

## Environmental Literacy of K-10 Student Completers

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### ABSTRACT

This study aimed to investigate the environmental literacy of K-10 student completers. The quantitative research design, specifically, the non-experimental descriptive-correlational design was used to determine the students' level of environmental knowledge and sensitivity, identify the students' environmental attitudes and behaviors, and determine the correlation between students' environmental knowledge, attitudes, sensitivity, and behaviors. Exploratory factor analysis design was used to clarify the underlying dimensionality of environmental literacy of the students and to disentangle the complex interrelationships among various aspects of environmental literacy and eventually identify the variables that go together as unified concept. A total of 614 out of 759 students (81%) currently enrolled in a senior high school in one university were asked to participate in the study. Results showed that the student completers of K-10 grade levels have moderate level of environmental literacy and environmental knowledge and behavior and high level of environmental attitude and sensitivity. Students who are more knowledgeable about the environment have strong sensitivity and attitudes but do not necessarily have strong pro-environmental behaviors. Thus, although students may have pro-environment knowledge, this knowledge is not necessarily translated into positive behaviors towards the environment. Lastly, environmental literacy of the students has three broad dimensions of blended environmental attitude and sensitivity, pro-environmental behaviors and environmental knowledge. The results imply that the science curriculum and instruction in these grade levels did not fail in their instruction but much is still to be done to achieve the highest degree of environmental knowledge, pro-environmental behaviors, positive environmental attitudes and environmental sensitivity.

### KEYWORDS

environmental literacy, environmental knowledge,  
environmental behavior, environmental attitude,  
environmental sensitivity

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### Introduction

The Philippine environment is composed of interdependent, overlapping and interconnected ecosystems: the forest and uplands, the agricultural/cropland, the fresh-water, the coastal and marine ecosystems, and the urban population. Many of these ecosystems are abundant in important

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mineral and other natural resources. A wide array of flora and fauna thrive in these ecosystems. Of the world's flora species, 5% of which are found in the Philippines. Around 6% of birds, and 4% of mammals, and 67% of the species in the major groups of animals and plants are exclusively found in the Philippines. The coral reefs in the Philippines are second only to Australia's Great Barrier Reef in terms of diversity of coral and fish species, and they have the second highest number of seagrass species in the world. Unfortunately, these ecosystems face severe and significant problems of environmental degradation caused by the depletion of resource stocks and the production of polluting emissions (Coxhead and Jayasuriya, 2002).

Today, the state of the Philippine environment is characterized by several major environmental problems, namely deforestation, fisheries depletion, land and water system degradation, and urban pollution. These problems directly affect the health and well-being of the population and the performance and growth potential of the country's economy (Coxhead and Jayasuriya, 2002). For instance, the Department of Environmental and Natural Resources (DENR) reported that forest cover loss in the Philippines between 1980 and 2010 ranged from 20,000 to 62,000 hectares per year or an average of 40,000 hectares per year (DENR, 2015). In terms of air pollution, the level of total suspended particulates (TSP) in Metro Manila in 2013 reached 118 micrograms per normal cubic meter (ug/Ncm). This is above the healthy guideline value 90 ug/Ncm per year for TSP set by the Philippine Clean Air Act of 1999 (Yap, 2014). It is also very alarming that "out of the Philippines' 421 rivers, as many as 50 are considered dead and unable to support any but the most robust life" (Greenpeace, 2017).

To curb the continuous and rampant environmental degradation, environmental education among Filipinos is needed so that they take the responsibility of conserving and protecting their environment and participate in environmental actions that may effectively diminish if not eliminate problems which destroy the environment.

In 1968, Charles Roth asked the questions: "What is Environmental Literacy? How shall we know the environmentally literate citizen?" These questions made him the first person to use the term and define it as "a basic consciousness, awareness and understanding of the individuals towards environmental issues" (Roth, 1968). In 1992, Roth proposed that environmental literacy has levels: nominal, functional and operational. He also explained that each level is characterized by knowledge and affect skills and behavior outcomes. These levels are found to be very useful in determining environmental competencies leading to environmental literacy.

After Roth, many researchers explored the nature of environmental literacy. Today, it is considered to be a domain of four interrelated components: knowledge, dispositions, competencies, and environmentally responsible behaviors (Hungerford and Volk, 1990; Stern, 2000; Hollweg et al., 2011). Thus, environmental literacy encompasses not only an individual's environmental knowledge and attitude but also environmental behaviors and problem solving skills (Roth, 1992; Mcbeth et al., 2008). An environmentally literate individual has knowledge and understanding about environmental problems thus promotes pro-environmental behaviors of society (Roth, 1992; Teksoz et al., 2012).

Hollweg et al. (2011) explained that knowledge component of environmental literacy include knowledge about the physical, ecological, social, cultural and political systems; it has its dispositions component which involves sensitivity, attitudes, personal responsibility and motivation; and competencies component which is one's ability to identify, analyze, investigate, evaluate and resolve environmental issues, and environmentally responsible behavior component refers to practices in eco-management, persuasion, consumer/economic action, political action and legal action.

