International Electronic Journal of Environmental Education
Vol.8, Issue 2, 2018, 105-122
RESEARCH ARTICLE

Investigating of Pre-Service Science Teachers' Beliefs on Education for Sustainable Development and Sustainable Behaviors**

Hüseyin ATEŞ*,
Ahi Evran University, Kırşehir, TURKEY

Kibar Sungur GÜL
Nevşehir Hacıbektaş Veli University, Nevşehir, TURKEY

To cite this article: Ates, H. & Gül, K. S. (2018). Investigating of pre-service scienceteachers' beliefs on education for sustainable development and sustainable behaviors*, International Electronic Journal of Environmental Education, 8*(2), 105-122

Abstract

Sustainability problems such as hunger, obesity, unhealthiness, clean water, and the destruction of biological diversity in nature etc. has increased in this century. All over the world, meetings, panels and summits are arranged; researchers who are experts in the field are investigating ways to overcome these problems. Recently, especially after importance of education in sustainable development was pointed out in some reports such as Panel for Education for Sustainable Development arranged in Rio in 1992 or Thessaloniki Decleration, studies has focused on this area. To cope with these problems, in many researches it was stated that identifying the underlying causes should be first aim. However, Teachers generally acknowledge that sustainable development is abstract and difficult to conceptualize. Especially, in science education, awareness of sustainable development plays an important role. Science teachers or pre-service science teachers who will be teacher in near future should be equipped with the necessary competence through professional support to get over the difficulties. Consequently, this research focused on investigating of pre-service science teachers' beliefs on education for sustainable development and sustainable behaviors. The results of the study showed that pre-service science teachers are aware of importance of ESD and considering results of awareness stage of them, their sustainable behaviors are at good level. Additionally, it was found that relationship between their beliefs and behaviors is moderate level.

Keywords: Education for Sustainable Development, Sustainable Behavior, Science Education

Introduction

The capacity of the planet we live doesn't provide enough places to live anymore. Currently, many studies pointed out that bio capacity of our world has not meet the demand of our needs for the last 40 years (*Living Planet Report*, 2014). However, those troubles we experience cause sustainability problems such as hunger, obesity, unhealthiness, clean water, the destruction of biological diversity in nature, depletion of the ozone layer and climate change, (Brundtland, 1985). According to the recent report prepared by United Nations General Assembly (2015),

- Less than 3 percent of the water resources is fresh water and 2.5 percent of it is frozen in Antarctica, Arctic, and in the glaciers. Therefore,

ISSN: 2146-0329
***E-mail: huseyinates_38@hotmail.com**
**** A part of this study was presented in II. International Congress Students Engagement in School: Perspectives of Psychology and Education – Motivation for Academic Performance hold in Lisbon/Portugal between 11th and 13th of July 2016.**

humanity has only 0.5 percent of the total ecosystem and freshwater needs of people.

- The speed with which people pollute the lakes or the rivers is faster than nature can recycle and purify water in rivers and lakes.
- More than 1 billion people still can not access clean water.
- Substantial water use contributes to global water stress. It is independent of nature, but the infrastructure required to supply water is expensive.

Many studies such as researchers, research institutions and universities pointed out that serious changes in the climate have an effect on human activities (e.g., IPCC, 2014; McMichael, Haines, Slooff, & Kovats, 1996; United Nations Framework Convention on Climate Change [UNFCCC], 1992; Wu, Lu, Zhou, Chen, & Xu, 2016). Especially, since 1950s, an unprecedented change in the climate has problem to arise (Chen, 2015). Both nature and human being are affected by serious problem which lead to variations in the reflection of earth's surface and atmosphere, an increase in the greenhouse effect have an impact an increase in the surface temperature of the earth and changes in reaching sun's energy to earth, (Environmental Protection Agency [EPA], 2004).

IPCC (2007) and United Nations Environment Programme [UNEP] (2007) reports indicated that climate changes observed in the last 50 years occurred with more than 90 % probability because of human behaviors who are threatening both own life and planet life.

The best way for individuals to manage these behaviors is to pay attention to household consumptions which are related to CO_2 emissions (Feng, Zou, & Wei, 2011) influence total energy use with approximately 45-55% (Schipper, Bartlett, Hawk, & Vine, 1989). For example, consumption, the use of energy and waste disposal in the household are involved in environmentally significant behaviors needed to be varied through environmentally friendly direction (Nordlund & Garvill, 2002). Recycling, using less air conditions (If air conditions work with 26°C, carbon dioxide emissions reach to 21 kg annually), less elevator, television, PC, electronic office paper carefully and less plastic bags (decrease CO2 emissions with 0.1 gram) are only few of the low-carbon living consumption (Guangcheng & Junyan, 2010).

