Research Article https://doi.org/10.12973/eu-jer.11.4.2357

European Journal of Educational Research
Volume 11, Issue 4, 2357 - 2371.
ISSN: 2165-8714
https://www.eu-jer.com/

Environmental Literacy and Teaching Activities of Preschool Teachers in Vietnam

Ho Uyen Tran
The University of Da Nang – University of Science and Education, VIETNAM/ National Taiwan Normal University, TAIWAN

Ben A. LePage
National Taiwan Normal University, TAIWAN/ Academy of Natural Sciences, USA

Wei-Ta Fang*
National Taiwan Normal University, TAIWAN

Received: May 17, 2022 ▪ Revised: August 20, 2022 ▪ Accepted: September 27, 2022

Abstract: In this study we modeled the environmental literacy of Vietnamese preschool teachers. 324 in-service preschool teachers from Ha Noi, Da Nang, and Ho Chi Minh, Vietnam contributed to the study via an online survey. Structural Equation Modeling (SEM) was used to test the hypotheses of the relationships between environmental knowledge (KN), environmental awareness (AS), decision attitude (DA), personal behavior (PB) and environmental teaching activities (ACT) of these teachers. The results showed that the level of environmental literacy of preschool teachers in Vietnam was moderate with mean score for AS, DA, PB, and ACT ranged from 3.18 to 4.32 on a 5-point Likert-type scale. The results also indicate that the preschool teacher's KN had a positive impact on AS and DA; PB was influenced by AS, but not by KN or DA. In addition, a correlation analysis showed AS and PB had a positive impact on ACT, while DA had a negative influence on ACT. These findings imply that preschool teachers with certain desirable environmental literacy had more tendencies to implement ACT. Based on the findings, recommendations and implications are provided for policy makers, preschool teachers, and researchers in Vietnam and other countries.

Keywords: *Environmental literacy, environmental teaching activities, preschool teachers, Vietnam.*

To cite this article: Tran, H. U., LePage, B. A., & Fang, W. T. (2022). Environmental literacy and teaching activities of preschool teachers in Vietnam. *European Journal of Educational Research, 11*(4), 2357-2371. https://doi.org/10.12973/eu-jer.11.4.2357

Introduction

In Vietnam, meeting the country's future sustainable development objectives may be a challenge. Managing pollution, the unsustainable use of natural resources, and the loss of biodiversity in the face of global climate change will continue to impact Vietnam's rich, but delicate environmental resources (Institute of strategy, policy on natural resources and environment [ISPONRE], 2012; Ministry of Natural Resources and Environment [MONRE], 2020; Schirmbeck, 2017). As such, the Vietnamese government has identified that there is no better solution to meeting these goals than investing in environmental education programs for the people. Therefore, the Ministry of Education and Training (MOET) approved a number of strategies and policies for strengthening the environmental education programs in Vietnamese schools (See Appendix 1). The directives that were implemented provide important legal instruments for putting environmental education activities in Vietnam's national education system into action. In recent years, the MONRE and the MOET have focused on building and completing the content of environmental education at all levels in the country's education system by: Promoting environmental studies; reviewing, building, and strengthening the system of electronic materials available for environmental education; and enhancing environmental protection initiatives and solutions developed by the students through competitions and awards. However, in Vietnam, there is currently no specific course that is focused on environmental protection education for K to 12 students. Environmental topics are integrated into other subjects such as nature, social studies, and literature at the primary school level, or biology; geography, civics, agri-technics, literature, mathematics, physics, and chemistry in secondary school. At the preschool level, environmental education is incorporated in various learning activities, gaming, sightseeing, and other extra curriculum activities.

The results of several studies have indicated that the successful implementation of environmental education at all levels depend on the environmental literacy of the teachers with respect to their knowledge, awareness, environmental protection practices, attitude, competencies, and skills related to environmental education (Lahiri, 2017; Pathirana, 2015; Yalcin et al., 2016). Hicks and Bord (2001) warn that many educators, despite their commitment to global

* **Corresponding author:**
Wei-Ta Fang, Graduate Institute of Environmental Education, National Taiwan Normal University, Taiwan. ✉ wtfang@ntnu.edu.tw

understanding, can make things worse for students by teaching global problems as if they were a solely cognitive endeavor. They argued that education on global issues sometimes increased the student's negative feelings and attitudes, but these negative feelings and attitudes are often overlooked or not recognized when they do appear because they are not considered to be important facets of education.

We are not aware of any studies on the relationship between a teacher's level of environmental literacy and the components that comprise environmental literacy or environmental teaching activities in Vietnam. Therefore, we used a structural equation modeling (SEM) in this study to model and quantitatively describe the strength of the relationships between the components of a preschool teacher's environmental literacy and environmental teaching activities in Vietnam. This model may be a useful guide for educators and curriculum designers to plan and implement environmental education pedagogic strategies that should contribute to the teaching effectiveness about the environment for students. As such, in the following sections, we provide a definition for environmental literacy, environmental teaching activities, and the hypotheses that underlie our modeling approach.

Environmental Literacy

Although environmental literacy is a recently developed concept, there is no one universally-accepted definition. Roth (1992) suggested that it's the capacity to perceive and interpret the health of environmental systems and the ability of people to take appropriate action(s) to maintain, restore, or improve the health of those systems. Coyle (2004) argued that environmental literacy is distinct from a person's simple awareness of the environment or individual conduct knowledge because of its depth of information and the actual thinking and doing skills that are imparted. Fang (2020) defined it as the person's level of knowledge, competencies, and actions that lead to a healthier and more sustainable public that are based on the social influences and behaviors governed by social and personal norms.

The environmental literacy models that have been proposed over the past few decades show a high degree of similarity and consistency with one another with respect to their key components, although each model was based on different assumptions and priorities (McBride et al., 2013; Simmons, 1995). It can be said that environmental literacy aligns well with the awareness, knowledge, attitudes, skills, participation objectives, and guiding principles of environmental education (Engleson & Yockers, 1994). The components of environmental literacy in this study are comprised of a person's level of environmental knowledge, awareness, attitude, and personal behavior.

Environmental Teaching Activities

Environmental teaching activities are defined as any kind of instruction that a teacher undertakes with the goal of creating ecological concerns and values in a student's environmental respect. The ability to implement teaching activities inside and outside of the classroom is considered to be an indicator to assess teacher performance as a developer of knowledge, skills, and curricula (Citriadina et al., 2019). Shuman and Ham (1997) argued that teaching environmental education is related to a teacher's level of knowledge and skills and the learning environment. Teachers considered entertaining and engaging activities such as "planting trees", "examining plants and animals", "organizing nature trips", "collecting garbage" and "carrying out scientific experiments", "examining recyclable materials," and "watching documentaries on the environment" should be definitely included as learning modules/components in preschool environmental education (Türkoğlu, 2019).

The implications of creating a sustainable elementary school campus in central Taiwan based on conservation of the natural environment was examined and it was found that the most popular natural environment teaching activities were: "learning about living things on campus", "teaching knowledge about the natural ecological environment", and "investigating the outdoor environment" (Yeh & Lin, 2016). The environmental teaching activities most frequently selected by the teachers (e.g., picking up trash, caring for animals) were activities that reinforced moral values, achievable, provided immediate and obvious feedback, and being relevant (Peyton, 1984).

Many studies have concentrated on identifying the types of environmental teaching activities practiced by teachers (Peyton, 1984; Türkoğlu, 2019; Yeh & Lin, 2016). But, research data on the path models between environmental literacy and environmental teaching activities are absent. Therefore, we needed to ask whether there is a linear relationship between the components of environmental literacy and environmental teaching activities.

Hypotheses and Model Proposed

In this study we explored the correlations between the components of environmental literacy and environmental teaching activities of preschool teachers in Vietnam. Based on the extant literature, the following hypotheses were tested using the proposed framework.

Environmental Knowledge and Environmental Awareness

Using the Awareness – Knowledge – Attitude - Skills – Action (AKASA) model, Kuppusamy and Mari (2017) concluded that the relationship between KN and AS of the students in Malaysia are significantly positive and strong statistically. Aminrad et al. (2013) found a significant, but weak relationship between AS and KN with an "*r*" of .165 and *p* value of .001 (Significance level used is $p \leq .05$) among secondary school students in Malaysia. According to Raghuvanshi (2016), there was a positive relationship between KN and AW around environment in global issues. Thus, the first hypothesis proposed was:

Hypothesis 1 (H1): Environmental knowledge has a positive influence on environmental awareness.