Another hallmark of environmental literacy, in addition to knowledge, attitude, and behavior, is environmental sensitivity. Peterson (1982) defined environmental sensitivity as "the expression of caring and positive feelings towards the environment" he describes it as a "set of positive affective characteristics that result in an individual, viewing the environment from an empathetic perspective." Studies on sensitivity showed that it is significantly correlated with, and predictive of behavior (Marcinkowski, 2001; Sivek and Hungerford, 1990). It is therefore worth exploring how the elements of environmental literacy: knowledge, attitude, sensitivity and behaviors, relate with each other.

In support to all these, the K-12 curriculum of the Philippine educational system provides a science education curriculum that aims to develop the scientific literacy among learners which include various environmental literacy contents integrated in all grade year levels in a manner of spiral progression (DepEd, 2012).

The core learning area standard for science for the entire K to 12 states:

The learner demonstrates understanding of basic science concepts, applies science process skills, and exhibits scientific attitudes and values to solve problems critically, innovate beneficial products, protect the environment and conserve resources, enhance the integrity and wellness of people, and make informed and unbiased decisions about social issues that involve science and technology. This understanding will lead to learner's manifestation of respect for life and the environment, bearing in mind that Earth is our only home (DepEd, 2012, p.2).

This year, thousands of students completed K to 10 and are enrolled in senior high schools to finish their grades 11 and 12. It is assumed that they are environmentally literate members of the society who manifest skills of responsible stewards of nature, after instruction. DepEd provision states that

At the end of Grade 10, the learner should have developed scientific, technological and environmental literacy so that they will not be isolated from the society where they live, will not be overwhelmed by change, and can make rational choices on issues confronting them (DepEd, 2012, p.4).

It is in this light that this study was conducted. It investigated the degree of knowledge, their sensitivity to environmental problems, and their pro-environmental attitudes and behaviors. Also this research intends to examine whether a person who is environmentally literate has the knowledge of environmental processes and issues needed to make informed decisions and participate in environmental conservation efforts. Specifically, this study sought to answer the following questions:



1. What are the students' levels of environmental knowledge, behavior, attitude and sensitivity?
2. What is the relationship among students' levels of environmental knowledge, behavior, attitude and sensitivity?
3. What is the underlying dimensionality of environmental literacy of the students?

This present study addresses the need for research on environmental literacy among Filipino students. Information about environmental literacy can be the bases for ensuring that behaviors that affect the environment and efforts for environmental protection are deeply rooted in knowledge, attitude, and sensitivity to this global issue.

The findings of this study will inform science teachers of K to Grade 10 on the effectiveness of science instruction provided that pedagogical content knowledge is related to environmental concepts. DepEd policy-makers and curriculum developers regarding how to further strengthen the K to 12 education program vis-à-vis its goal to produce environmentally literate citizens may also find the results of the study very useful.

Review of literature showed that several studies have been conducted in relation to environmental literacy around the world. The studies by Teksoz, et al. (2011), Sheila Shamuganathan and Karpudewan, (2015); Spinola, (2015); MutahirIqbal et al. (2015), Karatekin, (2012); Bogan and Kromrey (1996), Negev et al. (2008); Garcesa and Limjuco (2014); Mcbeth and Volk (2010); Ejem et al. (2013), emphasized that environmental literacy consists of various components namely knowledge, attitudes, behaviors, awareness, concerns and sensitivity on one's environment and focused on determining, comparing, gauging the level of environmental literacy of their respondents. The present study is similar but not identical to the studies of Sontay et al. (2015), Yumusak et al. (2016) and Goldman et al. (2015). In their studies, the relationship of each of the different components of environmental literacy, the impact of technological tools on the level of environmental literacy, the level of environmental literacy on specific variables such as ecological knowledge, verbal commitment, actual commitment, general environmental feelings, and environmental issue and action skills, were highlighted. These components, however, were not covered. Though the present study parallels with the aforementioned researches, this investigation aimed to explore the interrelation of each different components of environmental literacy: environmental knowledge level, awareness, behavior, and environmental attitudes.

## Method

### Research Design

The quantitative research design was used in this study to explore the environmental literacy of K-10 student completers. Specifically, the non-experimental descriptive-correlational design was used to determine the students' level of environmental *knowledge* and *sensitivity*, identify the students' environmental *attitudes* and *behaviors*, and determine the correlation between students' environmental *knowledge*, *attitudes*, *sensitivity*, and *behaviors*. Lastly, this study also employed multivariate design, specifically, the

exploratory factor analysis, to clarify the underlying dimensionality of environmental literacy of the students. This part of the study disentangled the complex interrelationships among environmental knowledge, attitude, sensitivity and behaviors and identified the variables that go together as unified concept of environmental literacy.

### **Sample**

A convenient sample composed 614 senior high school students in the Philippines were asked to participate in the study. There were 278 males (45.3%) and 336 females (54.7%) who composed the total number of samples in the study. More students completed K-10 grade levels from the private schools (486 or 79%) than public schools (128 or 21%).

