



The Use of Two-Tier Diagnostic Test to Explore Environmental Literacy

Teerada Longsiri¹, Supika Vanitchung², Manat Boonprakob³, Chanyah Dahsah⁴

Abstract

The environmental issues have become more serious so the development of environmental literacy citizens is an efficient and sustainable way to solve environmental problems. Environmental education plays an essential role to develop environmental literacy citizens in both formal and informal context. Since the environmental literacy consists of two dimensions including environmental knowledge and environmental ethics, environmental literacy's evaluation remains elusive. Multiple-choice test and rating scale questionnaire are commonly used to evaluate environmental literacy. However, both instruments have limited reliability since they might produce students randomly guessing for correct answers, and choosing neutral response on the scale instead of extreme ones. This study developed a two-tier diagnostic test as an instrument aiming to accurately evaluate the environmental knowledge and ethics, which are the two dimensions of environmental literacy. The test consisted of 22 items in environmental knowledge and 10 items in environmental ethics. They were evaluated by three experts and tested by 121 middle school students. The test reliability is .67. The results suggested that students had moderate environmental literacy and environmental level knowledge showing in 75.2% and 71.9% respectively, while they had high level of environmental ethics showing in 52.9%. The statistical analysis of Pearson's correlation between environmental knowledge and ethics suggested a weak positive correlation (.378). Thus, the environmental education should emphasis more on environmental knowledge, especially on environmental issues.

1. Introduction

Environmental problems have become one of the most serious issues in the world. Environmental education aims to equip students to become environmentally literate citizens preventing and solving environmental problems [1]. Environmentally literate person is not only a person who has basic environment knowledge, awareness and sensitivity toward environmental issues, but also the one who is able to solve environmental problems appropriately [2,3]. Many researchers developed environmental literacy instruments following environmental literacy framework, including 1) knowledge 2) affective 3) cognitive skills and 4) behavior such as a national survey [4], and middle school environmental literacy survey [5]. Multiple-choice tests and rating scale questionnaires are commonly used.[5,6] However, the instruments have some problems since multiple-choice test encourages students to guess for correct answers [7], and rating scale questionnaires encourages students to choose neutral response instead of the extreme ones [8]. In this study, environmental literacy framework was defined in two dimensions as stated in UNESCO Educational Frameworks, which are; environmental knowledge and environmental ethics. The frameworks suggested that environmental ethics are attitude, values and behavior toward environmental of humans [9], and Benchmark on the Way to Environmental Literacy K-12 suggested three components of environmental literacy which are environmental knowledge, skill and ethics [10].

Understanding students' environmental literacy prior knowledge allows teachers and educators in develop environmental education teaching aiming enhance students' environmental knowledge and ethics. Therefore, the purpose of this study was to investigate environmental literacy levels in middle school students using a two-tier diagnostic test, and identify the relationship between environmental knowledge and ethics.

¹ Science Education Center, Thailand

² Faculty of Environmental Culture and Ecotourism, Thailand

³ Behavioural Science Research Institute, Thailand

⁴ Science Education Center, Faculty of Science, Thailand



2. Research Methodology

2.1 Participants

The participants were 121 middle school students in an industry estate area.

2.2 Instrument

The study developed the Environmental Literacy Instrument based on The Middle School Environmental Literacy Instrument (MSELI) [5], a Proposed Framework in the Program for International Student Assessment (PISA) 2015 [11] and Ecocentric and Anthropocentric Attitude toward the Environment Scale [12]. The first draft of two-tier diagnostic test includes 45 items. The first tier was a multiple-choice format, and the second tier was a blank space allowing students to explain why a particular choice was selected. The instrument was pilot by 29 middle school students. The responses were analyzed and grouped for a two-tier diagnostic test development. A two-tier test is a two-level multiple-choice. The first tier is in four multiple-choice format aiming to evaluate students' knowledge and understanding. The second tier is again in the multiple-choice format asking students for reasons to support the selected choice in the first tier. The second tier consists of correct, misconception and wrong answers. Those choices were developed based on students' response in the pilot study. The instrument consisted of two parts. The first part was used to evaluate the environmental knowledge, including 22 items divided into three components: a) environmental knowledge (11 items), b) knowledge of environmental issues (7 items), and c) socio-political knowledge (4 items). The second part was used to evaluate the dimension on environmental ethics, including 10 items divided into five components: 1) environmental values 2) environmental sensitivity and participation 3) analyze and evaluate effect of human activities toward natural environment 4) environmental behavior and 5) human responsibility towards natural environment. Each theme consisted of two items. The reliability of the instrument was measured by coefficient of Cronbach's alpha, and the value for whole test was 0.67.

2.3 Data Collection and Data Analysis

The data were collected in June 2016. The participants had 60 minutes to complete the test. In order to be count as a correct response, they must answer correctly in both tiers. The data were analyzed by using the SPSS Statistics 20 to evaluate descriptive analysis and Pearson's correlation to determine the relationship between environmental knowledge and ethics. The total score of the environmental literacy test was 32. It consisted of three levels including low (0-10), moderate (11-20) and high (21-32). For each dimension; environmental knowledge and environmental ethics, there were three levels including low (0-7), moderate (8-14), high (15-22), and low (0-3), moderate (4-7) and high (8-10) respectively.

3. Result

The results indicated the level of environmental literacy was shown in Table 1, the number of correct responses in each component in Table 2, and the correlation between the environmental knowledge and environmental ethics in Table 3.

Table 1. The number of students in each level of environmental literacy and its dimensions.

Dimension	Number of students (%)		
	Low	Moderate	High
Environmental Knowledge	27 (22.3)	87 (71.9)	7 (5.8)
Environmental Ethics	6 (5.0)	51 (42.1)	64 (52.9)
Environmental Literacy	9 (7.4)	91 (75.2)	21 (17.4)



Table 2. Percent of correct response in each component of environmental knowledge and ethics.

Dimension	Component	Correct response (%)
Environmental knowledge	ecological knowledge	54.7
	knowledge of environmental issues	28.3
	socio-political knowledge	39.0
Environmental ethics	environmental values	64.0
	environmental sensitivity and participation	87.2
	analyze and evaluate effect of human activities toward natural environment	72.3
	environmental behavior	77.3
	human responsibility toward natural environment	59.1

Table 3. The correlation of environmental knowledge and ethics.

Correlation	r	p
knowledge and ethics	.378**	.00

** $p < .01$

4. Conclusion

The results showed that students were at moderate level of environmental literacy which is consistent with the previous research studies [5,6]. For the environmental knowledge, most of the students were also at moderate level. They gave correct responses about the ecological knowledge, socio-political knowledge, and environmental issues resulting in 54.7%, 39.0%, and 28.9% respectively. The results indicated the students had a better understanding about ecology, but had insufficient knowledge of environmental issues. For environmental ethics, most of them were at high level; more than 50% got correct response in all environmental ethics components. The environmental sensitivity and participants components ranked the highest (87.2%) while human responsibility toward natural environment ranked the lowest. This indicated that most of the students were in non-anthropocentrism. Surprisingly, there was weak correlation between environmental knowledge and environmental ethics in this sample (.378), which was different from the other research studies [4,13,14]. The students tended to have high environmental ethics knowledge, but low knowledge about environment. The result of this study indicated that environmental knowledge is needed to be taken more seriously in both formal and informal environment education, especially the knowledge of environmental issues and it is claimed as one of the topic or knowledge that students should learn in the 21st century era [15].

This paper is a part of the Ed.D. dissertation, Development of the Place-based Curriculum in Environmental Science to Promote Environmental Literacy: A Case Study Rayong Province, of the first author.



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