International Electronic Journal of Environmental Education
Vol.6, Issue 2, 2016, 54-75
RESEARCH ARTICLE

The Impact of Affective Constraints on Shaping Environmental Literacy: Model Testing Using Mediator and Moderator Variables

Nilay ÖZTÜRK*
Middle East Technical University

Gaye TEKSÖZ
Middle East Technical University

To cite this article: Öztürk, N. & Teksöz, G. (2016). The impact of affective constraints on shaping environmental literacy: Model testing using mediator and moderator variables. *International Electronic Journal of Environmental Education, 6*(2), 54-75.

Abstract

The aims of this study were; first to investigate the mediating effects of pre-service teachers' (PTs) attitude toward environment on the relationship between their environmental concern and environmental responsibility, and second, to explore the moderating effect of gender on the relationships between; PTs' environmental concern and responsibility; and environmental attitude and responsibility. A total of 1626 PTs completed the Environmental Literacy Survey. The findings revealed that PTs' attitude had a significant mediating effect on the relationships between environmental concern and responsibility. Furthermore, the results of the moderation analysis showed that the relationships did not differ in female and male participants.

Key words: Environmental literacy, attitude, responsibility, gender, mediation, moderation.

Introduction

Our attempt with this research is to explore the mediating effect of attitude toward environment on the relationship between environmental concern and environmental responsibility. Besides, we attempted to reveal the moderating effect of gender on the relationship between environmental concern and environmental responsibility and the moderating effect of gender on the relationships between attitude toward environment and environmental responsibility. What brought us to investigate the relation among these environmental literacy dimensions through mediation and moderation analysis however is the inconsistency related to the impact of attitude on the other components of environmental literacy (EL). Therefore in the following section we have put our reasonings forward in relation with the history of EL research, than we presented the results obtained by the use of one of the novel approach (mediation and moderation analysis). Therefore the context of this research is to propose a new insight to EL literature for attempting to explore the relationships between affective components of EL (environmental concern, responsibility, attitude) as well as the effect of gender on these relationships by model testing using mediator and moderator analysis thus to invigorate one of the inconsistent areas of EL research.

The concept of environmental literacy was first defined by Roth in an article for Massachusetts Audebon (1968). He was replying "to the then frequent media references to environmental illiterates who were responsible for polluting the

E-mail: nilayozzturk@gmail.com

ISSN: 2146-0329

environment" (Roth, 1992 p. 7). Roth then asked the question, "how shall we know the environmentally literate citizen?" (p. 7), which became the starting point for discussion and the development of the concept. Although concern about the environment has substantially developed since then and now refers to much more than pollution, developing environmental literacy remains the primary goal of environmental education.

In the early days, the Tbilisi declaration (UNESCO-UNEP, 1977) was important in marking the beginning of the idea of environmental education and opened the way for definitions of environmental literacy. In 1980, Hungerford, Peyton, and Wilke (1980) defined the environmentally literate as having positive attitudes, strong sense of responsibility as well as knowledge on issues and action strategies. In their announcement of the 1990 as the International Environmental Literacy Year, the United Nations offered a broad definition of environmental literacy (UNESCO-UNEP, 1989). During the 1990s, environmental literacy was refined by Marcinkowski (1991), who expanded on the definition in the Tbilisi declaration. Subsequently, Roth (1992) defined environmental literacy as having the four strands of; knowledge, skills, affect (sensitivity, attitude and values) and behaviour (personal investment, responsibility, active involvement). Moreover, he emphasized the unique feature of environmental literacy in that it goes beyond the cognitive skills, involving thinking, acting and valuing. Furthermore, declaring that there is variation in people's development of environmental literacy Roth (1992) determined that there were three levels of environmental literacy; namely, nominal, functional and operational, in each of which there are the stages of awareness, concern, understanding and action. Roth (1992) also emphasized that capability at a particular developmental stage should not be confused with the achievement of the operational literacy itself. As he wrote, "a person who is environmentally aware is not necessarily environmentally literate; nor is a person who possesses broad environmental understanding; nor is one who demonstrates great environmental concern; nor necessarily is one who takes action on environmental issues" (p. 27).

Stables and Bishop (2001), on the other hand, argued that references to environmental literacy in the environmental education literature do not refer to fundamental debates about literacy. According to the authors, the justification for using the term in the way that it appears in those references remains limited due to existing notions of environmental literacy having a lack of grounding in the literacy debate outside environmental education. Therefore, Stables and Bishop consider the environment as the text and they make distinctions between strong (taking a broad view of literacy and acknowledging its full ramifications with environmental education) and weak (inconsistent with the field of environmental education) conceptions of environmental literacy. Accepting the environment as the text, however, brings authors to the point that, "we do not merely understand our environment scientifically, or in terms of one scientific approach, but 'read' it historically, aesthetically, and so on" (p. 93). Yet, according to the authors, "there are many 'correct' or different ways of understanding the environment" (p. 93). Thus, beginning from the end of the 20th century, the debate related to environmental literacy has continued concerning the relationships between the components of attitudes, knowledge and responsible environmental behaviour (Arnon, Orion, & Carmi, 2014; Cheng & So, 2015; Erdogan & Ok, 2011; Esa, 2010; Goldman, Assaraf, & Shaharabani, 2013; Goldman, Yavetz, & Pe'er, 2006; Hsu, 2004; Hsu & Roth, 1998; Hsu & Roth, 1999; McBeth, Trudi, & Volk, 2009; Pe'er, Goldman, & Yavetz, 2007; Shephard et al., 2014; Author, 2013; Yavetz, Goldman, & Pe'er, 2009). In other words, the debate that was about the definition of the environmental literacy in the 1990s now focuses on the relationships among the components that explain the achievement of overall operational environmental literacy.

In the related literature, the target has moved to the changes occurring in the components themselves and the relationship between the components over time and with and without exposure to environmental education (Pe'er, Goldman, & Yavetz, 2007). According to a considerable amount of research, increasing an individual's environmental knowledge results in more positive attitudes toward the environment (Bradley, Waliczek, & Zajicek, 1999; McMillan, Wright, & Beazley, 2004). However, the relationship between the cognitive components, affective components and behaviour maintain their complexity. Therefore, we still adhere to the claim made by Hungerford and Volk in 1990 that knowledge, as a critical component of environmental literacy, is not on its own, a sufficient precursor for environmentally responsible behaviour. The affective components are necessary for the transfer of knowledge into responsible environmental behaviour and are important for the development environmental literacy.