Environmental Knowledge and Personal Behaviors

Using a research approach based upon the Theory of Reasoned Action (TRA), Paço and Lavrador (2017) pointed to the lack of relationship between KN and behavior. Mahat et al. (2017) stated that a high KN does not necessarily result in positive environmental actions. In another study, Ahamad et al. (2010) argued that some environmental actions such as saving energy or reducing waste in the household can be taken as a habit and does not require KN. As such, the second hypothesis proposed was:

Hypothesis 2 (H2): Environmental knowledge has no influence on personal environmental behaviors.

Environmental Knowledge and Attitudes Toward Decision-Making on Environmental Issues

A positive relationship was found between knowledge and attitude in many studies (Esa, 2010; Fah & Sirisena, 2014; Murphy & Olson, 2008; Pe'er et al., 2007). Esa (2010) showed a high correlation between KN and attitude ($r = .561$, $r^2 = .34$), which means good knowledge of the environment contributes to a positive environmental attitude. Arcury (1990) found KN to be consistently and positively related to environmental attitudes, although the relationship is not particularly strong, and Liu et al. (2015) found a positive, but weak correlation between knowledge and attitude. That the direction of the relationship is more important than its size, it can be said that people with adequate KN will also have more positive environmental attitudes (Genc & Akilli, 2016). Thus, the third hypothesis that we proposed was:

Hypothesis 3 (H3): Environmental knowledge has a positive influence on attitudes toward decision-making on environmental issues.

Environmental Awareness and Personal Behaviors

Adopting the Comprehensive Action Determination model, Fang et al. (2021) showed that environmentally related awareness had a positive influence on personal norms towards the recycling behaviors of Taipei City residents (β-value = .56 and *t*-value = 7.94). Nguyen and Bui (2020) studied the relationship between pro-environmental awareness and the behavior of local people in developing community-based tourism in The Mekong Delta, Vietnam. The authors concluded that if the local people have a good awareness of environmental protection, they were then motivated to take practical actions to protect the environment. It's been proposed in a number of other studies that AS and environmental behavior are positively correlated (Sabzehei et al., 2016; Saxena & Srivastava, 2012; Sengupta & Das, 2010). Therefore, the fourth hypothesis we proposed was:

Hypothesis 4 (H4): Environmental awareness has a positive influence on personal environmental behaviors.

Environmental Awareness and Attitudes Toward Decision-Making on Environmental Issues

A significant positive relationship between AS and attitude towards the environment exists among secondary school students in Tamilnadu and Kerala, India ($r = .52$, $p < .01$) (Dhayalan, 2019). Aminrad et al. (2013) indicated a positive relationship between awareness and attitudes related to environmental issues among secondary school students in Malaysia, which was highly correlated ($r = .990$, $p = .000$). Kaur (2013) found a moderate positive and significant correlation between environmental education awareness and the environmental attitude of teacher. When a teacher had a good AS, they showed a positive attitude towards the environment, and when they had a positive attitude towards environment, they showed a readiness to acquire more knowledge about environment, issues, and solutions. Therefore, the fifth hypothesis proposed was:

Hypothesis 5 (H5): Environmental awareness has a positive influence on attitudes toward decision-making on environmental issues.

Attitudes Toward Decision-Making on Environmental Issues and Personal Behaviors

According to Pathirana (2015), the correlation between perceived practices and attitudes in teachers and preschool teachers in Sri Lanka were low ($r = .022$; $p > .05$), which conveys the message that high positive environmental attitudes may not lead to responsible environmental practices. Liang et al. (2018) argued that the teachers in their study that had positive attitudes toward the environment might not guarantee corresponding actions to protect the environment. Lui

et al. (1999) also indicated that teacher trainees of the Hong Kong Institute of Education tended to show a positive attitude towards environmental protection, yet their behavior and habit were not entirely consistent to the stated attitudes. Thus, the sixth hypothesis proposed was:

Hypothesis 6 (H6): Attitudes toward decision-making on environmental issues has no influence on personal environmental behaviors.

Environmental Literacy and Environmental Teaching Activities

Liu et al. (2015) argued that teachers with better environmental literacy were more likely to teach environmental education and the teachers who reported having experience in planning environmental education programs or taught some environmental teaching activities had a better score in the behavior domain and overall environmental literacy than those that had not taught environmental education (the mean were 3.68 vs. 3.47). Salvador et al. (2017) concluded that pre-service teachers with higher levels of AS may be more effective environmental education teachers in the future. According to Kim and Fortner (2006), the teacher's attitudes on environmental issues are directly related to the time that they devote to environmental issues in their lessons and the teaching. Teachers that have a positive attitude towards the environment were found to have more tendencies towards environmental education (Kim & Fortner, 2006; Ko & Lee, 2003). Thus, the following three hypotheses proposed were:

Hypothesis 7 (H7): Environmental awareness has an influence on environmental teaching activities.

Hypothesis 8 (H8): Personal environmental behaviors have an influence on environmental teaching activities.

Hypothesis 9 (H9): Attitudes toward decision-making on environmental issues have an influence on environmental teaching activities.

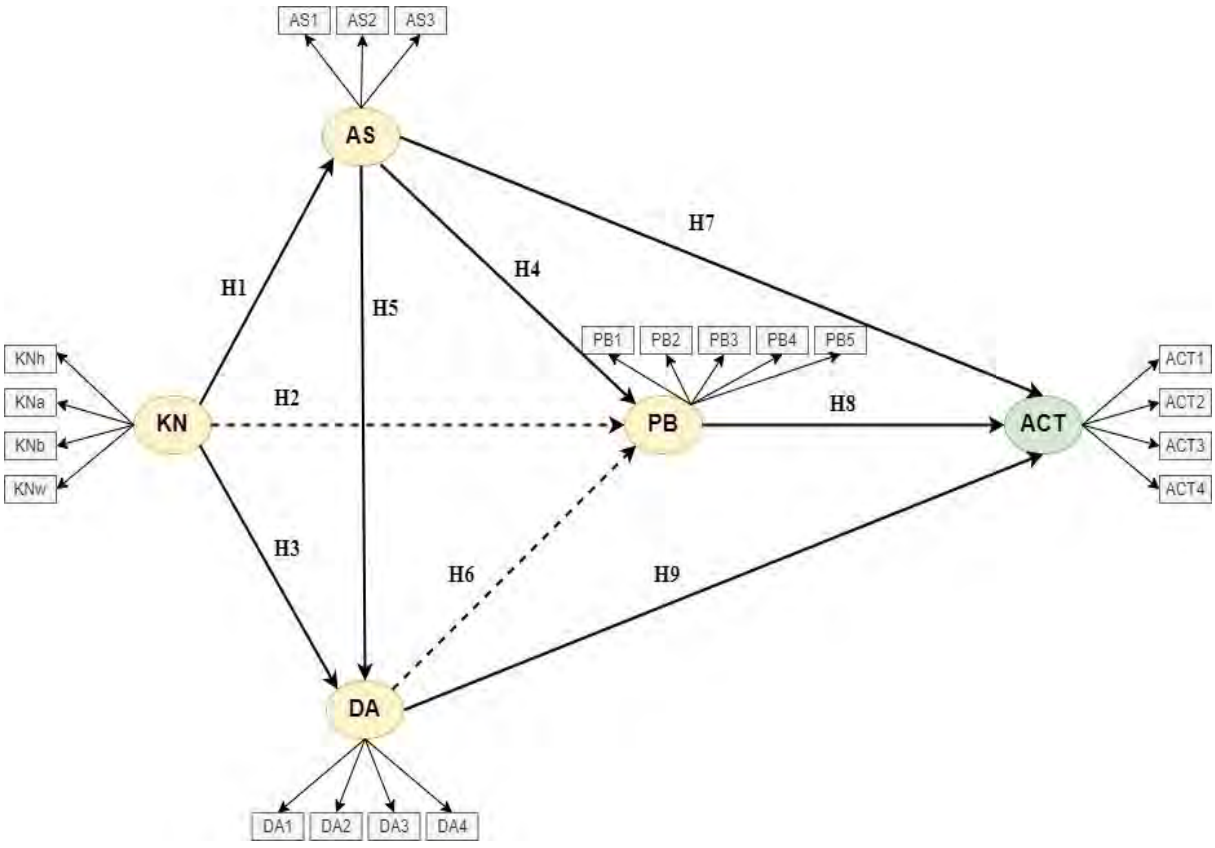

Figure 1. The Hypotheses Model for the Relationship between Environmental Literacy and Environmental Teaching Activities

Methodology

Research Design

This study was designed for Vietnamese preschool teachers with the purpose of modeling their level of environmental literacy and environmental teaching activities based on data obtained from an online questionnaire survey. Nine hypotheses that quantitatively measured the correlation between the components of environmental literacy and environmental teaching activities were tested and the model was then empirically tested using SEM.