### **Research Instruments**

Four instruments were used to achieve the purpose of the research. To address the validity of the test, assessment of the first draft of the instrument was done. This draft was content validated by an expert who is a science education specialist. To address the reliability of the tests, pilot testing in two sections of Grade 11 students of Unibersidad de Santa Isabel Senior High School (Pili Campus) was done. The Chronbach alpha of the tests ranged from 0.72 to 0.81 which indicated that the tests have acceptable internal consistency.

***Environmental Knowledge Test (EKT).*** This is a 30-item objective test composed of 15 true-false test items and 15 multiple choice test which the table of specifications of the test was based on the DepEd K-12 content standards was subjected to the conventional content validation and reliability testing to establish the acceptable psychometric properties. Three experts validated the content of the test and a pilot-tested to improve the final version of the test. To interpret the scores, the scale of interpretation for the environmental knowledge test used are the following: 1 – 6 = Very low level; 7 -12 = Low level; 13 – 18 = Moderate level; 19- 24 = High level; 25- 30 = Very high level.

***Environmental Behavior Test (EBT).*** This 40-item test identified what students choose to do in order to reduce their impacts on the environment. Sample test items include: “I recycle paper and buy recycled paper products.” “I turn off sink faucets while brushing teeth, shaving, or washing.”, “I turn off lights, TV sets, computers, and other electronic equipment when they are not in use.”, and “I talk to my family and friends about what they can do to help environmental problems.” For the following group of statements, students were instructed to indicate how frequently they do each of the actions mentioned by placing a check mark in the appropriate box which contain any of the following: Never, Seldom, Sometimes, Often, or Always.

***Environmental Attitude Test (EAT).*** This 30-item Likert test was used to assess the student attitudes regarding the environment, i.e., the way they think and feel about the environment. This test basically identifies the predisposition or the tendency of the students to respond positively or negatively towards the environment. The students were asked to indicate the extent of their conformity to each of the following statements or the extent to which they agree or disagree with each statement. Examples of items which will be included in the test include: “Commercial car wash should use recycled water.”, “We should give our views about environment without fear.”, “We should be concerned that the rapid



destruction of natural resources is now a major problem.” and “People should be held responsible for any damages they cause to the environment.”

***Environmental Sensitivity Test (EST).*** This Likert 35-item test aims to determine students’ caring and positive feelings towards the environment. Some items which were included in the test include: “*I feel that it is my responsibility to help solve environmental problems.*”, “*I am concerned about how much waste is produced in our country.*”, “*I am worried about the wastewater that flows towards the sea and river without treatment process.*”, “*It would make me happy if the place nearby me is a forested area.*”

For the group of statements in the EBT, EAT, and EST, students were instructed to the extent/degree of their conformity or the extent to which they agree or disagree with each statement by placing a check mark in the appropriate box. They were told to be honest and there are no right or wrong answers. To interpret the scores in the environmental behavior, environmental attitude, and environmental sensitivity tests, the following scale was used: 1.0 – 1.5 = Very low level; 1.6 - 2.5 = Low level; 2.6 – 3.5 = Moderate level; 3.6 -4.5 = High level; 4.6 – 5.0 = Very high level.

### **Data Collection Plan**

During the administration of the questionnaires, the respondents were oriented thoroughly. Written instructions on how to accomplish the questionnaires were included in the questionnaires. The students were assured of confidentiality of the information. After the questionnaires were retrieved, data were collated and analyzed. Since the environmental literacy tests were administered to the samples that are in the senior high school during the end of the first semester, the instruction they received may have already an impact on their environmental literacy. Nonetheless, since all of them took the same science subjects, the mediating variable had been controlled.

### **Data Analysis**

Data were analyzed using SPSS version 20. Descriptive statistics was used to describe the respondents and the proportion of answers by the respondents for each item. Inferential statistics was used to ascertain differences in the students’ level of environmental *knowledge, attitudes, sensitivity, and behaviors.*

The scales of interpretation used in the scores are: Correlational statistics to determine the correlation between students’ environmental *knowledge, attitudes, sensitivity, and behaviors.*

For the exploratory factor analysis, two phases of analysis were undertaken: factor extraction and factor rotation. The first phase reduced the variables in the data matrix into a smaller number of factors to extract clusters of highly interrelated variables from the correlation matrix. The second phase was performed on the factors that met the extraction criteria to enhance the interpretability of the factors by aligning variables more distinctly with a particular factor. The factor loadings shown in the rotated factor matrix were examined to identify and name the underlying dimensionality of the original set of variables and to compute the factor scores (Polit and Beck, 2004).

### **Results**

## A. Level of environmental knowledge, attitude, behaviors, and sensitivity of K-10 student completers

### A.1. Environmental Knowledge

The results showed that the students have a moderate level environmental knowledge based on the total average score of  $M \pm SEM = 17.25 \pm 0.14$  ( $SD = .14$ ) in the 30-item environmental knowledge test. They have also a moderate level of environmental behavior based on the total average score of  $M \pm SEM = 3.20 \pm .021$  ( $SD = .022$ ) in the environmental behavior test. Students have high level of environmental attitude and environmental sensitivity based on the total average scores they obtained in the environmental attitude test ( $M \pm SEM = 4.01 \pm 0.30$ ,  $SD = .030$ ) and environmental sensitivity test ( $M \pm SEM = 4.27 \pm .019$ ,  $SD = .019$ ), respectively (Table 1).