The background for the current debate related to the relationships among the components of environmental literacy relies upon Roth's (1992) claim given above. He stated that in terms of the stages of environmental literacy capability at a particular developmental stage should not be confused with achievement of operational literacy itself. This raises the question of what the most predominant component that determines operational environmental literacy is and whether there is a key component of environmental literacy that would allow us define a person as inevitably environmentally literate.

In a study that explores the barriers to pro-environmental behaviour, Kollmuss and Agyeman (2002) proposed a model for pro-environmental behaviour. Their model displayed how the different factors influence each other and pro-environmental behaviour and that most of the factors are self-explanatory. As well as reporting that the greatest positive influence on pro-environmental behaviour is achieved when internal and external factors act synergistically, the authors reported that environmental knowledge, values, and attitudes, together with emotional involvement make up a complex which is called 'pro-environmental consciousness'. Likewise, Tsevreni (2011) presented an alternative approach to environmental education that focuses on children's ideas and action rather than scientific knowledge.

The tendency of environmental educators to focus on emotion rather than scientific knowledge has echoes of Gardner's multiple intelligence theory (1999) and his attitude towards understanding:

> I want my children to understand the world, but not just because the world is fascinating and the human mind is curious. I want them to understand it so that they will be positioned to make it a better place. Knowledge is not the same as morality, but we need to understand if we are to avoid past mistakes and move in productive directions. An important part of that understanding is, knowing who we are and what we can do… Ultimately, we must synthesize our understandings for ourselves. The performance of understanding that try matters are the ones we carry out as human beings in an imperfect world which we can affect for good or for ill (p. 180-181).

The reason behind such a discussion is beyond the scientific curiosity; it is related to the search for more effective environmental education and the development of environmentally literate future generations. Five decades have passed since Roth posed the question ("how shall we know the environmentally literate citizen?"), but it appears that there is not sufficient progress in increasing our knowledge of the environment. Furthermore, there needs to be an assessment of how environmental education has developed in line with the important global problems which were described by the UN Millennium goals in 2000 which include; poverty, hunger, primary education, gender equality, child mortality, and environmental sustainability. Therefore, environmental education as a source of knowledge needs regenerating by strengthening the concept of environmental literacy.

The way to remedy environmental education may come from the following three assertions as given above: 1. Different people are drawn to different semiotic systems (Gardner, 1999). 2. Capability at a particular developmental stage should not be confused with the achievement of the operational literacy itself (Roth, 1992) 3. We do not merely understand our environment scientifically or in terms of one scientific approach, but "read" it historically, aesthetically, and so on. Thus, there are many "correct" or different ways of understanding the environment (Stables & Bishop, 2001). We have inferred that what these three statements appear to have in common is the affective components of environmental literacy, and this may be the key that can allow us to define a person as inevitably environmentally literate.

Moreover, the above-mentioned claims lead us to focus on environmental attitudes that have been defined as a psychological tendency expressed by evaluating the natural environment with some degree of favour or disfavour (Milfont & Duckitt, 2010). Attitudes apply to general feelings toward ecology and the environment, feelings and concern for specific environmental issues and feelings towards acting to remedy environmental problems. Pro-environmental attitudes rise and fall with current events and vary with age, gender, socioeconomic status, nation, urban-rural residence, religion, politics, values, personality, experience, education, and environmental knowledge. Therefore, environmental attitudes are important because they often, but not always, determine behaviour that either increases or decreases environmental quality.

One of the scales to measure environmental attitudes is the New Environmental Paradigm (NEP) developed by Dunlap and Van Liere (1978) and that was later revised as the New Ecological Paradigm Scale (Cordano, Welcomer, & Scherer, 2003; Dunlap, Van Liere, Mertig, & Jones, 2000). Providing a tool for evaluating an individual's environmental orientation, NEP represents an ecocentric worldview and allows researchers to assess an individual's environmental orientation on a continuum from ecocentrism to anthropocentrism.

From the literature search, we have hypothesized that the key component of environmental literacy which allows us to define a person as inevitably environmentally literate may be related to affective components, and for our study, we defined the affective components as; environmental attitudes, concern and responsibility.

It is evident from the environmental education literature that there is a relationship between environmental concern and responsibility; however, we need to explore the mechanism(s) through which an effect operates and how its boundary conditions or contingencies are established. Therefore, posing questions of "how" and "when" may result in a deeper understanding of these components of environmental literacy, thus leading us define a person's environmentally literacy (Hayes, 2012). Accordingly, our purpose was to explore the effect of attitude on the other affective dimensions of environmental literacy namely; environmental concern and responsibility.

To explore the effects of attitude toward environment on the relationship between environmental concern and environmental responsibility we used the mediation analysis as proposed by Hayes (2013). In addition, we used moderation analysis to determine the effect of gender on the relationship between environmental concern and environmental responsibility, and the effect of gender on the relationship between the attitude towards environment and environmental responsibility. In environmental education literature, gender has generally been evaluated as being implicated in the relation between the value orientations and behaviour. For example; Stern, Dietz, and Kalof (1993) reported that women have stronger beliefs than men about consequences for self, others, and the biosphere.

Similarly, the research undertaken by Bord and O'Conner (1997) showed that differences in perceived vulnerability to risk explain the gender gap found in environmental surveys and other areas of potential risk. As a result, they reported that, in response to every question in the survey that involves reactions to a specific risk, women were more concerned than men; however, in terms of health-risk perceptions of environmental concerns, the gender gap disappeared.

Moreover, research on environmental concern has consistently found that women have modestly stronger pro-environmental values, beliefs, and attitudes than men. Xiao and McCright (2015) used a structural equation modelling technique on General Social Survey data in the US from 2000 and 2010, and found that women report greater pro-environmental views and concern about environmental problems than men.

We chose pre-service teachers (PTs) as the sample because as key people in environmental education, PTs are the preliminary target population in attempts to explore the means of developing the knowledge and practice through more effective environmental education.

The main purposes of the present study are; first to investigate the mediating effects of PTs' attitude toward environment on the relationship between their environmental concern and environmental responsibility. Second, we attempted to reveal the moderating effect of gender on the relationships between PTs' environmental concern and environmental responsibility; and the moderating effect of gender on the relationships between attitude toward environment and environmental responsibility. To this end, our research questions (RQ) were:

RQ.1. What is the mediating effect of the PTs' attitude toward environment on the relationship between their environmental concern and environmental responsibility?

RQ.2. What is the moderating effect of gender on the relationship between the PTs' environmental concern and environmental responsibility?

RQ.3. What is the moderating effect of gender on the relationship between the PTs' attitude toward environment and environmental responsibility?