Research Participants

The participants in this study were teachers at preschools in the cities of Ha Noi, Da Nang and Ho Chi Minh and they were selected using a random sampling approach (Fraenkel & Wallen, 2009; Lavrakas, 2008). Ha Noi, Da Nang, and Ho Chi Minh are three large urban areas in Vietnam. A total of 324 responses out of 328 responses were collected, of which about 50% of the participants were from Da Nang. There were four responses that did not meet the sample requirements, so they were rejected to ensure validity of the data obtained. According to Hair et al. (2010), the minimum sample size is 100 for the number of latent constructs for five groups or less and each group must have more than three observed variables. In addition, the minimum sample size for SEM has been suggested to be 150 (Bentler & Chou, 1987). Some researchers suggest that the sample size for SEM should be between 200 to 500 and at least 200 (Çelik & Yılmaz, 2013). The sample size in this study was 324 respondents. Based on the 324 responses used for the analysis (Table 1), the majority of respondents were under the age of 35, most had at least a bachelor's degree in Early Childhood Education (ECE), and 55.9% had one to five years of teaching experience. In addition, because of the profession requirements in Vietnam, all preschool teachers are female.

Table 1. Demographic Descriptions of the Sample (N = 324)

Variable	Description	Frequency (N=324)	Percentage (%)	Cumulative percentage (%)
Age	18 to 25	119	36.7	36.7
	26 to 35	163	50.3	87.0
	36 to 45	40	12.4	99.4
	Greater than 45	2	0.6	100
Education	Intermediate degree in ECE major	56	17.3	17.3
	Associate degree in ECE major	36	11.1	28.4
	Bachelor's degree in ECE major	196	60.5	88.9
	Master's degree in ECE major	20	6.2	95.1
	Other	16	4.9	100
Work experience	Less than 1 year	34	10.5	10.5
	1 to 5 years	181	55.9	66.4
	5 to 10 years	63	19.4	85.8
	10 to 15 years	32	9.9	95.7
	15 to 20 years	9	2.8	98.5
	More than 20 years	5	1.5	100

Instrument and Data Collection

A structured questionnaire was used as the quantitative research method with the aim of covering a large number of respondents (Fraenkel & Wallen, 2009). The use of a structured questionnaire ensures that the closed answers are fixed, rigid, and have no scope of confusion as they have a specific set of responses that limit the respondents. In addition, these responses can be used by allocating a value to every answer which makes it easy to compare responses of different individuals and enables quantitative analysis of survey findings. The questionnaire consisted of two sections. The first is related to the demographic profiles of the participants and the second part consisted of 36 questions related to the five variables that we measured. These variables were: environmental knowledge (KN), environmental awareness (AS), personal behaviors (PB), attitudes toward decision-making on environmental issues (DA) and environmental teaching activities (ACT). The questions used were adopted from questionnaires that were validated and used in previous studies. Eighteen multiple choice questions about the KN were from DeChano (2006). The KN questions were classified into four categories: knowledge relating to human activity (KNh) with six questions; knowledge relating to the atmosphere (KNa) with four questions; knowledge relating to biodiversity and ecosystems (KNb) with four questions; and knowledge relating to water (KNw) with four questions (See Appendix 1). Three questions were related to AS and four question were sourced from Goulgouti et al. (2019).

A 5-point Likert-type scale with five possible responses (strongly disagree, disagree, have no opinion, agree, and definitely agree) was used to measure the participant's response to these questions (Goulgouti et al., 2019). For the PB variable, five items were Yavetz et al. (2009). Using a Likert-type scale with five possible responses (never, very seldom, sometimes, often, almost always) to measure the frequency of implementing these behaviors. Four items were developed based on the scope of integrating environmental education in the preschool curriculum in Vietnam for the ACT (MOET, 2009). The Likert-type scale with five possible responses (never, very seldom, sometimes, often, almost always) was applied to rate the participant's level of implementing these activities.

The questionnaire was in Vietnamese and was converted into a Google document that could be completed online. The questionnaire link with the introduction of the research was widely shared through social networking groups and

emailed to reach survey audiences. A set of 50 lesson plan samples were provided as a gift to the respondents and to encourage the participation of preschool teachers.

Data Analyses

Because the participants were preschool teachers that were members of social network groups, it is possible that some of the responses are from/reside outside of Ha Noi, Da Nang, and Ho Chi Minh cities. Based on the preschool address where they worked, participants that were not preschool teachers in the three cities were removed before the data were analyzed to ensure integrity of the sample.

Since the KN was tested by multiple-choice questions, the scores were expressed as a fraction of 10, where a score of 10 would mean that a participant answered all questions correctly. Sample means, standard deviation scores, and percentages of the five key variables were determined using descriptive statistics. The Pearson correlation technique was used to measure the strength and direction of the relationship between the key variables. The Pearson correlation coefficient is denoted by r and can range from +1 to 0 where a value of 0 indicates that there is no association between the two variables. The stronger the association, the closer the value of r will be to +1. Finally, the data were analyzed using SEM to test our hypotheses (see Hypotheses section). Path coefficients (β-value) and t-values were calculated to evaluate the magnitude and statistical significance of the relationships. The higher the absolute value of the beta coefficient, the stronger the relationship. A t-value greater than +2 or less than −2 is acceptable. The higher the t-value, then the greater the confidence in the coefficient as a predictor. R-squared (R^2) is calculated to determine the goodness of fit of the data in the regression model (Hair et al., 2010). The Statistical Package for Social Sciences (SPSS) and Analysis of Moment Structure (AMOS) version 22 were utilized for the data analyses.

Reliability and Validity of the Questionnaire

The questionnaire for this study included multiple choice questions to measure KN and 5-point Likert-type scales to measure AS, DA, PB, and ACT. Composite reliability (CR) and Cronbach's α values were used to determine the internal consistency of these scales. Convergent validity was evaluated using the average variance-extracted values (AVE). The data in Table 1 show that the Cronbach's α value of the questionnaire was higher than .70, which suggests that the internal consistency of the items was good and the designed scales were reliable. The Cronbach's α values for the respective variables were: AS (.859), DA (.894), PB (.814), ACT (.841), and KN (.502). The AVE value for the variables was more than .50, except for KN, which had an AVE value of .4123. All of the CR values were higher than .70, which again indicates that the internal consistency of these items was good.

The more inter-related an item is to another, then the higher the CR coefficient. However, there is no clear agreement on the specific criteria for interpreting Cronbach's α (Streiner, 2003). According to George and Mallery (2003), a Cronbach α value of < .50 is unacceptable, between .50 and < .60 is poor, between .60 and < .70 is questionable, between .70 and < .80 is acceptable, between .80 and < .90 is good, and greater than .90 is excellent. Another interpretation for this coefficient is that a Cronbach's α value of < .50 has low reliability, .50 to < .70 is moderately (acceptable) reliable, and > .70 is high (good) and reliable (Hinton et al., 2004). Dall'Oglio et al. (2010) stated that a Cronbach's α value higher than .70 is generally considered to be satisfactory; however, when there are less than 20 items, a value of .50 is satisfactory. In this study, four Cronbach's α values were above .70 and the other Cronbach α values were above .50, so they all passed the reliability test.

According to Bagozzi and Yi (1998), the minimum cut-off value for item factor loadings are above .50, AVE in each construct exceeds .50 and CR in each construct exceeds .70. In cases where the AVE value is less than .50, but the CR value is greater than .60, the convergent validity of the construct is sufficient (Fornell & Larcker, 1981). Therefore, it is reasonable to conclude that the convergent validity of this study is acceptable.