**Table 1.** Level of environmental knowledge, attitude, behaviors, and sensitivity of K-10 student completers

Environmental Literacy Dimension	N	Mean $\pm$ SEM	SD	Interpretation
Environmental Knowledge	614	17.25 $\pm$ .144	.142	Moderate
Environmental Behavior	614	3.20 $\pm$ .021	.022	Moderate
Environmental Attitude	614	4.01 $\pm$ .030	.030	High
Environmental Sensitivity	614	4.27 $\pm$ .019	.019	High

The female K-10 student completers showed higher level environmental knowledge ( $M \pm SEM = 17.15 \pm 0.220$ ,  $SD = 3.66$ ) than their male counterpart ( $M \pm SEM = 17.32 \pm 0.190$ ,  $SD = 3.48$ ). However, this difference was found to be insignificant,  $t(614) = -.587$ ,  $p = .557$  (Table 2).

**Table 2.** Level of environmental knowledge of K-10 student completers grouped according to their gender

Gender	Environmental Knowledge			
	N	Mean $\pm$ SEM	SD	Interpretation
Male	278	17.15 $\pm$ .220	3.66	Moderate
Female	336	17.32 $\pm$ .190	3.48	High

Note:  $t(614) = -.587$ ,  $p = .557$ .

K-10 students who completed their high school from the public school obtained a higher total average score ( $M \pm SEM = 17.70 \pm 3.35$ ,  $SD = 3.80$ ) than the students who completed high school from the private school ( $M \pm SEM = 17.11 \pm 0.158$ ,  $SD = 3.49$ ) in the environmental knowledge test. The difference in the environmental knowledge between these two groups of students was not significant,  $t(612) = -1.82$ ,  $p = .069$  (Table 3).

**Table 3.** Level of environmental *knowledge* of K-10 student completers grouped according to their high school they graduated from

High School Graduated From	Environmental Knowledge			
	N	Mean $\pm$ SEM	SD	Interpretation
Private	486	17.11 $\pm$ .158	3.49	Moderate
Public	128	17.76 $\pm$ .335	3.80	High

Note:  $t(612) = -1.82$ ,  $p = .069$

### A.2. Environmental Behavior

The female K-10 student completers showed higher level environmental behavior ( $M \pm SEM = 3.23 \pm .027$ ,  $SD = .497$ ) than their male counterpart ( $M \pm SEM = 3.16 \pm .031$ ,  $SD = .525$ ). However, this difference in environmental behavior between the males and female students was found to be insignificant,  $t(612) = -1.643$ ,  $p = .101$  (Table 4).

**Table 4.** Level of environmental *behavior* of K-10 student completers grouped according to their gender

Gender	Environmental Behavior			
	N	Mean $\pm$ SEM	SD	Interpretation
Male	278	3.16 $\pm$ .031	.525	Moderate
Female	336	3.23 $\pm$ .027	.497	Moderate

Note:  $t(612) = -1.643$ ,  $p = .101$

Students who completed their high school from the public school obtained a higher total average score ( $M \pm SEM = 3.24 \pm .043$ ,  $SD = .49$ ) than the students who completed high school from the private school ( $M \pm SEM = 3.18 \pm 0.023$ ,  $SD = .52$ ) in the environmental behavior test. The difference in the environmental behavior between these two groups of students was not significant,  $t(612) = -1.072$ ,  $p = .389$  (Table 5).



**Table 5.** Level of environmental *behavior* of K-10 student completers grouped according to the high school they graduated from

High School Graduated From	Environmental behavior			
	N	Mean±SEM	SD	Interpretation
Private	486	3.18 ± .023	.52	Moderate
Public	128	3.24 ± .043	.49	Moderate

Note:  $t(612) = -1.072, p = .284$

### A.3. Environmental Attitude

Although not significant ( $t(612) = 1.341, p = .180$ ), the male K-10 student completers showed higher level environmental attitude ( $M \pm SEM = 4.35 \pm 0.048, SD = .80$ ) than their female counterpart ( $M \pm SEM = 4.27 \pm 0.038, SD = .04$ ) (Table 6).

**Table 6.** Level of environmental *attitude* of K-10 student completers grouped according to their gender

Gender	Environmental Attitude			
	N	Mean±SEM	SD	Interpretation
Male	278	4.35 ± .048	.80	High
Female	336	4.27 ± .038	.04	High

Note:  $t(612) = 1.341, p = .180$

In terms of environmental attitude of the K-10 completers' students who completed their high school from the private and public schools, obtained the same total average score ( $M \pm SEM = 4.33 \pm 0.019, SD = .42$  and  $M \pm SEM = 4.32 \pm 0.039, SD = .42$ ). These results were ascertained by the t-test:  $t(612) = .099, p = .921$  (Table 7).