Methodology

Research Design

The design of the study was based on survey and correlational research. In survey research, certain aspects or characteristics of a group of people are investigated asking them a list of questions (Frankel & Wallen, 2006). Since one of the main purposes of the present study was to reveal the environmental literacy of PTs enrolled in the faculty of education, we chose to use the survey research design. The other research design used in the present study was the correlational research design. In this design, a combination of moderation and mediation analysis was utilized (Hayes, 2013).

Moderation occurs when the relationship between two variables depends on a third variable, called the moderator variable. This third variable is characterized as an interaction. In the correlational analysis framework, a moderator is the third variable that affects the zero-order correlation between an independent and a dependent variable. The moderation analysis aims to answer the questions related to 'when'. In the present study, the moderation analysis was used to determine the effect of gender on the relationships between PTs' environmental concern and environmental

responsibility, and between PTs' attitude toward environment and environmental responsibility.

A mediation model also uses a third explanatory variable, called the mediator variable, to identify and explicate the mechanisms or processes underlying a relationship between an independent and a dependent variable. Mediating relationships occur when the third variable plays an important role in governing a relationship between the two other variables. The mediation analysis focuses on answering the questions related to 'how'. In the present study, the mediation analysis was used to explore the effect of PTs' attitude toward environment on the relationship between their environmental concern and environmental responsibility.

Sample

The participants of this study were 1626 PTs enrolled in the school of education of a university located in Anatolia Region (Kırşehir province) in Turkey. Almost 70 % of the PTs were from the departments of Computer Education and Instructional Technologies, Elemenary Education, Turkish Language Education and Social Sciences Education. However the rest were from the Departments of Science Education (16.1%), Mathematics Education (6.6%) and Early Childhood Education (8.5). Thirty percent of the participants were male and 70% were female with the average age of 20.3 years.

Instrument

The instrument used in the study was the Environmental Literacy Survey (Kaplowitz & Levine, 2005). The original survey consists of four main categories with distinct sets of questions concerning knowledge, environmental attitude, responsibility, and concern. However, in the present study, the last three components were utilized. Using these components, the respondents' environmental attitudes (10 items), responsibility (19 items), and concern (9 items) were investigated using a 5-point Likert-type scale. To measure PTs' attitudes and values related to the environment, the environmental attitude items were adapted to the present study from the New Ecological Paradigm Scale (NEP) (Dunlap, Liere, Mertig, & Jones, 2000). The environmental responsibility items measured PTs' perceptions about their responsibility to take part in pro-environmental actions. Finally, the environmental concern items revealed PTs' sensitivity and level of concern related to certain environmental problems and issues. In addition to these items, ten demographic questions were asked to determine the respondents' self-evaluation of their environmental background and obtain personal information; such as age, grade level, department, gender, and parents' level of education.

The instrument was originally developed in English, and previously translated and adapted to Turkish by Author (2009). In their study, the Turkish version of the questionnaire was peer-reviewed by three experts in the field of science education and one expert in the field of environmental science and some revisions were made. The Turkish version of the questionnaire was pilot-tested and its validity has been confirmed by Author (2009). The authors used the Cronbach alpha and found the internal consistency of the environmental attitude, responsibility, and concern dimensions to be 0.64, 0.80, and 0.88, respectively. In the present study, the internal consistency was also assessed using the Cronbach's alpha and found to be 0.56, 0.77, and 0.85 for the attitude, responsibility and concern item sets, respectively. In order to ensure the construct validity, the researchers also carried out a confirmatory factor analysis using AMOS 21. The results indicated a good fit, proved with high fit indices

(RMR= 0.052; GFI= 0.89; RMSEA= 0.051). Since they did not load to the factors significantly, one item related to attitude; namely "The Earth has plenty of natural resources if we just learn how to develop them" and one responsibility item, "Landowners should be allowed to drain wetlands for agricultural or industrial uses", were omitted.

Data Colleciton and Analysis

Data collection was carried out during the fall of 2013. One of the authors of the study collected the data from PTs in all classrooms. The consistency of data collection was ensured by following the same procedure in all classrooms. The participation was voluntary and ethical commission permissions were taken prior to the data collection process.

The survey data was quantitatively analysed. Following the descriptive analyses, the mediation analysis was used to reveal the mediating effect of PTs' attitude toward environment on the relationship between their environmental concern and environmental responsibility. Then, the moderation analysis was conducted to examine the moderating effect of gender on the relationships; between PTs' environmental concern and environmental responsibility; and between PTs' attitude toward environment and environmental responsibility. A statistical tool called PROCESS (Hayes, 2012) was used to conduct both the mediation and moderation analyses. Most statistical software does not allow modern moderation and mediation analyses to be conducted in a straightforward way. PROCESS, however, is a versatile modelling tool for SPSS that combines many of the functions of popular procedures and tools (such as SOBEL and INDIRECT) in one simple-to-use procedure.

Findings

We present the results in four sections, in accordance with our research questions: 1. PTs' self-evaluations about environmental problems; 2. General characteristics of PTs' environmental literacy; 3. Mediating effects of attitude toward environment on the relationship between environmental concern and environmental responsibility; 4. Moderating effect of gender on the relationships between environmental concern and environmental responsibility, and between attitude and responsibility.

Pre-service Teachers' Self-evaluations on Their Perceptions Related to Environmental Problems

Participants were asked four questions to evaluate their environmental background about their perceptions regarding environmental problems/issues. As presented in Table 1, 55.2% of Turkish PTs stated that they have a fair amount of environmental concern and 49.4% reported their degree of knowledge about environmental issues and problems to be "only a little". In addition, 65% of the participants reported environment as the second or most important problem faced globally. In this study, nearly half of the Turkish PTs (48.5%) stated that their childhood and the environmental behaviours of their parents had an influence on their perceptions about environmental problems.

Table 1.

Participants' self evaluation on their environmental background

Item	*Agreement (%)*
Perceptions on concern about environmental problems	
A lot	5.7
A fair amount	55.2
A little	34.5
Only a little	3.7
Not at all	1.0
Perceptions about the importance of the environmental problems	
Environment as one of the 2 or 3 most important problems	65.0
Environment as an important problem with several more important ones	31.7
Environment as an unimportant problem	1.1
Environment as not a problem	2.2
Perceptions about the degree of knowledge about environmental issues and problems	
A lot	2.1
A fair amount	47.3
Only a little	49.4
Practically nothing	0.6
Don't know	0.6
Do you think your childhood and parents' environmental behaviors have an influence on your perceptions about environmental problems now?	
Yes	48.5
Maybe	33.1
No	11.6
No idea	6.8

Pre-service Teachers' Environmental Literacy in terms of Attitude, Concern and Responsibility

Environmental attitudes. The mean score of Turkish PTs concerning the environmental attitude items was 3.83 out of 5 (SD=1.06). The highest mean score was found to be 4.59 for the item, "Plants and animals have as much right as humans to exist". The lowest mean, on the other hand, was 3.18 that was obtained from the responses to the item, "The balance of nature is strong enough to cope with the impacts of modern industrial nations". Furthermore, this item received the highest frequency (30.9%) among the "undecided" responses, followed by the item, "We are approaching the limit of the number of people the earth can support" (26 %). Therefore, although the M value for the attitude dimension of the Environmental Literacy Survey was reasonably high, the above-mentioned results related to the "undecided" responses indicate that PTs have quite uncertain positions related to the relationship between human beings and environment (Table 2).