Table 2. Reliability and Validity of the Scales (N = 324)

Scale	CR	Cronbach's α	AVE
KN	.7339	.502	.4123
AS	.9915	.859	.7825
DA	.9267	.894	.7640
PB	.8731	.814	.5795
ACT	.8941	.841	.6786
Overall		.701	

Common Method Bias

Since the respondents answered all of the statements that measured different constructs in the questionnaire at the same point in time, a methodological bias may arise (Podsakoff et al., 2003). This Common Method Bias is controlled by the method proposed by Podsakoff et al. (2003). Specifically, Harman's single-factor test (Harman, 1976) was performed

with the collected data in this study. The Harman's single-factor test showed that the total variance extracted by one factor was 23.177%, which less than the recommended threshold of 50% (Kock, 2021). Thus, this result showed that even the presence of methodological bias did not significantly affect the estimates that were obtained.

Results

Descriptive Statistics

The overall mean score for KN was 6.98 (SD = 1.393) and the mean scores for each variable ranged from 3.18 to 4.32 (Table 3). In addition, the factor loading values ranged from .517 to .951, which is greater than .50 and demonstrates that the factor extracts possess sufficient variance from the corresponding variable (Bagozzi & Yi, 1998; Fornell & Larcker, 1981; Hair et al., 2010).

Table 3. Descriptive Statistics for Variables and Items (N=324)

Variables / Item	Mean	SD	FL
Knowledge (KN)	**6.98**	**1.393**	
KNh. Knowledge relating to human activity (6 questions)	6.01	1.97	.596
KNa. Knowledge relating to the atmosphere (4 questions)	7.28	2.25	.717
KNb. Knowledge relating to biodiversity and ecosystems (4 questions)	8.78	1.90	.716
KNw. Knowledge relating to water (4 questions)	5.86	2.61	.517
Awareness (AS)	**4.32**	**0.598**	
AS1. It's every teacher's responsibility to include environmental subjects and values in their teaching.	4.24	0.701	.827
AS2. I believe that I can contribute to the quality of the environment through my personal behavior.	4.32	0.677	.919
AS3. It is each person's responsibility to take care of the environment.	4.40	0.652	.905
Decision attitude (DA)	**3.18**	**1.232**	
DA1. There's no use in trying to influence my family or friends on environmental issues.	2.48	1.263	.629
DA2. Concern for the environment is out of proportion.	3.47	1.508	.951
DA3. It's humanity's right to exploit nature's resources according to their needs.	3.47	1.479	.947
DA4. Action conducted by single citizens are useless because the 'authorities' aren't impressed by the 'little citizen".	3.29	1.398	.927
Personal behavior (PB)	**3.77**	**0.679**	
PB1. Collect, classify and recycle waste	3.72	0.853	.732
PB2. Reuse used writing paper as draft paper	3.99	0.833	.774
PB3. Purchase 'environmentally friendly' products (e.g., ozone friendly sprays, products with recyclable packaging, economy size products).	3.85	0.833	.805
PB4. Participate in campaigns for cleanup and care of public spaces.	3.65	0.875	.744
PB5. Dispose of used batteries in proper collection container instead of waste basket.	3.62	1.071	.749
Environmental teaching activities (ACT)	**3.68**	**0.738**	
ACT1. Planting tree	3.88	0.813	.807
ACT2. Organizing field trips	3.56	0.914	.858
ACT3. Collecting garbage	3.69	0.920	.828
ACT4. Carrying out scientific experiments	3.58	0.933	.801

The Pearson's correlation coefficients between the variables we measured are presented in Table 4. The results revealed a weak negative relationship, but no significant relationship between KN and PB; KN and ACT; AS and DA; DA and PB, while a positive and significant correlation was seen with the variables marked with an asterisk. The relationship between PB and ACT was the strongest with $r = .398$ ($p < .01$).

Table 4. Pearson's Correlation Coefficient Matrix for Each Variable of This Study

	KN	AS	DA	PB	ACT
KN	1	.151**	.304**	-.013	-.030
AS		1	-.017	.282**	.359**
DA			1	-.002	-.139*
PB				1	.398**
ACT					1

($p < .05$ *; $p < .01$ ** (two-tailed), significant correlation)

Structural Equation Model

AMOS 22 was used to conduct path analysis for the hypotheses we tested in this study. The model's results and the goodness of fit indexes for the hypothesized measurement model were summarized in Table 5. The Adjusted Goodness of Fit Index (AGFI), No Normed Fit Index (NNFI), Parsimony Normed Fit Index (PNFI), Normed Fit Index (NFI), Comparative Fix Index (CFI), Goodness Fit Index (GFI), and Parsimony Comparative Fit Index (PCFI) were used to evaluate the model. Although it may be the convention that a standard of .90 for AGFI and NFI be used to judge the overall fit of a model, the .90 criterion has been censured as being too stringent for developing theories and/or models (Wu & Wang, 2006). Given that environmental education in preschools was under development rather than firmly established at the time of this study in Vietnam, the .90 standard was felt to be too stringent for the purposes of this study and, thus, the less stringent threshold was appropriate and the model deemed acceptable (Table 5).

Table 5. The Results of Structural Model Fit

Name of index	Threshold	Result	References
Chi-square	-	332.104	
df	-	161	
Chi-square/df	< 5	2.063	Hair et al. (2010)
RMSEA	< .080	.057	Hair et al. (2010); McDonald and Ho (2002)
AGFI	> .80	.882	Hair et al. (2010); Wu and Wang (2006); Hsu and Lin (2008)
NNFI	> .80	.933	Hair et al. (2010); Wu and Wang (2006)
PNFI	> .50	.759	Hair et al. (2010)
NFI	> .80	.896	Hair et al. (2010); Wu and Wang (2006)
CFI	> .90	.943	Hair et al. (2010); Bentler and Bonett (1980)
GFI	> .85	.910	Hair et al. (2010); Wu and Wang (2006); Seyal et al. (2002); Hsu and Lin (2008)
PCFI	> .50	.796	Hair et al. (2010)

The results of hypotheses we tested are presented in Table 5. The SEM included measurement and path models. Figure 2 presents the parametric results of the SEM used in this study.

Table 6. Significant Effect Path Coefficient

Path	*t*-value	*p*-value	*β*-value
KN → AS	2.455	.0140	.213
KN → DA	3.784	.000***	.456
AS → DA	-0.716	.474	-.045
DA → PB	0.808	.419	.060
AS → PB	4.953	.000***	.363
KN → PB	-0.817	.414	-.080
PB → ACT	5.406	.000***	.384
AS → ACT	4.348	.000***	.283
DA → ACT	-2.995	.003	-.164

($p < .05$ *; $p < .01$ **; $p < .001$ ***, significant correlation)

The findings of the path analysis for the respective hypotheses were briefly outlined as follows:

Hypothesis 1 (H1): Environmental knowledge has a positive influence on environmental awareness. H1 is supported with a path coefficient *β*-value of .213 and *t*-value of 2.455, which are significant.

Hypothesis 2 (H2): Environmental knowledge does not influence personal environmental behavior. H2 was supported with a path coefficient *β*-value of -.080 and *t*-value of -0.817, which were not significant.

Hypothesis 3 (H3): Environmental knowledge has a positive influence on attitudes toward decision-making on environmental issues. H3 was supported with a path coefficient *β*-value of .456 and *t*-value of 3.784, which were highly significant.

Hypothesis 4 (H4): Environmental awareness has a positive influence on personal environmental behaviors and H4 was supported with a path coefficient *β*-value of .363 and *t*-value of 4.953, which were highly significant.

Hypothesis 5 (H5): Environmental awareness has a positive influence on attitudes toward decision-making on environmental issues. H5 was unsupported, with a path coefficient *β*-value of -.045 and *t*-value of -0.716, which were not significant.

Hypothesis 6 (H6): Attitudes toward decision-making on environmental issues do not influence personal environmental behaviors. H6 was supported, with a path coefficient β-value of .060 and t-value of 0.808, which were not significant.