In order to avoid the damage to the world, one important feature is to provide sustainable development awareness defined firstly in Brutland report (our common future) in 1987 as "*meet the needs of the present without compromising the ability of future generations to meet their own needs*" (World Commission on Environment and Development, 1987, p. 41). Researchers pointed three pillars of sustainability as environmental, social and economic factors and the relationships among them need to be considered systemically (Stratton, Hagevik, Feldman & Bloom, 2015). Especially, to provide sustainability awareness, one of the big factors is education. Hence, importance of education on sustainable development also pointed out intensely in many research areas (e.g., Council for Environmental Education published a strategy report [CEE]; Decade of Education for Sustainable Development (DESD)). As one of them, in Earth summit in Rio in 1992, the concept of 'education for sustainable development' was introduced and defined by Panel for Education for Sustainable Development (PESD) as *"enables people to develop the knowledge, values, and skills to participate in decisions about the way we do things individually and collectively, both globally and locally, that will improve the quality of life now and without damaging the planet for the future."* (CEE, 1998, p.3). Additionally, the concept of education for sustainability got attention and came into the focus with the "Thessaloniki Decleration"

(UNESCO, 1997). Researchers as well as policy-makers have highlighted the importance of a specific approach in teaching called ESD, allowing educators to tackle the complexity of sustainable development in education (Sandell, Ohman, & Östman, 2005; Wals, 2011). The United Nations designated the period 2005-2014 as the DESD represented a lever for the integration of sustainability in all sectors of education across the globe (UNESCO, 2006).

Along with all those mentioned, the study was conducted with the framework of science education which has great importance on ESD as seen in related literature (e.g., Burmeister & Eilks, 2012; Stratton et al., 2015). Although there are a number of goals in science curriculum related to sustainability, science teachers should not only be concerned with understanding, or beliefs about the factors that cause unsustainability, but also how to reduce these causes at the same time (Skamp, Boyes, & Stanisstreet, 2013). To be more precise, gaining pro-environmental behaviors is can be thought of as the duty of the teacher on helping the student. Although in the 21st century give big importance to sustainability, the source of the problem related to sustainability is based on the past. In recent years, researches have emphasized the importance of developing the interaction between science education and ESD in order to educate responsible individuals for a sustainable future (Stratton et al., 2015). Gaining awareness of sustainable behavior is beneficial to individuals' reasoning, motivation and engagement in the teaching of subjects related to sustainable development as well. Because educators aim gaining environmental awareness to students, teachers should demonstrate sustainable behaviors firstly. Pre-service teacher education can be seen as an equilibrium point for promotion and implementation of sustainability (Ferreira, Ryan, & Tilbury, 2006; Steele, 2010). When pre-service teachers graduate, they will refine their existing professional practice into a full professional identity. Ideally, the professional identity will mean an understanding of, and a willingness to engage in, Education for Sustainable Development (Hickey, Whitehouse, & Evans, 2010). In Turkey, science education attaches importance to ESD curriculum as well. Recently, two science curriculums have published. While the aim of the curriculum published in 2013 is to educate science literate individuals who learn lifelong with the conscious of sustainable development. (Ministry of National Education [MONE], 2013), according to science curriculum published in 2017, one of aims of science education is to recognize the interaction between individual, environment and society and to develop sustainable development awareness of society, economy and natural resources (Ministry of National Education [MONE], 2017). Considering literature related to sustainable development in science education, although sustainability has an important position on science education, there is still big gap related to studies conducted on beliefs about ESD (e.g., Boon, 2011; Corney, 2006; Ko & Lee, 2003; Sagdic & Sahin, 2016; Summers, Corney, & Childs, 2004) and sustainable behaviors (e.g., Keleş, 2017). The results of studies investigated teachers' beliefs showed that teachers believe that there is lack of management supports at schools, controversy between sustainable development and related departments and lack of knowledge (e.g., Corney, 2006; Summers, Childs, & Corney, 2005). Additionally, according to literature review conducted by Sağdıç and Sahin, (2016), there is no consensus among teachers about the different aspects of ESD. For example, some teachers believe that it is easier for students to relate these topics to their daily lives, considering that it is more appropriate for students to include local topics in their teaching practices on sustainability. On the other hand, some teachers have developed another point of view that global affairs are more interesting among students (Summers et al., 2003). Nevertheless, teachers generally acknowledge that sustainable development is abstract and difficult to conceptualize (Winter & Firth, 2007; Zachariou & Valanides, 2006). Some of them emphasized that sustainable development-related terms such as democracy, equality, sustainability and prosperity

are more challenging to gain a correct understanding of sustainable development (Summers, et al., 2004). To get over the difficulties, science teachers should be equipped with the necessary competence through professional support (Sağdıç & Sahin, 2016).