**Table 7.** Level of environmental *attitude* of K-10 student completers grouped according to their high school they graduated from

High School Graduated From	Environmental Attitude			
	N	Mean±SEM	SD	Interpretation
Private	486	4.33 ± .019	.42	High



<b>Public</b>	128	4.32 ± .037	.42	High
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Note:  $t(612) = .099$ ,  $p = .921$

#### A. 4. Environmental Sensitivity

Environmental sensitivity of both male and female K-10 completers were high, however, the total average score of the female students ( $M \pm SEM = 4.37 \pm 0.023$ ,  $SD = .42$ ) was significantly higher ( $M \pm SEM = 4.15 \pm 0.029$ ,  $SD = .49$ ),  $t(612) = -6.074$ ,  $p = .000$  (Table 8).

**Table 8.** Level of environmental *sensitivity* of K-10 student completers grouped according to their gender

Gender	Environmental Sensitivity			
	N	Mean±SEM	SD	Interpretation
<b>Male</b>	278	4.15±.029	.49	High
<b>Female</b>	336	4.37±.023	.42	High

Note:  $t(612) = -6.074$ ,  $p = .000$

The level of environmental sensitivity of the K-10 completers who finished their high school from the private and public schools were the same ( $M \pm SEM = 4.27 \pm .021$ ,  $SD = .47$  and  $M \pm SEM = 4.27 \pm .038$ ,  $SD = .43$ , respectively). These results were ascertained by the t-test:  $t(612) = .016$ ,  $p = .987$  (Table 9).

**Table 9.** Level of environmental *sensitivity* of K-10 student completers grouped according to their high school they graduated from

High School Graduated From	Environmental Sensitivity			
	N	Mean±SEM	SD	Interpretation
<b>Private</b>	486	4.27 ± .021	.47	High
<b>Public</b>	128	4.27± .038	.43	High

Note:  $t(612) = .016$ ,  $p = .987$

**B. Relationship among the environmental *knowledge, attitude, behaviors, and sensitivity* of K-10 student completers**

Environmental knowledge and environmental attitude of the K-10 student completers were weak but positively correlated,  $r(614) = .17, p = .000$ . Environmental behavior was weak but positively correlated,  $r(614) = .29, p = .000$ , with environmental attitude but moderately and positively correlated,  $r(614) = .33, p = .000$ , with environmental sensitivity. Environmental attitude and environmental sensitivity were strongly and positively correlated,  $r(614) = .76, p = .000$  (Table 10).

**Table 10.** Intercorrelations among environmental *knowledge, attitude, behaviors, and sensitivity* of K-10 student completers

<b>Environmental Literacy Dimension</b>	<b>Environmental Knowledge</b>	<b>Environmental Behavior</b>	<b>Environmental Attitude</b>	<b>Environmental Sensitivity</b>
<b>Environmental Knowledge</b>	---	.034	.165**	.195**
<b>Environmental Behavior</b>		---	.286**	.334**
<b>Environmental Attitude</b>			---	.757**
<b>Environmental Sensitivity</b>				---

Note: \*\* correlation is significant at the 0.01 level (2-tailed)

These findings imply that although students may have pro-environment knowledge, this knowledge is not necessarily translated into positive behavior towards environment. But when students have positive behavior towards environment, they tend to be environmentally sensitive.

### C. Underlying dimensionality of environmental literacy of K-10 student completers

Table 11 shows the results of the exploratory factor analysis, which was done in two phases: factor extraction and factor rotation. After the extraction of clusters of highly interrelated items and enhanced interpretability of the factors through alignment into more distinct ones, the underlying dimension of environmental literacy of the K-10 students completed were identified. The analysis resulted into three broad condensed variables/factors. The first dimension of environmental literacy is the “blended environmental attitude and sensitivity.” The second dimension of environmental literacy is “pro-environmental behaviors”. which pertain in communicating about one’s knowledge about environmental issues and how to help solve environmental problems, recycling, patronizing locally grown food, conserving water, planting trees, and proper waste disposal. The third dimension of environmental literacy



is “environmentalknowledge”, specifically, understanding ofenergy transfer, biogeochemical cycle, ecological interaction, ecosystem and species extinction.