Hypothesis 7 (H7): Environmental awareness has an influence on environmental teaching activities. H7 was supported, with a path coefficients β-value of .283 and t-value of 4.348, which were highly significant.

Hypothesis 8 (H8): Personal environmental behaviors have an influence on environmental teaching activities. H8 was supported, with a path coefficient β-value of .384 and t-value of 5.406, which were highly significant.

Hypothesis 9 (H9): Attitudes toward decision-making on environmental issues have an influence on environmental teaching activities. H9 was supported, with a path coefficient β-value of -.164 and t-value of -2.995, which were very significant.

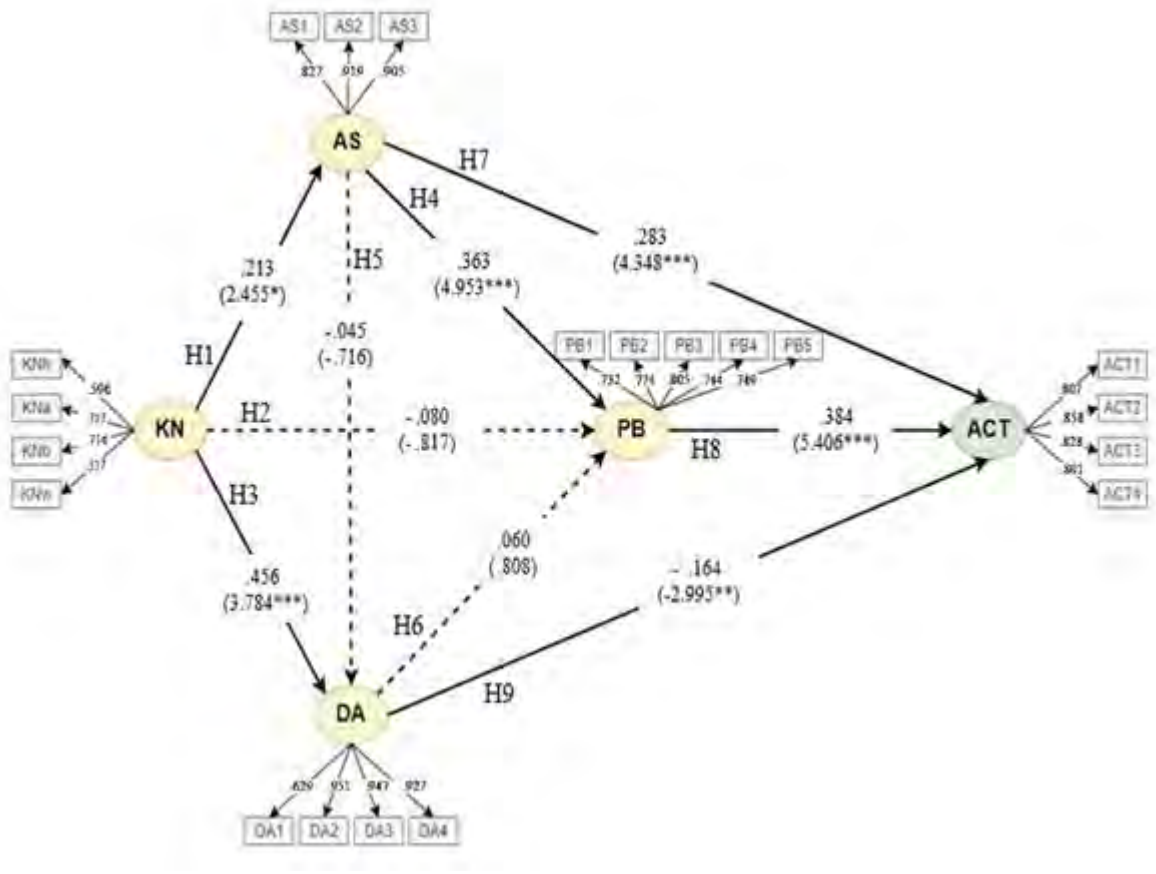

Figure 2. Path Analysis Diagram of This Study

Except for H5 where we tested the influence of environmental awareness on decision attitude (DA) all of the other hypotheses are accepted. It can be seen that 32% of the variance of ACT was explained by the related variables, which show that this model explained the data well (Table 6).

Table 7. The Variance Explained of Variables

Variable	R^2
AS	.045
DA	.201
PB	.127
ACT	.320

Discussion

The importance of the role of a teacher in environmental education has been determined in previous studies (Aini & Laily, 2010; Guner, 2013; Pathirana, 2015; Yalcin et al., 2016). Educators, especially preschool teachers, play an influential role in developing new behavioral patterns for their students to adopt a sustainable lifestyle (Aini & Laily, 2010). David (1998, as cited in Guner, 2013) mentioned that preschool teachers play a facilitator role in forming children's long-lasting environmental attitudes and values (Guner, 2013). Environmental literacy was recommended as one of the competencies that educators need to provide in a high-quality environmental education program (North American Association for

Environmental Education, n.d.; Richards & Farrell, 2005). Preschool teacher attitudes towards the environment and environmental issues substantially influence children's environmental awareness and positive environmental attitudes and behaviors toward the environment (Yalcin et al., 2016). If teachers do not have the knowledge related to environmental awareness/protection, a positive attitude towards environment, and the competencies to impart that knowledge to their students, then the ability to educate children on environmental issues will be less effective (Pathirana, 2015). Therefore, a teacher's environmental education performance is an important issue that needs to be understood first. However, teachers with good environmental literacy may not guarantee good student environmental education performance.

The statistical results show that while most of participants (92.59%) correctly answered more than 50% of the environmental knowledge questions, the figure for those who had correct responses above 75% was just 1/3 (35.18%) of participants. In the 1997 National Environmental Education & Training Foundation research report, a value of 75% correct answers for environmental knowledge was established for every adult in the United States (Coyle, 2004). Thus, it can be said that the environmental knowledge of preschool teachers in this study did not meet the 1997 recommendation.

The average scores for AS, DA, PB and ACT ranged from 3.18 to 4.32 on a 5-point scale (Table 3). These results showed that the environmental literacy of preschool teachers in Vietnam was moderate on a 5-point scale and our findings are similar to the results seen in previous studies (Aini & Laily, 2010; Erbasan & Erkol, 2019; Türkoğlu, 2019; Yalcin et al., 2016). Erbasan and Erkol (2019) determined that the primary school teachers' level of environmental literacy was moderate with mean score of 125.90 in the scale developed by McBeth et al. (2008, as cited in Erbasan & Erkol, 2019). Since the maximum possible score of the scale is 180, the authors concluded that this result is not at the desired level on environmental literacy for the teachers that took part in their study. In Aini and Laily (2010), preschool teachers were to some extent prepared with basic essential elements for environmental education; however, their present level of preparedness for environmental education needed to be enhanced. Yalcin et al. (2016) concluded that teachers that organize trips outside of a classroom setting, utilize games, stories and drama, plant trees, grow plants, collect garbage, and do scientific research related to environmental education provide children with much needed information and life experiences. In Türkoğlu (2019), preschool teachers that were studied pointed out that the activities that should be done within the scope of an environmental education program included planting trees, examining plants and animals, organizing nature trips, collecting garbage, making scientific experiments, examining recyclable materials and watching documentaries on the environment.

The focus of this study was to build a model that described the environmental literacy of preschool teachers in Vietnam. The outcome of our analysis shows that eight out of nine hypotheses (H1, H2, H3, H4, H6, H7, H8, and H9) were supported and one (H5) was rejected. According to the findings, KN had a positive impact on AS and DA, which was consistent with the conclusions of Aminrad et al. (2013) who found similar ressults. The results also indicate that preschool teachers' personal behavior (PB) was influenced by AS, but not by KN and DA. This result is similar to recent studies on the relationship among the components of environmental literacy (Fang et al., 2021; Nguyen & Bui, 2020; Sabzehei et al., 2016; Saxena & Srivastava, 2012; Sengupta & Das, 2010). Karaismailoglu and Erten (2018) also observed that a person's attitude toward the environment and the environmental knowledge of the teachers in their study did not have a positive effect on behavior alone, but knowledge and attitude had a positive effect on each other ($r = .436$, $p < .01$).