Table 2.

Percentage of respondent agreement with environmental attitude items

	Frequency (%)				
Item	*Agree*	*Undecided*	*Disagree*	*M*	*S.D.*
We are approaching the limit of the number of people the earth can support.	59.5	26.0	14.5	3.63	1.03
When humans interfere with nature it often produces disastrous consequences.	64.6	19.4	16.0	3.72	1.07
Plants and animals have as much right as humans to exist.	92.6	2.4	5.1	4.59	0.89
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	40.7	30.9	28.4	3.18	1.16
Despite our special abilities humans are still subjects to the laws of nature.	58.2	22.5	19.2	3.53	1.14
The so-called "ecological crisis" facing humankind has been greatly exaggerated.	62.3	23.7	14.0	3.69	1.06
Humans were meant to rule over the rest of nature.	69.2	11.7	19.0	3.81	1.23
Humans will eventually learn enough about how nature works to be able to control it.	80.5	11.1	8.4	4.08	0.99
If things continue on their present course, we will soon experience a major ecological catastrophe.	84.9	8.7	6.5	4.27	0.97
Average	68.0	17.3	14.5	3.83	1.06

Environmental responsibility. For the environmental responsibility items, Turkish PTs scored, on average, 3.97 out of 5. Nearly all the participants agreed to the item, "It is important that everyone be aware of environmental problems" with a mean score of 4.60 and the agreement percentage of 94.8 (Table 3). The next item was "All plants and animals play an important role in the environment", which is similar to the attitude item, "Plants and animals have as much right as humans to exist" that also received the highest mean value. Similarly, the items that consider only human (or non-human) received the highest frequencies of all; for example, "Government should pass laws to make recycling mandatory" (M=4.46); and "Collective action (i.e. movements) is central to solving environmental problems" (M=4.38). However, items that include both human and non-human interrelationships received the lowest frequencies, as in the following items; "Wild animals that provide meat for people are the most important species to protect" (M=3.24) and "Landowners should be allowed to drain wetlands for agricultural or industrial uses" (M=2.68).

Table 3.

Percentage of respondent agreement with environmental attitude items

	Frequency (%)				
Item	*Agree*	*Undecided*	*Disagree*	*M*	*S.D.*
We are approaching the limit of the number of people the earth can support.	59.5	26.0	14.5	3.63	1.03
When humans interfere with nature it often produces disastrous consequences.	64.6	19.4	16.0	3.72	1.07
Plants and animals have as much right as humans to exist.	92.6	2.4	5.1	4.59	0.89
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	40.7	30.9	28.4	3.18	1.16
Despite our special abilities humans are still subjects to the laws of nature.	58.2	22.5	19.2	3.53	1.14
The so-called "ecological crisis" facing humankind has been greatly exaggerated.	62.3	23.7	14.0	3.69	1.06
Humans were meant to rule over the rest of nature.	69.2	11.7	19.0	3.81	1.23
Humans will eventually learn enough about how nature works to be able to control it.	80.5	11.1	8.4	4.08	0.99
If things continue on their present course, we will soon experience a major ecological catastrophe.	84.9	8.7	6.5	4.27	0.97
Average	68.0	17.3	14.5	3.83	1.06

Environmental concern. Among the given environmental problems, Turkish PTs were found to have the highest concern for 'water shortage' and 'poor drinking water quality' with the mean scores of 4.26 and 4.25, respectively (Table 4).

Table 4.

Percentage of participants' responses on environmental concern items

Item	*Not concerned*	*A little concerned*	*Undecided*	*Somewhat concerned*	*Very concerned*	*M*	*S.D.*
Air pollution	3.1	13.7	7.1	58.4	17.8	3.74	1.00
Water pollution	2.0	10.3	7.6	53.4	26.8	3.93	0.96
Automobile emissions	10.7	17.8	17.6	39.5	14.4	3.29	1.22
Industrial wastes	12.2	19.7	17.5	36.3	14.3	3.21	1.25
Hazardous wastes	9.4	16.1	13.4	37.9	23.2	3.49	1.26
Poor drinking-water quality	2.4	6.5	6.3	33.1	51.7	4.25	0.99
Water shortage	2.0	6.3	6.2	34.6	50.9	4.26	0.96
Ozone layer depletion	7.9	16.1	13.2	40.7	22.1	3.53	1.22
Climate change	5.1	13.4	13.8	42.2	25.5	3.70	1.14
Average	6.08	13.3	11.4	41.7	27.4	3.71	1.11

In terms of the results on the descriptive statistics, PTs in this study had positive environmental attitudes and responsibilities when human and environment were separately considered; however, they were undecided when there was a case of interrelation between human and nature.

PTs environmental concern was only regarding the problems of national concern. Water shortage and drinking water quality have currently been on the agenda of Turkey due to the less rainfall compared to past years which is considered to be one of the impacts of climate change. However, the results showed that PTs in this study did not perceive global problems as the results of or reasons for the national problems.

The results of the descriptive analysis, therefore, possess the characteristic of PTs environmental literacy that there may be an additional interrelation/s between environmental attitudes, responsibility and concern, which can further explain the above-mentioned attitudes toward environment.

The Mediating Effect of Attitude toward Environment on the Relationship between Environmental Concern and Environmental Responsibility

As mentioned before, one of the purposes of the present study was to investigate the mediating effects of attitude toward environment on the relationship between environmental concern and environmental responsibility. Before proceeding with the mediation analysis, the Pearson correlation coefficients among the variables were calculated and given in the Table 5 below.

Table 5.

Pearson correlations and reliability of the variables

Variable	α	*Pearson correlation (r)*		
		1	2	3
1. Attitude	.56		0.49*	0.10*
2.Responsibility	.77			0.16*
3. Concern	.85			

*p<.01

As shown in Table 5, the correlation coefficient was found to be 0.49 between the attitude and responsibility variables, 0.10 between attitude and concern, and 0.16 between responsibility and concern. Therefore, all the Pearson correlations were significant at the 0.01 significance level. The reliability coefficients were between 0.56 and 0.85, which are consistent with the results of the previous studies.