**Table 11.** Results of Principal Component Analysis to extract underlying dimensions of environmental literacy of K-10 student completers

	Component		
	1	2	3
Energy transfer through food chains and food webs is very efficient because with each transfer, no chemical energy is lost.			.412
As nutrients move through the biogeochemical cycles, the period of their accumulation in each of the portion of the cycle is the same.			.436
When two or more species attempt to use the same limited resource in an ecosystem, their interaction is called...			.462
Because they are rapidly being cut down, the rainforests today are endangered ecosystems. How might widespread destruction of the rainforests affect other ecosystems in the world?			.463
Which of the following is TRUE about extinction of species?			.418
I talk to my friends and relatives about protecting endangered and threatened species and what everyone can do about it.			.615
I plant trees and take care of them.			.679
I recycle paper and buy recycled paper products.			.559
I suggest that our family buy organic food.			.594
I compost food wastes.			.526
I report water leaks.			.465
I turn off sink faucets while brushing teeth, shaving, or washing.			.678
I use recycled water for watering lawns and house plants.			.522
I replace our lawn with native plants that need little or no watering.			.711
I water lawns and yards only in the early morning or evening.			.654
I turn off lights, TV sets, computers, and other electronic equipment when they are not in use.			.679
If I see an aluminum can on the ground I pick it up and throw in segregation bin.			.507
I recycle paper, glass, and/or metal waste products at home or at school.			.555



I report environmental problems or violations that I have noticed to the proper authorities.	.707
I talk to my family and friends about what they can do to help environmental problems.	.707
I talk to people if I notice doing something that harms the environment.	.637
I choose to purchase a product that is packaged in reusable, returnable, or recyclable containers or packages.	.563
Everyone should grow some of our food using organic methods.	.503
We should act to prevent wastes from entering drainage system.	.608
Wood-burning stoves, fireplaces, and kerosene and gas-burning heaters should be properly installed and maintained so that smoke does not contribute to air pollution.	.558
We should avoid using pesticides, like DDT, and other hazardous chemicals.	.535
We should give our views about environment without fear.	.605
We should communicate to government officials our position on environmental issues.	.607
We should be concerned about the current environmental problems, such as pollution, overpopulation, and habitat destruction.	.632
We should be concerned that the rapid destruction of natural resources is now a major problem.	.619
We should show good examples on saving our environment.	.641
We should know what global warming is all about.	.565
We should be concerned about the effects of rapid population growth.	.578
We should conserve energy at home and workplaces.	.588
Plants and animals have as much right as humans to exist.	.429
Despite our special abilities, humans are still subject to the laws of nature.	.484
People should be held responsible for any damages they cause to the environment.	.579
Government should pass laws to make recycling mandatory.	.602
Lifestyle changes, like decrease in meat consumption, will help solve environmental problems.	.488
It is better to wash a car from a bucket of soapy water, and use the hose for rinsing only.	.533
Using recycled water in washing cars saves water.	.592

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Garden and yard plants should be fertilized with manure or compost instead of commercial inorganic fertilizer.	.557
People should use the most energy-efficient home heating and cooling systems, lights, and appliances available.	.486
Storing gasoline, solvents, and other volatile chemicals inside a home is dangerous.	.464
We must avoid using pesticides and other hazardous chemicals, or use them in the smallest amounts possible.	.649
We should use less harmful and usually cheaper substances, like vinegar, baking soda, and borax, instead of commercial chemicals for most household cleaners.	.634
I am willing to support or join nongovernmental organization (NGOs) seeking change for the benefit of the environment.	.603
For cooling, we should open windows and use ceiling fans or exhaust or window fans.	.598
I must be fully informed on environmental issues.	.669
I am concerned about too much use of pesticides, especially near bodies of water like rivers and lakes.	.617
We should not dispose pesticides, paints, oil, and other hazardous chemicals by flushing them down the toilet or pouring them down the drain.	.523
Tree planting activities should be done regularly.	.571
I believe that environmental education should be started at an early age.	.687
I am worried about the wastewater that flows towards the sea and river without treatment process.	.651
I believe that sprays and deodorants deplete the ozone layer.	.432
Countries that possess nuclear, chemical and biological weapons make me uncomfortable.	.498
I think that air pollution increases respiratory diseases.	.614
I believe media organizations should emphasize environmental issues.	.709
It is important that everyone is aware of environmental problems.	.624
I am concerned about how much waste is produced in our country.	.687
I am concerned about the rate of species extinction in the world.	.657
I feel that it is my responsibility to help solve environmental problems.	.598
There is much that I can do that will help solve environmental problems.	.518
Recycling is laborious but beneficial to the environment.	.508

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I am concerned about the issue of deforestation.	.643
Knowing about environmental problems and issues is important to me.	.640
I am interested in reading about nature and environment.	.516

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Note: Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

## Discussion and Conclusion

This study primarily explored the Environmental Literacy of the K-10 student completers. The first question that the study sought to answer was “*What are the levels of environmental knowledge, attitude, behavior and sensitivity?*” The results showed that the K-10 student completers have a moderate level of environmental knowledge and environmental behavior and high in the level of environmental attitude and sensitivity. This was confirmed based on their total average scores obtained in the environmental knowledge, behavior, attitude and sensitivity test results. It indicated that students although do not possess high level of environmental knowledge and environmental behavior they tend to have more pro-environmental attitude and are more sensitive towards the environment. These research findings confirmed the study of Yumusak et al. (2016) which revealed that although students have low information level on conceptual and important environmental issues, their environmental attitude was high; they were sensitive to environment and tended to protect it. These results are also similar to the study of Shamuganathan and Karpudewan (2015), which stated that responsible environmental behavior is influenced by the students’ attitude and beliefs towards performing responsible environmental behavior and knowledge about the environmental issues.

