advance statistical analysis such as SEM.

References

Ajzen, I. (1988). *Attitudes, personality, and behaviour*. Chicago, IL: The Dorsey Press.

Arbuckle, J.L. (1998). *Amos users' guide*. Chicago: Small Waters Corp.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the academy of marketing science*, *16*(1), 74-94.

Barraza, L., & Walford, R. A. (2002). Environmental education: A comparison between English and Mexican school children. *Environmental Education Research*, *8*(2), 171-186.

Bentler, P.M. (1990). Comparative fit indices in structural models. *Psychological Bulletin*, 107, 238-246.

Bentler, P.M., & Bonnett, D.G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588-606.

Bradley, J.C., Waliczek, T. M., & Waliczek, J. M. (1999). Knowledge and environmental attitude of high school students. *Journal of Environmental Education, 30*(3), 17-23.

Cheak, M., Volk, T., & Hungerford, H. (2002). *Molokai: An investment in children, the community, and the environment* [Monograph]. Carbondale, IL: Center for Instruction, Staff Development and Evaluation.

Chin, W. W. (1998). Commentary: Issues and opinion on structural equation modeling. *MIS quarterly*, vii-xvi.

Chu, H.E., Lee, E.A., Ko, H.R., Shin, D.H., Lee, M.N., Mee Min, B., et al. (2007). Korean year 3 children's environmental literacy: A prerequisite for a Korean environmental education curriculum. *International Journal of Science Education*, *29*(2), 731-746.

Connell, S., Fien, J., Lee, J., Sykes, H., & Yencken, D. (1999). If it doesn't directly affect you, you don't think about it: A qualitative study of young people's environmental attitudes in two Australian cities. *Environmental Education Research*, *5*(1), 95-104.

Courtenay-Hall, P., & Rogers, L. (2002). Gaps in mind: Problems in environmental knowledge-behaviour modeling research. *Environmental Education Research*, *8*(3), 283-297.

Deng, J., Walker, G.J., & Swinnerton, G. (2006). A comparison of environmental values and attitudes between Chinese in Canada and Anglo-Canadians. *Environment and Behaviour*, *38*(1), 22-47.

Diekman, A., & Preisendorfer, P. (1998). Environmental behaviour. *Rationality & Society*, *10*(1), 79-103.

Dietz, T. (1998). Social structural and social psychological bases of environmental concern. *Environment and Behaviour*, *30*(4), 450-472.

Disinger, J.F., & Roth, C.E. (1992). *Environmental literacy* [ERIC/CSMEE digest]. Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education (CSMEE), Ohio State University.

Eagles, P. F. J., & Demare, R. (1999). Factors influencing children's environmental attitudes. *Journal of Environmental Education*, *30*(4), 33-38.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of marketing research*, 382-388.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of marketing research*, 382-388.

Garthwaite, P. H. (1994). An Interpretation of Partial Least Squares. *Journal of the American Statistical Association*, 89 (425), 122-27.

Gefen, D., Straub, D. W., & Boudreau, M. C. (2000). Structural equation modeling and regression: Guidelines for research practice. In *Communications of the association for information systems*.

Gifford, R., Hay, R., & Boros, K. (1982/83). Individual differences in environmental attitudes. *Journal of Environmental Education*, *14*(2), 19-23.

Green, P.L. (1999). *The effect of participation in a 'Greening the BCC Curriculum' workshop series on the environmental literacy of a community college faculty*. Unpublished dissertation, Florida International University.

Hair, J.F., Anderson, R.E., Tatham, R.L., & Black, W.C. (1998). *Multivariate data analysis*, 5th Ed. Upper Saddle River: NJ: Prentice-Hall.

Hausbeck, K. W., Milbrathand, L. W., & Enright, S. M. (1992). Environmental knowledge, awareness, and concern among 11th grade students: New York State. *Journal of Environmental Education*, *24*(1), 27-34.

Hershey, M. R., & Hill, D. B. (1977-1978). Is pollution "a White thing"? Racial differences in preadults' attitudes. *Public Opinion Quarterly*, *41*(4), 439-458.

Hines, J.M., Hungerford, H.R., & Tomera, A.N. (1987). Analysis and synthesis of research on responsible environmental behaviour: A meta-analysis. *The Journal of Environmental Education*, *18(*2), 1-8.

Hsu, S. J., & Roth, R. E. (1988). An assessment of environmental literacy and analysis of predictors of responsible environmental behaviour held by secondary teachers in the Hualien area of Taiwan. *Environmental Education Research*, *4*(3), 229-248.

Hungerford, H., Peyton, R., & Wilke, R. (1980). Goals for curriculum development in environmental education. *The Journal of Environmental Education*, *11*(3), 42-47.

Hungerford, H., & Volk, T. (1998). Changing learner behaviour through environmental education. In H. Hungerford, W. Bluhm, T. Volk, & J. Ramsey (Eds.), *Essential readings in environmental education* (pp. 289-304). Champaign, IL: Stipes.

Iozzi, L., Laveault, D., & Marcinkowski, T. (1990). *Assessment of learning outcomes in environmental education*. Paris: United Nations Educational, Scientific, and Cultural Organizations.

Johnson, C.Y., Bowker, J. M., & Cordell, H. K. (2004). Ethnic variation in environmental belief and behaviour: An examination of the New Ecological Paradigm in a social psychological context. *Environment and Behaviour*, *36*(2), 157-186.

Johnson, B., & Christensen, L. (2000). *Educational research: Quantitative and qualitative approaches*. Needham Heights, MA, US: Allyn and Bacon.

Kaiser, F., Wolfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology*, *19*, 1-19.

Karim, J. (2009). Emotional Intelligence and Psychological Distress: Testing the Mediatory Role of Affectivity. *Europe's Journal of Psychology*, *5*(4), 20-39.