Figure 1 presents the mediation model using a diagram. In the model, attitude is the mediator variable between the concern and responsibility variables, and a, b, and c' are the regression coefficients. c' is the direct effect of concern on responsibility where the indirect effect of concern on responsibility through attitude is a*b. The total effect of concern on responsibility, denoted as c, is the sum of direct and indirect effects (c'+ a*b).

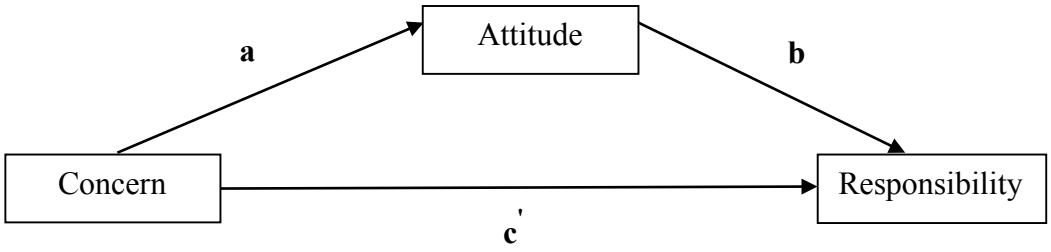

Figure 1. Mediation model diagram

The two regression equations of the present model are:

(1) Attitude = i_1 + aConcern

(2) Responsibility = i_2 + c'Concern + bAttitude, where i_1 and i_2 are the regression intercepts.

Table 6.

Path coefficients from the model

		Attitude				*Responsibility*		
		Regression coefficient	*SE*	*p*		*Regression coefficient*	*SE*	*p*
Concern	A	.065	.016	<.001	c'	.133	.024	<.001
Attitude					b	.836	.037	<.001
Constant	i_1	32.332	.549	<.001	i_2	42.156	1.458	<.001
		R^2=0.009				R^2=0.255		
		F(1, 1653)=16.219, p<.001				F(2, 1652)=283.534, p<.001		

Table 6 presents the results of the mediation analysis. According to the results, the coefficients a, b, and c' are significant. Coefficient a (a=0.065) indicates that there is a significant correlation between the concern and attitude variables, which means that as the concern scores increase by one unit, attitude scores increase by 0.065 unit. The regression coefficient b (b=0.836) shows that there is a significant correlation between the attitude and responsibility variables; so, when attitude increases by one unit, responsibility scores increase by 0.84 units. The indirect effect of attitude on responsibility (a*b= 0.054), on the other hand, means that as the variable concern increases by one unit, responsibility increases by 0.054 unit. The direct effect of concern on responsibility (denoted as c', was computed as 0.133 as displayed in Table 6) is the estimated difference in environmental responsibility between two PTs with the same level of environmental attitude but different level of environmental concern (one unit). The coefficient is positive, which means that a PT with more concern but an equal level of attitude is estimated to possess 0.133 units higher responsibility.

The indirect effect of concern on responsibility through attitude (a*b) shows the difference related to the effect of concern that will be created on responsibility; when the concern score increases by one unit as a result of the influence of attitude on concern, it influences responsibility. In terms of the direct effect, however, it is necessary to determine whether the indirect effect is different from zero (Hayes, 2013). If this is the case, then it can be suggested that attitude serves as a mediator variable for the effect of concern on responsibility. According to the bootstrap confidence interval generated by the PROCESS for the indirect effect in the mediation model, the lower limit of the bootstrap confidence interval (BootLLCI) for the indirect effect was 0.0269 and the upper limit (BootULCI) was 0.0832. Since this interval does not include zero, it can be concluded that attitude has a significant mediating effect on the relationship between the variables of concern and responsibility. Finally, the total effect of concern on responsibility (c= c' + a*b) is the sum of direct and indirect effects and computed as 0.187, which is statistically significant with p being <0.001 and the confidence level being somewhere between 0.1328 (LLCI) and 0.2418 (ULCI).

In the mediation analysis, when a mediator variable reduces the relationship between the independent and dependent variable to zero, it is called a full mediation. In our case, when attitude was included as the mediator variable into the model, the relationship between concern and responsibility were not reduced to zero; however, it was close to zero, and the PROCESS analysis revealed that the indirect effect was significant. Therefore, we can conclude that there was an indirect effect between the variables of this study and attitude had a significant mediating effect on the relationship between concern and responsibility.

The Moderating Effect of Gender on the Relationship between Environmental Concern and Responsibility

In the moderation analysis, the moderating effect of gender on the relationship between concern and responsibility was investigated. Figure 2 presents the related conceptual model and the equation of the analysis is given below:

Responsibility = i_1+c_1Concern$+c_2$Gender$+c_3$Concern*Gender

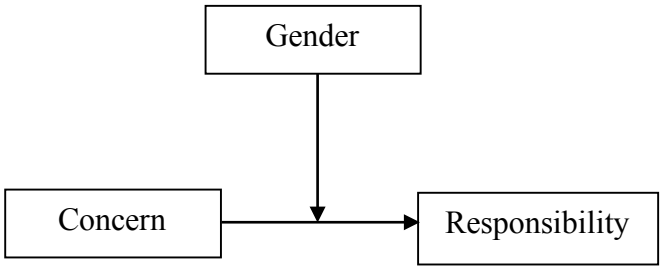

Figure 2. Conceptual model of the moderation analysis

As shown in the statistical models (Figure 3), the paths are; 1-) from the independent variable to the dependent variable, 2-) from the moderator variable to the dependent variable, and 3-) from the interaction variable (concern*gender) to the dependent variable.

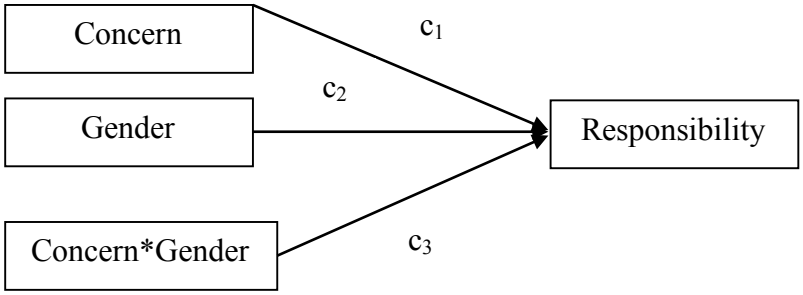

Figure 3. Statistical model of the moderation analysis

In the statistical model, the key result is the estimate of c_3 not being statistically different from zero, which means that the effect of concern is not dependent, at least linearly, on gender. On the contrary, if c_3 was significantly different from zero, it would be an indication that the effect of concern depended on gender. Table 7 presents the results from the PROCESS analysis examining the moderation effect of gender on the relationship between concern and responsibility.