We also identified that there was a correlation between AS, PB, DA and ACT, and AS and PB had a positive impact on ACT, while DA had a negative influence on ACT. We found that there were no relevant data/studies within which the relationship between environmental literacy and environmental teaching activities was examined. Although evidence of the correlation between these two factors has not been clearly shown in previous studies, many scholars have affirmed the essential role of environmental literacy is related to the environmental education of teachers (Kim & Fortner, 2006; Ko & Lee, 2003; Liu et al., 2015; Salvador et al., 2017). According to Knapp and Barrie (2001), teachers were expected to be environmentally literate. The findings in this study were not necessarily surprising given that the results of their study is nearly 25 years old and environmental education and literacy are relatively young topics. The AS and PB scores of the participants in this study were high with values of 4.32 and 3.77, respectively, while the DA score had a low value of 3.18. As the same time, there was no relationship between DA and AS, between DA and PB. These results may be the reason for the difference in the linear correlation coefficient between AS and ACT, PB, and ACT, which were positive influence, while the influence between DA and ACT was negative.

Finally, the model derived from this study has a good model fit with an R^2 for the ACT variable of .32.

Conclusion

This study was conducted to model the environmental literacy of preschool teachers in Vietnam based on KN, AS, attitudes toward decision-making on DA, personal behavior and skills in term of ACT of preschool teachers in Vietnam. The findings showed that the environmental literacy of preschool teachers in Vietnam should be enhanced. According to the findings in this study, we concluded that if the environmental awareness of a preschool teacher is increased, it should then lead to improved environmentally - related behaviors. In addition, we also concluded that teachers with higher

levels of environmental awareness and personal environmental behaviors tended to perform activities within the scope of environmental education more frequently. In conclusion, the findings have supported most of hypotheses developed for this study, except for one that AS has a positive influence on DA.

Recommendations

According to our findings, some recommendations and implications were generated for policy makers, preschool teachers, and researchers in Vietnam and other countries. First, environmental education should be promoted more strongly at each country's level nationally. In Vietnam, the MOET could more proactively coordinate with the MONRE regularly to design and improve professional training programs on the environment and environmental education competencies for in-service preschool teachers. The results generated by the model in this study showed a positive correlation between AS, PB, and ACT. At the same time, AS was influenced by KN. Therefore, these regularly revised/updated professional training programs should be designed in the spirit of continuous improvement with the idea of strengthening practical experiences, not only through environmental knowledge, but also by improving a preschool teacher's environmental awareness and personal behaviors related to environment. In addition, the MOET also should issue specific guidelines on the implementation of environmental education activities for children in preschools.

Second, preschool teachers need to be active in improving their environmental literacy and their self-efficacy beliefs toward environmental education through a variety of sources such as books, videos, scientific journals, internet, and actively participate in organizations and community activities related to the environment. Preschools are recommended to systematically guide, encourage, and supervise teachers in integrating the contents of environmental education into their work and implementing environmental teaching activities. Holding competitions about the environment, such as designing and applying teaching aids made from recycled and natural materials, reducing the carbon footprint in the classroom, and environmental protection knowledge contests for example. These activities may be a method to increase a teacher's willingness and positive attitude toward the environment and environmental education.

Third, it is believed that the current study will lead to future research in in Vietnam and abroad using a similar framework, which will make substantial contributions in the field of environmental literacy and teaching activities of preschool education teachers. Researchers in other countries are encouraged to verify this model by using samples from their own countries to test our assumptions and hypotheses as they relate to the correlation between environmental literacy and environmental teaching activities. In the context of Vietnam, future research on environmental education practices by teachers in preschools is also recommended.

Limitations

As is the case with any model, the model used and data generated in this study has limitations. The model cannot/should not be generalized because it represented only preschool teachers in three cities in Northern, Central and Southern Vietnam. However, the results showed that the model explained the data well (R^2 = .32) and may overcome the lack of a model that could be used to study environment literacy in all preschool teachers in Vietnam. Therefore, this model would be useful for promoting environmental literacy and environmental education among preschool teachers in Vietnam.

Authorship Contribution Statement

Tran: Conceptualization, design, analysis, and writing. LePage: Editing, writing, analysis, and reviewing. Fang: Reviewing, writing, analysis, and supervision.

References

Ahamad, S. N., Juhdi, N., & Awadz, A. S. (2010). Examination of environmental knowledge and perceived pro-environmental behavior among students of university Tun Abdul Razak, Malaysia. *International Journal of Multidisciplinary Thought*, *1*(1), 328-342. https://bit.ly/3dHazYR

Aini, M., & Laily, P. (2010). Preparedness of Malaysian pre-school educators for environmental education. *Pertanika Journal Social Sciences & Humanities*, *18*(2), 271-283. https://bit.ly/3RhIyVh

Aminrad, Z., Zakariya, S. Z., Hadi, A. S., & Sakari, M. (2013). Relationship between awareness, knowledge and attitudes towards environmental education among secondary school students in Malaysia. *World Applied Sciences Journal*, *22*(9), 1326-1333. https://bit.ly/3fnN739

Arcury, T. A. (1990). Environmental attitude and environmental knowledge. *Human Organization*, *49*(4), 300-304. https://doi.org/10.17730/humo.49.4.y6135676n433r880

Bagozzi, R. P., & Yi, Y. (1998). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74-94. https://doi.org/10.1007/BF02723327

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588–606. https://doi.org/10.1037/0033-2909.88.3.588

Bentler, P. M., & Chou, C.-P. (1987). Practical issues in structural modeling. *Sociological Methods Research*, *16*(1), 78-117. https://doi.org/10.1177/0049124187016001004

Çelik, H. E., & Yılmaz, V. (2013). *Lısrel 9.1 ile yapısal eşitlik modellemesi* [Structural equation modeling with Lisrel 9.1]. Anı Publishing.

Citriadina, Y., Wiyono, B. B., Huda, M., & Arifin, I. (2019). The influences of teacher performance in public high schools in Indonesia. *International Journal of Innovation, Creativity and Change*, *9*(6), 25-41. https://bit.ly/3dMZipU

Coyle, K. (2004). *Environmental literacy in America.* The National Environmental Education & Training Foundation.

Dall'Oglio, A. M., Rossiello, B., Coletti, M. F., Caselli, M. C., Ravà, L., Ciommo, V. D., Orzalesi, M., Giannantoni, P., & Pasqualetti, P. (2010). Developmental evaluation at age 4: Validity of an Italian parental questionnaire. *Journal of Paediatrics and Child Health*, *46*, 419–426. https://doi.org/10.1111/j.1440-1754.2010.01748.x

DeChano, L. M. (2006). A multi-country examination of the relationship between environmental knowledge and attitudes. *International Research in Geographical and Environmental Education*, *15*(1), 15-28. https://doi.org/0.2167/irgee/184.0

Dhayalan, J. D. (2019). Relationship between environmental awareness and attitude towards environment among secondary school students. *IOSR Journal*. https://bit.ly/3Dr5wWN

Engleson, D. C., & Yockers, D. H. (1994). *A guide to curriculum planning in environmental education*. Wisconsin Dept. of Public Instruction.

Erbasan, Ö., & Erkol, M. (2019). Examination of primary school teachers' environmental literacy levels. *International Journal of Contemporary Educational Research*, *6*(2), 311-324. https://doi.org/10.33200/ijcer.566198

Esa, N. (2010). Environmental knowledge, attitude and practices of student teachers. *International Research in Geographical and Environmental Education*, *19*(1), 39-50. https://doi.org/10.1080/10382040903545534

Fah, L. Y., & Sirisena, A. (2014). Relationships between the knowledge, attitudes, and behaviour dimensions of environmental literacy: A structural equation modeling approach using SMART_PLS. *Journal for Educational Thinkers*, *5*, 119–144. https://bit.ly/3xUgpg4

Fang, W.-T. (2020). *Envisioning environmental literacy: Action and outreach.* Springer Nature Singapore Pte Ltd. https://doi.org/10.1007/978-981-15-7006-3

Fang, W.-T., Huang, M.-H., Cheng, B.-Y., Chiu, R.-J., Chiang, Y.-T., Hsu, C.-W., & Ng, E. (2021). Applying a comprehensive action determination model to examine the recycling behavior of Taipei city residents. *Sustainability*, *13*, 490. https://doi.org/10.3390/su13020490

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 39-50. https://doi.org/10.2307/3151312

Fraenkel, J. R., & Wallen, N. E. (2009). *How to design and evaluate research in education* (7th ed.). McGraw-Hill.