When all these reasons are taken into consideration, it is believed that this topic is important and current study contributes to literature. Especially, to the best of our knowledge, there is no study conducted on pre-service science teachers' views about ESD and sustainable behaviors in the related literature in Turkey context and studies conducted on relationship between beliefs and behaviors.

Purpose and Research Questions

The purpose of this study was to investigate pre-service science teachers' beliefs on ESD and sustainable behaviors. Three research questions guided the study.

1) What are pre-service science teachers' beliefs on ESD?
2) What are the levels of pre-service science teachers' sustainable behaviors?
3) What is the relationship between pre-service science teachers' sustainable behaviors and their beliefs on ESD?

Method

Research Design

Correlational research was used in the present study. Correlational studies investigate the possibility of relationships between only two variables, although investigations of more than two variables are common. The relationships among two or more variables are studied without any attempt to influence them (Frankel, Wallen, & Hyun, 2011).

Sample

A convenience sample of 292 Turkish pre-service science teachers (53 males and 239 females) participated in this study. These participants enrolled in elementary science education departments of two public universities located in Kırsehir and Nevsehir in Turkey. Target population of the study was PSTs from all grade level enrolled voluntarily in these universities in the spring semester of 2016-2017. Demographic characteristics of students participating to this study from these universities were given in Table 1 respectively. These characteristic variables were grade level, age and gender.

Table 1

PSTs' demographic characteristics

Grade level			
1st grade 125 (%42,8)	2nd grade 87 (%29,8)	3rd grade 34 (%11,6)	4th grade 44 (%15,1)
Age			
18-20 171 (%58,6)	21-23 113 (%38,7)	24-26 7 (%2,4)	27 and over 1 (%0,3)
Gender			
Male 53 (%18.2)		Female 237 (%81.2)	

Instrumentation

In this study, data were collected through two different scales developed by Sagdic and Sahin (2015) and Guler and Afacan (2012): Education for Sustainable Development Scale (ESDS) and The Behaviour Scale for Sustainable Environmental Education (BSSEE), respectively. ESDS was administered to assess PSTs' beliefs on ESD and, BSSEE was administrated to assess PSTs' sustainable behaviors.

Education for Sustainable Development Scale (ESDS)

In the present study, ESDS, developed by Sagdic and Sahin (2015), was used to determine PSTs' beliefs on ESD. The scale includes 32 items that use a five-point Likert type ranging from scores '1' to '5'. '1' corresponded to strongly disagree (SD), '2' corresponded to disagree (D), "3" corresponded to undecided (U), "4" corresponded to agree (A) and "5" corresponded to strongly agree (SA). ESDS consists of three sub-dimensions such "*beliefs on implementation of sustainable development*", "*beliefs on limitation of sustainable development*" and "*beliefs on adequacy of ESD in Turkish education system*". In the present study, the scale was examined by two experts studying related to sustainable development education and an expert studying on teacher beliefs in order to be sure about its face and content validity. Confirmatory sub-dimension analysis (X = 937,85, df = 457, p = 0.000; CFI = 0.92, RMSEA = 0.71), discriminant and convergent validity analysis conducted by researchers. Results indicate that beliefs on ESD scale is a valid scale to assess teachers' beliefs.

The Behaviour Scale for Sustainable Environmental Education (BSSEE)

Another measurement tool is "*The Behaviour Scale for Sustainable Environmental Education (BSSEE)"* was developed by Guler and Afacan (2012): to examine PSTs' sustainable behaviors. BSSEE includes 29 items that use is a five-point Likert-type ranging from scores '1' to '5'. '1' corresponded to strongly disagree (SD), '2' corresponded to disagree (D), "3" corresponded to undecided (U), "4" corresponded to agree (A) and "5" corresponded to strongly agree (SA). The scale consisting of three

sub-dimensions such as "*Behaving in an Energy-Saving Way*", "*Following Environmental Publications or Broadcasts and Reacting to People Who Damage the Environment*", "*Using Environmentally-Friendly and Recyclable Products*". Its Cronbach's alpha coefficient is 0.94 which suggests that it is highly reliable (Demirci Guler & Afacan, 2012). The data are regarded suitable for sub-dimension analysis on the condition that the Kaiser- Mayer- Olkin (KMO) value is higher than 0.60 and the Barlett's test yields a significant result (Pallant, 2005). The KMO value conducted by researchers for the scale was found to be 0.960. Furthermore, the Barlett's test yielded a significant result ($\chi 2=10472.162$; df=990; p=0.000). Based on these values, it was suitable to run FA. Afterwards, an exploratory sub-dimension analysis was carried out in order to determine the sub-dimension structure of the scale.