Table 7.

Results of the moderation analysis

		Coeff.	*SE*	*t*	*p*
Intercept	i_1	75.468	0.191	394.888	<.001
Concern (X)	c_1	0.187	0.034	5.580	<.001
Gender (M)	c_2	0.430	0.447	0.962	.336
Concern*Gender (XM)	c_3	0.041	0.077	0.532	.595
		R^2=0.028, MSE=59.688			
		F(3, 1631)=11.741, p<.001			

The regression coefficient for XM was found to be 0.041 and was not statistically different from zero, with t(1631) being 0.532 and p being 0.595. Thus, the effect of concern on responsibility does not depend on gender. This means that the relationship between concern and responsibility did not differ in females and males. The non-significant moderation effect of gender on the relationship between concern and responsibility was also supported by the PROCESS output, which displayed the range between the lower limit confidence interval (LLCI = -0.1098) and the upper limit confidence interval (ULCI = 0.1914) for the interaction including zero.

The Moderation Effect of Gender on the Relationship between Attitude and Responsibility

The possible moderation effect of gender on the relationship between attitude and responsibility was investigated using moderation analysis. Figure 4 presents the related conceptual model and the equation of the analysis is given below:

Responsibility = $i+c_1$Attitude$+c_2$Gender$+c_3$Attitude*Gender

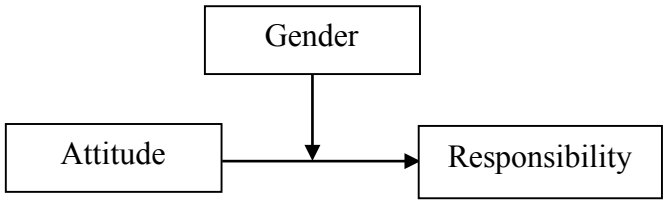

Figure 4. Conceptual model of the moderation analysis

As shown in statistical models (Figure 5), the paths are; 1-) from the independent variable to the dependent variable, 2-) from the moderator variable to the dependent variable, and 3-) from the interaction (attitude*gender) to the dependent variable.

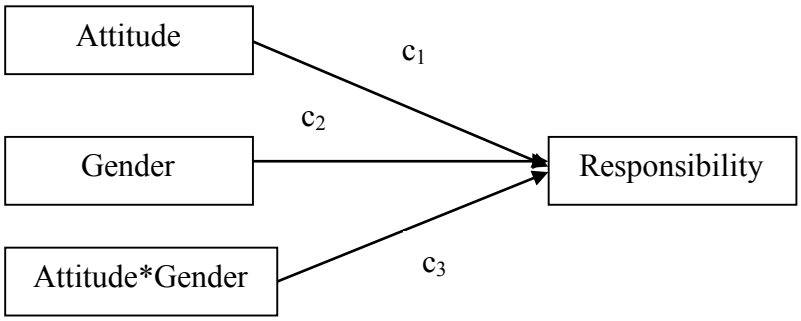

Figure 5. Statistical model of the moderation analysis

In this statistical model, the estimate of c_3 was not statistically different from zero, which means that the effect of attitude was not dependent, at least linearly, on gender. If c_3 was significantly different from zero, we would conclude that the effect of attitude depended on gender. Table 8 gives the results from the PROCESS analysis examining the moderation effect of gender on the relation between attitude and responsibility.

Table 8.

Results of the moderation analysis

		Coeff.	*SE*	*t*	*p*
Intercept	i_1	75.479	0.169	447.012	<.001
Attitude (X)	c_1	0.846	0.061	13.772	<.001
Gender (M)	c_2	-0.101	0.372	-0.272	.786
Attitude*Gender (XM)	c_3	-0.103	0.128	-0.801	.423
		R^2=0.244, MSE=46.425 F(3, 1631)=64.954, p<.001			

The regression coefficient for XM was -0.103 and was not statistically different from zero with t(1631) being -0.801 and p being 0.423. Therefore, the effect of attitude on responsibility did not depend on gender. In other words, the relationship between attitude and responsibility was not different in females and males. The non-significant moderation effect of gender on the relationship between attitude and responsibility is also observed from the PROCESS output, which gives the range between the lower limit confidence interval (LLCI = -.3550) and the upper limit confidence interval (ULCI = .1492) for the interaction including zero.

Discusion and Conclusions

We began with an ambitious question, “how to remedy environmental education”. We were inspired by the claims asserting that affective components of environmental

literacy are the key to define a person as inevitably environmentally literate. Our purpose was to explore the effect of attitude on the other affective dimensions of environmental literacy; namely environmental concern and responsibility. We used the mediation analysis to explore the effect of environmental attitude on the relationship between the variables of environmental concern and environmental responsibility. In addition, we used the moderation analysis to determine the effect of gender on the relationship between environmental concern and environmental responsibility, and between attitude toward environment and environmental responsibility.

As a result, we found that attitude had a significant mediating effect on the relationship between concern and responsibility. We can, therefore, conclude that attitude is one of the major components that determine operational environmental literacy. Although this is not a new finding, it is important in terms of displaying the mediating effect of attitude. It is not sufficient to consider the direct effects of internal and external factors to explain pro-environmental behaviour; the mediating effects also need to be explored. As shown in the present study and also reported by Kollmuss and Agyeman (2002), the biggest positive influence on pro-environmental behaviour is achieved when internal and external factors act synergistically.

Our findings related to PTs' scores on attitude, concern and responsibility items demonstrate the mediating effect of attitude on concern and responsibility. Although the PTs in this study had high attitudes scores, they seemed to be undecided when asked about the interrelation between human and nature. Yet, their environmental concern was mainly with regard to the problems of national concern. They perceived the global problems as the results of/reasons for the national ones, which indicate that there is a further interrelation/s between affective/internal factors. In other words, PTs in this study were not sure about the relationship between human and nature and this uncertainty resulted in their environmental concern being limited to the problems that they personally experienced. Accordingly, their responsibility towards the environment was similar. When asked whether they agreed to the statement, "Wild animals that provide meat for people are the most important species to protect", 36 % remained undecided. Thus, the way PTs in this study "*read*" the environment can be the result of a cultural/social construct rather than a scientific one, and according to our results, this is mediated by their attitude.