Genc, M., & Akilli, M. (2016). Modeling the relationships between subdimensions of environmental literacy. *Applied Environmental Education & Communication*, *15*(1), 58-74. https://doi.org/10.1080/1533015X.2016.1141724

George, D., & Mallery, P. (2003). *SPSS for Windows step by step: A simple guide and reference. 11.0 update.* Allyn & Bacon. https://bit.ly/3d7xTPa

Goulgouti, A., Plakitsi, A., & Stylos, G. (2019). Environmental literacy: Evaluating knowledge, affect, and behavior of pre-service teachers in Greece. *Interdisciplinary Journal of Environmental and Science Education*, *15*(1), Article e02202. https://doi.org/10.29333/ijese/6287

Guner, Z. (2013). *Environmental education in early childhood teacher training programs: Perceptions and beliefs of pre-service teachers* [Master's thesis, Middle East Technical University]. Middle East Technical University Digital Archive. https://bit.ly/3xUgi48

Hair, J. F., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate data analysis* (7th ed.). Pearson Prentice Hall.

Harman, H. H. (1976). *Modern factor analysis* (3rd ed.). University of Chicago Press.

Hicks, D., & Bord, A. (2001). Learning about global issues: Why most educators only make things worse. *Environmental Education Research*, *7*(4), 413-425. https://doi.org/10.1080/13504620120081287

Hinton, P. R., Brownlow, C., McMurray, I., & Cozens, B. (2004). *SPSS explained.* Routledge. https://doi.org/jdvt

Hsu, C.-L., & Lin, J. C.-C. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & Management, 45*(1), 65–74. https://doi.org/csjbm3

Institute of strategy, policy on natural resources and environment. (2012). *National strategy for environmental protection until 2020 and vision toward 2030.* https://bit.ly/3eu5SS0

Karaismailoglu, E. S., & Erten, S. (2018). Investigation on environmental awareness level of teachers. In Kiray, S. A. (Ed.), *Proceeding of International Conference on Education in Mathematics, Science and Technology (ICEMST)* (pp. 96-103). ISRES Publishing. https://bit.ly/3rbxXRq

Kaur, I. (2013). Environmental education awareness and attitude among teacher educators Vipinder Nagra. *International Journal of Social Science* , *2*(2), 95-107. https://doi.org/110.5958/j.2321-5771.2.2.003

Kim, C., & Fortner, R. W. (2006). Issue-specific barriers to addressing environmental ıssues in the classroom: An exploratory study. *The Journal of Environmental Education*, *37*(3), 15-22. https://doi.org/d2z58f

Knapp, D. H., & Barrie, E. (2001). Content evaluation of an environmental science field trip. *Journal of Science Education and Technology*, *10*(4), 351-357. https://doi.org/10.1023/A:1012247203157

Ko, A. C.-C., & Lee, J. C.-K. (2003). Teachers' perceptions of teaching environmental issues within the science curriculum: A Hong Kong perspective. *Journal of Science Education and Technology* , *12*(3), 187-204. https://doi.org/css8v6

Kock, N. (2021). Harman's single factor test in PLS-SEM: Checking for common method bias. *Data Analysis Perspectives Journal, 2*(2), 1-6. https://bit.ly/3Djk0rF

Kuppusamy, S., & Mari, T. (2017). Relationship between environmental awareness and environmental knowledge using "AKASA" model among architecture students in private universities, Klang Valley, Malaysia. In S. Gianluca (Ed.), *Proceedings of the 2nd International Conference on Knowledge Engineering and Applications (ICKEA)* (pp. 151-155). Institute of Electrical and Electronics Engineers. https://doi.org/10.1109/ICKEA.2017.8169920

Lahiri, S. (2017). Education for sustainable development in teacher education in India. *ZEP : Zeitschrift Für Internationale Bildungsforschung Und Entwicklungspädagogik*, *40*(3), 30-36. https://doi.org/10.25656/01:16970

Lavrakas, P. J. (2008). *Encyclopedia of survey research methods (Vols. 1-0)*. Sage Publications, Inc. https://doi.org/gftwhb

Liang, S.-W., Fang, W.-T., Yeh, S.-C., Liu, S.-Y., Tsai, H.-M., Chou, J.-Y., & Ng, E. (2018). A nationwide survey evaluating the environmental literacy of undergraduate students in Taiwan. *Sustainability*, *10*(6), Article 1730. https://doi.org/gd77r2

Liu, S.-Y., Yeh, S.-C., Liang, S.-W., Fang, W.-T., & Tsai, H.-M. (2015). A National investigation of teachers' environmental literacy as a reference for promoting environmental education in Taiwan. *The Journal of Environmental Education*, *46*(2), 114-132. https://doi.org/10.1080/00958964.2014.999742

Lui, C. W., Tsang, P. K., & Chan, S. L. (1999, November 20). *A study of environmental attitude, behaviour and knowledge of HKIEd teacher trainees* [Paper presentation]. The Hong Kong Educational Research Association (HKERA) 16th Annual Conference: Exploring New Frontiers in Education, The Hong Kong Institute of Education, China.

Mahat, H., Hashim, M., Nayan, N., Saleh, Y., & Haron, S. M. (2017). Sustainable consumption practices of students through practice-oriented approach of education for sustainable development. *International Journal of Academic Research in Business and Social Sciences*, *7*(6), 703-720. https://doi.org/10.6007/IJARBSS/V7-I6/3031

McBride, B. B., Brewer, C. A., Berkowitz, A. R., & Borrie, W. T. (2013). Environmental literacy, ecological literacy, ecoliteracy: What do we mean and how did we get here? . *Ecosphere*, *4*(5), 1-20. https://doi.org/gj29vx

McDonald, R., & Ho, M. (2002). Principles and practice in reporting structural equation analysis. *Psychol. Methods*, *7*, 64-82. https://doi.org/10.1037/1082-989x.7.1.64

Ministry of Education and Training. (2009). *Early childhood education curricula.* Vietnamese Ministry of Education and Training.

Ministry of Natural Resources and Environment. (2020). *Report on environmental protection in 2019.* Vietnamese Ministry of Natural Resources and Environment. https://bit.ly/3L0OeSd

Murphy, T. P., & Olson, A. (2008). *The third Minnesota report card on environmental literacy: A survey of adult environmental knowledge, attitudes and behavior.* Minnesota Pollution Control Agency. https://bit.ly/3dGD1dr

North American Association for Environmental Education. (n.d.). *Professional development of environmental educators: Guidelines for excellence*. https://bit.ly/3d3tKLX

Nguyen, Q. N., & Bui, V. T. (2020). The relationship between pro-environmental awareness and behavior of local people in developing community-based tourism: A case in The Mekong Delta, Vietnam. *International Journal of Research and Scientific Innovation*, *7*(5), 97-100. https://bit.ly/3L5FbiF

Paço, A., & Lavrador, T. (2017). Environmental knowledge and attitudes and behaviours towards energy consumption. *Journal of Environmental Management*, *197*, 384-392. https://doi.org/10.1016/j.jenvman.2017.03.100

Pathirana, B. D. (2015). Investigating the relationship between knowledge, attitudes, and perceived environmental protection practices among Sri Lankan school teachers and preschool teachers. *South Asia Journal of Multidisciplinary Studies*, *1*(4), 62-76.