Although not significant, female K-10 completers showed slightly higher level of environmental knowledge than male students. This finding is similar to the findings of Alp et al. (2006) but is contrary to the research findings of Kollmuss and Agyeman (2002), Gambro and Switzky (1999), Olofsson and Ohman (2006), Meinhold and Malkus (2005) and Tikka et al. (2000) that the male students have more knowledge compared to female students but female students are more emotional, caring towards the environment and more desirous to change.

The level of environmental knowledge of the completers who graduated from private and public schools showed that public school completers is slightly higher than private completers. But this difference is not significant implying that both private and public high schools provided almost the same environmental education to the students.

The female students who participated in the study practiced more the pro-environmental behaviors than the male students. Although, statistically not significant, this slight difference is confirmed in the study of Mostafa (2007) and Zelezny et al. (2000) who found out that women are more concerned about environmental issues than are men. There could be many possible reasons for this finding. For examples, the theoretical explanations for this gender



difference about environmental behavior include the socialization of gender role (Zelezny and Bailey, 2006) and value orientation (Stern et al., 2005). According to Stern et al., (2005), females often possess stronger ethics of care and display more helpful and altruistic behavior. Female children often socialize to be more expressive, compassionate, nurturing, cooperative, independent and helpful in care-giving roles (Davidson and Freudenburg, 1996). Gender socialization theory postulates that behavior is predicted by the process of socialization whereby individuals are shaped by gender expectations within the context of cultural norms (Zelezny et al., 2000).

The results of the study showed that male K-10 student completers showed high level of environmental attitude than their female counterparts. Bradley et al.'s (1999) study found that male students having higher knowledge scores had more favorable environmental attitudes. Thus, the result of the present study is contrary to their findings because male students have slightly lower environmental knowledge but have higher environmental attitude. However, in another study reported by Panth, Verma and Gupta (2015) on the role of attitude in environmental awareness of undergraduate students, boys have more environmental attitude than girls. It is noted that difference between the environmental attitude levels of both genders were not significant, hence the K-10 curriculum was able to cater equally to both groups. The same can be said about environmental sensitivity of both the male and female student completers.

The results of the study showed that there are concepts that may have been overly taught or have spiraled in the curriculum intensely that apparently students learned these concepts well. These concepts are about the role of the carbon dioxide (CO<sub>2</sub>) in the atmosphere, the effect of chlorofluorocarbon (CFC) compounds in the destruction of ozone layer, the impact of using inorganic fertilizer, exponential population growth and ecological relationships. Nonetheless, there are also topics which probably are under taught or less given emphasis hence students have not mastered well. These include concepts such as ecosystem stability, Philippine climate, energy transfer, adaptation and some essential processes of biogeochemical cycles. The environmental behavior of K-10 student completers specifically needs reinforcement on the following: buying orchids, cacti, or other plants that are taken from the wild, helping to restore a nearby degraded forest or grassland, replacing their lawn with native plants that need little or no watering and eating less meat or avoid eating meat. They also need to be exposed to certain learning activities to improve their environmental attitudes particularly in relation to their perception of the 'ecological crisis' facing humankind, buying wood or paper products produced from old-growth forests, protection of wild animals, need for lifestyle changes, like decrease in meat consumption, and choosing wood substitutes such as bamboo for fencing. Lastly, to improve the students' environmental sensitivity, teaching and learning should emphasize the following: impact of over population, buying furs, ivory products, or other items made from endangered or threatened animal species, depletion of ozone layer due to the use of sprays and deodorants, reading about nature and environment and using wood substitutes such as bamboo furniture and recycled plastic outdoor furniture, decking, and fencing.

Kempton et al. (1995) observed that lack of environmental knowledge was equally strong among environmentalists and non-environmentalists. The study



therefore implies that environmental knowledge *per se* is not a prerequisite for pro-environmental behavior. Another study which was similar to this was the research of Garcera and Limjuco (2014) showed that the students obtained the highest level of ecological knowledge while lowest in the pro-environmental behavior. But when the students have positive behavior towards environment, they tend also to be environmentally sensitive. This is supported by the study of Mcbeth and Volk (2010) that in terms of sensitivity, the scores obtained showed that students' sensitivity were those for actual commitment-proenvironmental behavior. These previous studies were supported by the results of the study, particularly on the research objective which is "*What is the relationship among students' environmental knowledge, behaviors, attitude and sensitivity?*"

Based on the findings, it was shown that the correlation between environmental knowledge and environmental attitude is positively weakly correlated according to the correlation among environmental literacy dimensions (Table 18). This finding shows similarities to the study of Sontay et al. (2015) who determined that there was a positive and at medium level correlation between the environmental knowledge and attitude (affective). This indicated that the knowledge of the students towards the environment may somehow translate to their feelings towards the environment. Also, the study of Bradley et al. (1999) research on environmental knowledge and attitudes found that students with higher levels of environmental knowledge had greater pro-environmental attitudes. Thus, if a student has sufficient knowledge about the environment, he/she has a positive attitude towards the environment.