We also tested the moderating effect of gender on the relationships between environmental concern and responsibility, and between attitude and responsibility, and found that these relationships did not differ in females and males. Previous research describing gender as an agent causing difference in values, behaviour, beliefs, attitudes, concern, pro-environmental views (Stern et al., 1993; Xiao & McCright, 2015) and vulnerability to risk (Bord & O'Conner, 1997) has focused on the effect of gender on the individual variables; however, in this study, we focused on the mediating effect of gender on the relationship between other variables (environmental concern and environmental responsibility). To be precise, although gender makes a difference on attitude, for most of the cases, it does not do so when its effect is questioned with the regard to the relationships between the variables; thus supporting the difference shown by the mediation analysis.

In the literature, a few studies used mediation and moderation analyses in education and/or environmental education (e.g. Tarrant, Bright, & Cordell, 1997; Vaske & Kobrin, 2001). Yet, to our knowledge, there is no research investigating the mediating effect of attitude on the relationship between environmental concern and environmental responsibility, and the moderator effect of gender on the variables of environmental literacy. We, therefore, suggest that mediation and moderation analyses are useful to explore the interrelations between environmental literacy variables and further research should be conducted on other variables, particularly to explore the mediating

effect of knowledge on attitude. Furthermore, considering the changing nature of pro-environmental attitudes depending on current events and variations with age, gender, socioeconomic status, culture, urban-rural residency, religion, worldview, values, personality, experience, education and environmental knowledge, we suggest and encourage further attempts to perform a moderation analysis to explore the effects of the above-mentioned variables on attitude.

In conclusion, we are aware that the results and evaluations of this study are not a complete remedy for environmental education. However, we have proposed an alternative approach to asserting that the affective components of environmental literacy are the key to define a person as inevitably environmentally literate.

Furthermore, through our results we assert that, although we do not entirely deny the importance of cognitive component, affective components of environmental literacy shall be emphasized to define and raise persons inevitably environmentally literate. Because, through our results we added to environmental literacy reserach that, the relationship between environmental concern and responsibility may operate through attitude and consideration of this mechanism help us educators in developing effectiveness of education for sustainable development (ESD). As a matter of fact, the recent research and practice in ESD is in line with our claim. For example through their evaluations on the results project titled “Hello, Spring!“ Eelma et al. (2015) reported that, values and attitudes come from childhood and home plays an enormous role in the formation of attitudes and so does school and education. According to the results of the project, the authors claim that nature education improves the quality of life by sharing human values; it helps to develop respect, honesty, compassion, care and responsibility. Through the activities of the project which carry all these values, the development of a remarkable number of children’s values and attitudes towards life around us is positively influenced. Similarly, Strode (2015) states that in the current life sytles, education provides sphere of activities where the experience of humanity, society and an individual – knowledge, skills, attitudes and value-orientation in terms of the human him/herself, the human environment and nature – is particularly collected, maintained and distributed. Therefore, education is an intellectual need that has to assist people in maintaining and developing attitude towards values, intellectual values. Thus, according to the author the overall process of upbringing and education shall be value-oriented only in case if we can implement the principle of wholeness or holistics. And as Kõiv (2015) reported in their study to touch the students’ values, and offer practical tasks and vary the teaching methods in order to create connections between the students’ own lives, their communities and other peoples in different parts of the world. As the author stated, encouraging students to share their thoughts and attitudes and building their current values will have an influence their responsibility for the future, as well as the knowledge or facts they have learned about the World.

All in all, in line with the results of this research we draw out that giving the importance the affective components of environmental literacy deserve promises to develop the efficiency of ESD, thus raising more responsible generations, because as Nicol (2015) wrote “Love has got to do everything”.

▪ ▪ ▪

References

Arnon, S., Orion, N., & Carmi, N. (2014). Environmental literacy components and their promotion by institutions of higher education: An Israeli case study. *Environmental Education Research*. Advance online publication. doi:10.1080/13504622.2014.966656

Bord, R. J., & O'Connor, R. E. (1997). The gender gap in environmental attitudes: The case of perceived vulnerability to risk. *Social Science Quarterly, 78*(4), 830-840.

Barrow, R. (1980). *The Canadian curriculum: A personal view.* London, Ontario: University of Western Ontario.

Bradley, J. C., Waliczek, T. M., & Zajicek, J. M. (1999). Relationship between environmental knowledge and environmental attitude of high school students. *The Journal of Environmental Education, 30*(3), 17-21.

Cheng, I. N. Y., & So, W. W. M. (2015). Teachers' environmental literacy and teaching -stories of three Hong Kong primary school teachers. *International Research in Geographical an Environmental Education, 24*(1), 58-79.

Cordano, M., Welcomer, S. A., & Scherer, R. F. (2003). An analysis of the predictive validity of the new ecological paradigm scale. *The Journal of Environmental Education, 34*(3), 22-28.

Dunlap, R. E., & Van Liere (1978). The new environmental Paradigm: A proposed measuring instrument and preliminary results. *Journal of Environmental Education, 9*(4), 10-19.

Dunlap, R. R., Van Liere, K. D., Mertig, A. G., & Jones, R. E. (2000). Measuring endorsement of new environmental paradigm: A revised NEP scale. *Journal of Social Issues*, *5*(3), 425-442.

Eelma, T., Muuli, V., Rajasaar, V., Ruusmaa, J. and Tuisk, T. (2015, April). *Project „Hello, Spring!" – Over 20 years of Values Education through Nature and Environmental Education*. Paper presented at Pathways to the Future: Education for Sustainable Development, Tallinn, Estonia, p.42.

Erdogan, M., & Ok, A. (2011). As Assessment of Turkish Young Pupils' environmental literacy: A nationwide survey. *International Journal of Science Education, 33*(17), 2375-2406.

Esa, N. (2010). Environmental knowledge, attitude and practices of student teachers. *International Research in Geographical and Environmental Education, 19*(1), 39-50.

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education* (6th ed.). New York: McGraw-Hill.

Gardner, Howard (1999). *The Disciplined Mind: Beyond Facts and Standardized Tests, The K-12 Education That Every Child Deserves*. New York: Simon and Schuster (and New York: Penguin Putnam).

Goldman, D., Assaraf, O. B. Z., & Shaharabani, D. (2013). Influence of a non-formal environmental education programme on junior high school students' environmental literacy. *International Journal of Science Education, 35*(3), 515-545.

Goldman, D., Yavetz, B. & Pe'er, S. (2006). Environmental literacy in teacher training in Israel. *Environmental Behavior of New Students, 38*(1), 3-22.

Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling [White Paper]. Retrieved from *http://www.afhayes.com/public/process2012.pdf*

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach.* New York: The Guilford Press.

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

Hsu, S. J (2004). The effects of an environmental education program on responsible environmental behaviour and associated environmental literacy variables in Taiwanese college students. *The Journal of Environmental Education, 35*(2), 37-48.

Hsu, S., & Roth, R. E., (1998). An assessment of environmental literacy and analysis of predictors of responsible environmental behaviour held by secondary teachers in the Hualien Area of Taiwan. *Environmental Education Research, 4*(3), 229-249.

Hsu, S., & Roth, R. E., (1999). Predicting Taiwanese secondary teachers' responsible environmental behaviour through environmental literacy variables. *The Journal of Environmental Education, 30*(4), 11-18.

Hungerford, H. R. & Volk, Y. (1990). Changing learner behaviour through environmental education. *Journal of Environmental Education*, 35(2), 37-48.

Kaplowitz, M. D., & Levine, R. (2005). How environmental knowledge measures up at a Big Ten university. *Environmental Education Research, 11*, 143-160.

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

Kõiv, I. (2015, April). *Why should they care?* Paper presented at Pathways to the Future: Education for Sustainable Development, Tallinn, Estonia, p.64.

Marcincowski, T. (1991). The relationships between environmental literacy and responsible environmental behaviour in environmental education. In M. Maldague (Ed.), *Methods and techniques for evaluating environmental education.* Paris: UNESCO.

McBeth, W., & Volk, T. (2009). The national environmental literacy project: A baseline study of middle grade students in the United States. *The Journal of Environmental Education, 41*(1), 55-67.

McMillan, E., Wright, T., & Beazley, K. (2004). Impact of university-level environmental studies class on students' values. *The Journal of Environmental Education, 35*(3), 19-28.

Milfont, T. L., & Duckitt, J. (2010). The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of Environmental Psychology, 30*, 80-94.

Nicol, R. (2015, April). *What's love got to do with it? Probably everything*. Paper presented at Pathways to the Future: Education for Sustainable Development, Tallinn Estonia, p.29.

Pe'er, S., Goldman, D., & Yavetz, B. (2007). Environmental literacy in teacher training: Attitudes, knowledge, and environmental behaviour of beginning students. *The Journal of Environmental Education, 39*(1), 45-59.

Roth, C. E. (1968). *On the Road to Conservation*, 38-41. Massachusetts: Audubon.

Roth, C. E. (1992). *Environmental literacy: Its roots, evolution, and directions in the 1990s.* Columbus, OH: ERIC/CSMEE.

Shephard, K., Harraway, J., Lovelock, B., Skeaff, L. S., Strack, M., Furnari, M., & Jowett, T. (2014). Is the environmental literacy of university students measurable? *Environmental Education Research, 20*(4), 476-495.

Stables, A., & Bishop, K. (2001). Weak and strong conceptions of environmental literacy: Implications for environmental education. *Environmental education Research, 7*(1), 89-97.

Stern, P. C., Dietz, T., Kalof, L. (1993). Value Orientations, gender, and environmental concern. *Environment and Behaviour, 25,* 322-348.

Strode, I. (2015, April). *Highlighting the value prototyper of modern young people in the context of sustainable education and development.* Paper presented at Pathways to the Future: Education for Sustainable Development, Tallinn, Estonia, p.62.

Tarrant, M. A., Bright, A. D., & Cordell, H. K. (1997). Attitudes toward wildlife species protection: Assessing moderating and mediating effects in the value-attitude relationship. *Human Dimensions of Wildlife: An International Journal, 2*(2), 1-20. doi: 10.1080/10871209709359091

Tsevreni, I. (2011). Towards an environmental education without scientific knowledge: an attempt to create an action model based on children's experiences, emotions and perceptions about their environment. *Environmental Education Research, 17*(1), 53-67.

UNESCO-UNEP (1989). Environmental Literacy for all. *Connect, 15*(2), 1-2.

UNESCO-UNEP (1977). *Intergovernmental Conference on Environmental Education inTbilisi*, (USSR) Columbus.

United Nations Millennium Declaration (2000). *Resolution adopted by the General Assembly.* 55/2.

Vaske, J. J., & Kobrin, K. C. (2001). Place attachment and environmentally responsible behavior. *The Journal of Environmental Education, 32*(4), 16-21. doi: 10.1080/00958960109598658

Xiao, C., & McCright, A. M. (2015). Gender differences in environmental concern revisiting the institutional trust hypothesis in the USA. *Environment and Behavior, 47*(1), 17-37.

Yavetz, B., Goldman, D., & Pe'er, S. (2009). Environmental literacy of pre-service science teachers in Israel: A comparison between students at the onset and end of their studies. *Environmental Education Research*, *15*(4), 393-415.

International Electronic Journal of Environmental Education
Vol.6, Issue 2, 2016, 54-75
RESEARCH ARTICLE

Duyuşsal Faktörlerin Çevre Okuryazarlığına Etkileri: Aracı ve Etkileşim Değişkenleri Ile Model Testi

Nilay ÖZTÜRK*
Middle East Technical University

Gaye TEKSÖZ
Middle East Technical University

Özet

Bu çalışmanın amaçları 1- öğretmen adaylarının çevreye yönelik tutumlarının çevreye yönelik kaygı ve sorumluluk değişkenleri arasındaki ilişki üzerinde aracı bir etkisinin olup olmadığını ve 2- cinsiyet değişkeninin çevreye yönelik kaygı ve sorumluluk ile çevreye yönelik tutum ve sorumluluk ilişkileri üzerinde etkileşiminin olup olmadığını araştırmaktır. Çalışmanın veri toplama aracı olan Çevre Okuryazarlığı Anketi toplamda 1626 öğretmen adayına uygulanmıştır. Çalışmanın sonuçları göstermiştir ki, öğretmen adaylarının çevreye yönelik tutumları, çevreye yönelik kaygı ve sorumluluk değişkenleri arasındaki ilişki üzerinde anlamlı bir aracı etkiye sahiptir. Bunun yanı sıra, etkileşim analizlerinin sonuçlarına göre, cinsiyet değişkeninin çevreye yönelik kaygı ve sorumluluk değişkenleri ile çevreye yönelik tutum ve sorumluluk değişkenleri arasındaki ilişkiler üzerinde anlamlı bir etkileşimi yoktur.

Anahtar Kelimeler: Çevre okuryazarlığı, tutum, çevreye yönelik sorumluluk, cinsiyet, aracı değişken analizi, etkileşim değişkeni analizi.

E-mail: nilayozzturk@gmail.com

ISSN: 2146-0329