Pe'er, S., Goldman, D., & Yavetz, B. (2007). Environmental literacy in teacher training: Attitudes, knowledge, and environmental behavior of beginning students. *The Journal of Envıronmental Educatıon*, *39*(1), 45–59. https://doi.org/10.3200/JOEE.39.1.45-59

Peyton, R. B. (1984). Environmental education research related to teacher training. In L. A. Iozzi(Ed.), *Summary of research in environmental education, 1971-1982: Monographs in environmental education and environmental studies, volume 2* (pp. 131-136). ERIC. https://bit.ly/3RgAJiE

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Raghuvanshi, M. (2016). Knowledge and awareness: Linear regression. *Educational Process: International Journal*, *5*(4), 279-292. https://doi.org/10.22521/edupij.2016.54.2

Richards, J. C., & Farrell, T. S. (2005). *Professional development for language teachers: Strategies for teacher learning.* Cambridge University Press. https://doi.org/10.1017/CBO9780511667237

Roth, C. E. (1992). *Environmental Literacy: Its roots, evolution, and directions in the 1990s.* ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Sabzehei, M. T., Gholipoor, S., & Adinevand, M. (2016). A survey of the relationship between environmental awareness, attitude and pro-environmental behavior of female students at Qom University. *Journal of Environmental Education and Sustainable Development*, *4*(4), 5-16. https://bit.ly/3ROcGs2

Salvador, S. L., Prieto, J. M., & RuízPastran, M. (2017). Environmental awareness as a mediator variable on conceptions of science teaching and learning. *International Journal of Environmental and Science Education*, *12*(5), 1401-1426. https://bit.ly/3DiQ2nE

Saxena, P., & Srivastava, P. (2012). Environmental awareness of senior secondary students in relation to their eco-friendly behaviour. *Research Scapes* , *1*(2). https://bit.ly/3DfnQ5h

Schirmbeck, S. (2017). *Vietnam's environmental policies at a crossroads.* Friedrich Ebert Stiftung.

Sengupta, M., & Das, J. (2010). Environmental awareness and environment related behaviour of twelfth grade students in Kolkata: Effects of stream and gender. *Anwesa*, *5*, 1-8.

Seyal, A. H., Rahman, M. N. A., & Rahim, M. M. (2002). Determinants of academic use of the internet: A structural equation model. *Behaviour & Information Technology, 21*(1), 71 – 86. https://doi.org/fjrp79

Shuman, D. K., & Ham, S. H. (1997). Toward a theory of commitment to environmental education teaching. *The Journal of Environmental Education*, *28*(2), 25-32. https://doi.org/10.1080/00958964.1997.9942820

Simmons, D. A. (1995). Working paper # 2: Developing a framework for national environmental education standards. In Simmons, D. A. (Ed.), *The North American association for environmental education standards project: Papers on the development of environmental education standards* (pp. 53–58). North American Association for Environmental Education.

Streiner, D. (2003). Starting at the beginning: An introduction to coefficient alpha and internal consistency. *Journal of Personality Assess*, *80*(1), 99-103. https://doi.org/10.1207/S15327752JPA8001_18

Türkoğlu, B. (2019). Opinions of preschool teachers and pre-service teachers on environmental education and environmental awareness for sustainable development in the preschool period. *Sustainability*, *11*, Article 4925. https://doi.org/10.3390/su11184925

Wu, J.-H., & Wang, Y.-M. (2006). Measuring KMS success: A respecification of the DeLone and McLean's model. *Information & Management*, *43*, 728–739. https://doi.org/10.1016/j.im.2006.05.002

Yalcin, F. A., Yalcin, M., Bozan, S., & Gecikli, E. (2016). Preschool teachers' views of environmental education. *Bayburt Eğitim Fakültesi Dergisi*, *11*(2), 633-642. https://bit.ly/3DWFURO

Yavetz, B., Goldman, D., & Pe'er, S. (2009). Environmental literacy in pre-service teachers in Israel: A comparison between students at the onset and end of their studies. *Environmental Education Research*, *15*, 393-415. https://doi.org/10.1080/13504620902928422

Yeh, M. S., & Lin, M. R. (2016). *A research of connotation of sustainable campus of elementary school in central Taiwan based on the natural environmental conservation.* National Taichung University of Education Institutional Repository. https://bit.ly/3CeURxe

Appendix 1. *The multiple choice questions about the environmental knowledge*

(* Correct answer)

(KNh1) Which of the following has the greatest impact on the earth's environment?

a) damming rivers/ b. overpopulation; c) severe weather; or d) nuclear and power plants.

(KNh2) Pre-cycling means that: _____.

a) people buy things that can be used again; b) more people should ride bicycles; c) small children should wear the clothes of their older brother or sister; or d) items should be tested before we buy them.

(KNh3) An item which cannot be recycled and used again is: _____.

a) disposable diaper; b) newspaper; c) tire; or d) plastic bottle.

(KNh4) What is the approximate human population of the earth?

a) 3 billion; b) 4 billion; c) 6 billion; or d). 10 billion.

(KNh5) Which action can have the greatest impact on reducing the threat of global warming? A) recycling; b) reducing energy use; c) composting; or d) planting a tree.

(KNh6) What is the name of the global agency that works to protect the physical earth?

a) United Nations Environmental Programs (UNEP); b) United Nations Educational, Scientific, and Cultural Organization (UNESCO); c) World Health Organization (WHO); or d) United Nations Children's Fund (UNICEF).

(KNa1) The burning of fossil fuels has increased the carbon dioxide content of the atmosphere. What is the most immediate effect that this increasing amount of carbon dioxide is likely to have on our planet?

a) warmer climate; b) cooler climate; c) decreased relative humidity; or d) increased relative humidity.

(KNa2) Burning coal for energy is a problem because it: _____.

a) releases carbon dioxide and other pollutants; b) decreases needed acid rain; c) reduces the amount of ozone in the stratosphere; or d) is in limited supply.

(KNa3) Ozone layer in the earth's upper atmosphere protects us from: _____.

a) alien invasion; b) harmful, cancer-causing light rays;/ c) extremely cold winters; or d) extremely hot summers.

(KNa4) Carbon dioxide, methane, water vapor and nitrous oxide are examples of what?

a) greenhouse gases; b) major atmospheric components; c) major gases found in car exhaust; or d) are transpired by plants.

(KNb1) Most elephants are killed every year to provide people with: _____.

a) trophies; b) ivory; c) meat; or d) oil.

(KNb2) Ecology is the study of the relationship between: _____.

a) different species of animals; b) plants and the atmosphere; c) organisms and their environments; or d) human and the other animals.

(KNb3) Animals alive today are most likely to become extinct because: _____.

a) natural selection kills weaker animals; b) where they live is getting too warm; c) they are unable to reproduce because of pollution; or d) the habitat where they live is destroyed.

(KNb4) There are many different kinds of animals and plants, and they live in many different types of environments. What word is used to describe this idea?

a) multiplicity; b) biodiversity; c) socio-economics; or d) evolution.

(KNw1) Phosphates are harmful in sea water because they: _____.

a) can cause cancer in fish; b) stop reproduction in fish; c) make the water cloudy; or d) suffocate fish by increasing algae.

(KNw2) Building a dam on a river can be harmful for environment because it: _____.

a) makes the river muddy; b) increases level of pollution in water; c) causes the river to flood; or d) damages the river's natural ecosystem.

(KNw3) Worldwide, most childhood deaths are the results of: _____.

a) starvation; b) traffic accidents; c; water pollution; or d) child labor accidents.

(KNw4) Approximately 70% of all freshwater withdrawn for human use is used for _____.

a) drinking; b) cooking; c) washing people and clothing; or d) irrigation.

Appendix 2. *The legal basis for implementing environmental education in schools in Vietnam*

Type/ No.	Issued Date	Issued Organization	Description
Directive No.36-CT/TW	June 25th, 1998	The Politburo	Strengthening environmental protection in the period of national industrialization and modernization.
Decision No.3288/QD-BGD&ĐT	October 2nd, 1998	The MOET	Approving and promulgating documents on environmental education policies and strategies in Vietnamese schools.
Decision No.1363/QD-TTg	October 17th, 2001	The Prime Minister	The Inclusion of Environmental Protection Contents into the Program of the National Education System.
Decision No.256/2003/QD-TTg	December 2nd, 2003	The Prime Minister	National strategy for environmental protection until 2010 and vision toward 2020.
Resolution No.41-NQ/TW	November 15th, 2004	The Politburo	Environmental protection in the period of accelerating industrialization and modernization of the country.
Directive No. 02/2005/CT-BGD&DT	January 31st, 2005	The MOET	Strengthening environmental protection education in the national education system.
Decision No.1216/QĐ-TTg	September 25th, 2012	The Prime Minister	National strategy for environmental protection until 2010 and vision toward 2020.
Law on environmental protection	November 29th, 2005	The national assembly	Regulating the protection of the environment.
The revise Law on environmental protection	June 23rd, 2014	The national assembly	Replaced the Law on environmental protection 2005.