Kilbert, N.C. (2000). *An analysis of the correlations between the attitude, behaviour, and knowledge components of environmental literacy in undergraduate university students*. Unpublished masters thesis, University of Florida.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research*, *8*(3), 239-260.

Kuhlemeier, H., van den Bergh, H., & Lagerweij, N. (1999). Environmental knowledge, attitudes, and behaviour in Dutch secondary education. *The Journal of Environmental Education*, *30*(2), 4-11.

Makki, M.H., Abd-El-Khalick, E., & Boujaoude, S. (2003). Lebanese secondary school students' environmental knowledge and attitudes. *Environmental Education Research*, *9(*1), 21-33.

Mangas, V.J., & Martinez, P. (1997). Analysis of environmental concepts and attitudes among biology degree students. *Journal of Environmental Education*, *29*(1), 28-34.

Marcinkowski, T. (1998b). Predictors of responsible environmental behaviour: A review of three dissertation studies. In H. Hungerford, W. Bluhm, T. Volk, & J. Ramsey (Eds.), *Essential readings in environmental education* (pp. 247-276). Champaign, IL: Stipes.

Marcinkowski, T., & Rehrig, L. (1995). The secondary school report: A final report on the development, pilot testing, validation, and field testing of the Secondary School Environmental Literacy Assessment Instruments. In R. Wilke (Ed.), *Environmental education literacy needs assessment project: Assessing environmental literacy of students and environmental education needs of teachers: Final report for 1993-1995* (pp. 30-76). Stevens Point: University of Wisconsin-Stevens Point.

McBeth, B., Hungerford, H., Marcinkowski, T., Volk, T., & Meyers, R. (2008). *National Environmental Literacy Assessment Project: Year 1, National Baseline Study of Middle Grade Students*, Final Research Report. Report to U.S.EPA, NOAA, & NAAEE.

Miles, J., & Shevlin, M. (2001). *Applying regression and correlation. A guide for students and researchers*. London: Sage Publications.

Milfont, T., & Gouveia, V. (2006). Time perspective and values: An exploratory study of their relations to environmental attitudes. *Journal of Environmental Physchology*, *26*(1), 72-82.

Olli, E., Grendstad, G., & Wollebaek, D. (2001). Correlates of environmental behaviours: Bringing back social context. *Environment and Behaviour*, *33*(2), 181-208.

Peri, P. (1996). *The development of an instrument to assess environmental literacy of eleventh grade students in Wisconsin*. Unpublished masters thesis, University of Wisconsin, Stevens Point.

Petzelka, P., & Korsching, P.F. (1996). Farmers' attitudes and behaviour toward sustainable agriculture. *Journal of Environmental Education*, *28*(1), 38-45.

Said, A. M., Yahaya, N., & Ahmadun, E. R. (2007). Environmental comprehension and participation of Malaysian secondary school students. *Environmental Education Research*, *13*(1), 17-31.

Scott, D., & Willits, F. K. (1994). Enviromental attitudes and behaviour: A Pennsylvania survey. *Environment and Behaviour*, *26*(2), 239-260.

Simmons, D. (1995). Developing a framework for national environmental education standards [Working paper]. In D. Simmons (Ed.), *The NAAEE standards project: Papers on the development of environmental education standards* (pp. 9-58). Troy, OH: North American Association for Environmental Education.

Simmons, D. (1998). Education reform, setting standards, and environmental education. In H. Hungerford, W. Bluhm, T. Volk, & J. Ramsey (Eds.), Essential readings in environmental education (pp. 65-72). Champaign, IL: Stipes.

Sivek, D. J. (2002). Environmental sensitivity among Wisconsin high school students. *Environmental Education Research*, *8*(2), 155-170.

Tarrant, M. A., & Cordell, H. K. (1997). The effect of respondent characteristics on general environmental attitude-behaviour correspondence. *Environment and Behaviour*, *29*(5), 618-637.

Tenenhaus, M. (1998). La régression PLS. Paris : Publi-Union.

TOP 2000, Les plus grandes entreprises en Suisse, 1996. 1996. Genève et Zurich: PME Magazine et Handelszeitung.

Todt, D. E. (1995). *An investigation of the environmental literacy of teachers in South-Central Ohio using the Wisconsin Environmental Literacy Survey, concept mapping, and interviews*. Unpublished doctoral dissertation, Ohio State University, Columbus, OH.

Tuncer, G., Ertepinar, H., Tekkaya, C., & Sungur, S. (2005). Environmental attitudes of young people in Turkey: Effects of school type and gender. *Environmental Education Research*, *11*(2), 215-233.

Urbach, N., & Ahlemann, F. (2010). Structural equation modeling in information systems research using partial least squares. *Journal of Information Technology Theory and Application*, *11*(2), 5-40.

Ungar, S. (1994). Apples and oranges: Probing the attitude-behaviour relationship for the environment. *Canadian Review of Sociology and Anthropology*, *31*(3), 288-304.

Van Petegem, P., & Blieck, A. (2006). The environmental worldview of children: A cross-cultural perspective. *Environmental Education Research*, *12*(5), 625-635.

Wold, H. (1975). Soft Modeling by Latent Variables: the Non-linear Iterative Partial Least Squares Approach, in *Perspectives in Probability and Statistics, Papers in Honour of M. S.*

Wold, S., Ruhe, A., Wold, H., & Dunn, III, W. J. (1984). The collinearity problem in linear regression. The partial least squares (PLS) approach to generalized inverses. *SIAM Journal on Scientific and Statistical Computing*, *5*(3), 735-743.

Zimmerman, L.K. (1996). Knowledge, affect, and the environment: 15 years of research (1979-1993). *Journal of Environmental Education*, *27*(3), 41-45.