The correlation between environmental behavior and environmental attitude is weakly positively correlated. This was similar to the results of the studies done by Hines et al. (1986), Kuhlemeier et al. (1999), and Kaiser et al. (1999). Apparently as one's attitude towards environment becomes more positive, his or her actions or behaviors become more pro-environment. The same can be said about the moderately positive correlation between environmental behavior and environmental sensitivity. Like the results of Chen (2015) which showed that environmental attitude and environmental sensitivity appeared to have significant effect on environmental behavior, apparently, as the students' pro-environmental attitude and sensitivity increase, their behavior also becomes also more responsive to the problems of the environment.

Environmental attitude and environmental sensitivity were strong and positively correlated. This finding is similar to the study of Yumusak et al. (2016) who found out that the students' environmental attitude was high and they were sensitive and protective to the environment. Therefore, if the students have a positive attitude towards the environment, they have also a greater sensitivity towards the environment and are more motivated to perform environmentally responsible actions. It can be concluded that the extent by which the K-10 curriculum promote environmental knowledge parallels the extent by which the students expressed positive behaviors, sensitivity and attitudes towards the environment. It is therefore important that DepEd should follow what Steg and Vlek (2009) stressed: every teacher must ensure that knowledge about the environment should be enhanced and be translated to rational actions, attitudes and sensitivity towards the environment.



So, to the questions the study sought to answer: *“Are people who are more knowledgeable about the environment more likely to have strong pro-environmental attitudes, sensitivity, and behaviors? “Are environmental behaviors, sensitivity, attitudes and knowledge independent of each other?”*, the findings were clear that it does not follow that if one is environmentally knowledgeable about the environment, his or her behavior is pro-environment. What was clear was that people who are more knowledgeable about the environment have strong sensitivity and attitudes but not necessarily strong pro-environmental behaviors.

The result of the factor analysis revealed that environmental literacy of the K-10 student completers has three underlying dimensionalities such as blended environmental attitude and sensitivity, pro-environmental behaviors and environmental knowledge. Thus, as reconceptualized, the model of dimensionality for environmental literacy of K-10 student completers could just be limited to collapsed environmental attitude and sensitivity, and environmental behaviors, and environmental knowledge (Figure 2).

Whether it is the limitations of the tests which were administered to the students or not, apparently, the environmental literacy after completion of K-10 can be characterized by the following: First, a set of beliefs and feelings that an individual have for the environment, expresses his/her verbal and actual commitment, motivation and effect concerning nature and environmental issues. Embedded in this individual's belief and values system are expressions of emphatic, caring and positive feelings towards the environment, which are further enhanced by his/her life experiences. Second, a set of actions intentionally performed to create positive impact on the environment as one approaches problems and issues to ensure positive environmental consequence. It is also a way to advocate the responsible measure to protect the environment. And third are the knowledge structures and awareness about the environment and the problems that beset its components. It reflects that person's ability to understand and evaluate the many environmental issues.

In conclusion, the results of the study indicated that the student completers of K-10 grade levels have a moderate level of environmental literacy. The students have moderate level of environmental knowledge and behavior and high level of environmental attitude and sensitivity. Second, students who are more knowledgeable about the environment have strong sensitivity and attitudes and but does not necessarily have strong pro-environmental behaviors. Thus, although students may have pro-environment knowledge, this knowledge is not necessarily translated into positive behavior towards environment. And third, Environmental literacy of the students has three broad dimensions: blended environmental attitude and sensitivity, pro-environmental behaviors and environmental knowledge. Overall, the results imply that the science curriculum and instruction in these grade levels partially realized its objectives but much is still to be done to achieve the highest extent possible by which students possess environmental knowledge, practice pro-environmental behaviors, acquire positive environmental attitudes and express environmental sensitivity.

Based on the findings, it is recommended that teachers in the K-10 levels should focus on improving the students' environmental literacy particularly on

environmental knowledge and behaviors. Also, the following topics need to be emphasized to improve the K-10 students' environmental knowledge: concepts such ecosystem stability, Philippine climate, energy transfer, adaptation and some essential processes of biogeochemical cycles. In improving the K-10 student completers' environmental attitudes, the following must be emphasized in the learning process: the 'ecological crisis' facing humankind, buying wood or paper products produced from old-growth forests, protection of wild animals, need for lifestyle changes, like decrease in meat consumption, wand choosing wood substitutes such as bamboo for fencing. Moreover, to improve the students' environmental sensitivity, teaching and learning should emphasize the following: impact of over population, buying furs, ivory products, or other items made from endangered or threatened animal species, depletion of ozone layer due to the use of sprays and deodorants, reading about nature and environment and using wood substitutes such as bamboo furniture and recycled plastic outdoor furniture, decking, and fencing.

Future studies should include socio-demographic profile of the students as variables in the study and use of extracted items from the factor analysis can be items for a short version of the environmental literacy test. It is also recommended that the reconceptualized model of environmental literacy, wherein environmental sensitivity and attitude are blended instead of separated. This may be used to examine other groups of students.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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