Data Collection

The data were collected within a month in spring semester of 2016-2017 academic year. Before starting to collect data, the necessary permissions to conduct the research and the ethical permission from Ethical Committee were obtained from the two universities. Before the administration of the questionnaires, all participants were given and signed a consent form confirming that they volunteered to participate this study. All the questionnaires were administered by the same researcher to be sure about consistency of procedure of data collection. Each questionnaire took around 20 minutes to complete. The questionnaires were answered in the same lesson.

Data Analysis

Statistical Package for Social Sciences (SPSS) was used to analyze the data. First, descriptive statistics were conducted to assess PSTs' beliefs on ESD and sustainable behaviors. Second, inferential statistics was conducted to explore the relationship between PSTs' sustainable behaviors and their beliefs on ESD. Before performing analysis, assumptions related to inferential statistics including related pairs, homoscedasticity, linearity and outliers assumptions were checked and were found as satisfied.

Results

In below, it was mentioned about the results regarding PSTs' beliefs on ESD, PSTs' sustainable behaviors, and the relationship between PSTs' sustainable behaviors and their beliefs on ESD.

PSTs' beliefs on ESD

PSTs' average scores and standard deviations on *ESDS* were seen in Table 2. According to the descriptive statistics results, the participants scored with beliefs on ESD an average of 3.60.

Table 2

PSTs' scores on ESD scale

ESDS	Mean	Sd	Range
	3.60	.32	1.65-4.42

Three sub-dimensions of ESDS on which PSTs scored from highest to lowest were seen in Table 3.

Table 3.

PSTs' scores on sub-dimensions of ESD scale

Dimension	Mean	Sd	Range
Beliefs on implementation of ESD	4.02	.45	1.50-5.00
Beliefs on adequacy of ESD in Turkish education system	3.12	.82	1.00-5.00
Beliefs on limitations of ESD.	2.66	.69	1.00-4.43

Beliefs on implementation of ESD

Beliefs on implementations of ESD sub-dimension include twenty-one items. These items assess teachers' beliefs on ESD with respect to teaching methods, curriculum and potential benefits (Sağdıc & Sahin, 2016). The mean score of this sub-dimension was found as 4.02 over 5 with the standard deviation of .045. According to the test results, PSTs have favorable beliefs on implementation of ESD.

Beliefs on adequacy of ESD in Turkish education system

Beliefs on adequacy of ESD in Turkish education system sub-dimension includes four items. These items are about beliefs of elementary teachers on the sufficiency of textbook activities, curriculums and teacher trainings in terms of ESD (Sağdıc & Sahin, 2016). The mean score of it is 3.12 over 5 with the standard deviation of .82. These results show that PSTs have moderate beliefs on adequacy of ESD in the Turkish education system.

Beliefs on limitations of ESD

Elementary teachers' beliefs on limitation of ESD were assessed with six items. Items of this sub-dimension focus on difficulties originated from complex nature of ESD (Sağdıc & Sahin, 2016). The mean score of the sub-dimension was found as 2.66 out of 5 and the standard deviation of .69, which referred that the great majority of the PST have moderate beliefs on limitations of ESD .

PSTs' sustainable behaviors

PSTs' average scores and standard deviations on *(BSSEE)* were seen in Table 3. According to the descriptive statistics results, the participants scored with behaviors for sustainable environmental education an average of 3.71.

Table 3.

The Behaviour Scale for Sustainable Behaviours

(BSSEE)	Mean	Sd	Range
	3.71	.39	2.45-4.79

Three sub-dimensions of BSSEE on which PSTs scored from highest to lowest were seen in Table 4.

Table 4.

PSTs' scores on sub-dimensions of Sustainable Behaviours

Dimension	Mean	Sd	Range
Behaving in an Energy-Saving Way	3.83	.37	2.07-4.73
Using Environmentally-Friendly and Recyclable Products	3.48	.62	1.50-5.00
Following Environmental Publications or Broadcasts and Reacting to People Who Damage the Environment	2.66	.69	1.00-4.43

Behaving in an Energy-Saving Way

Behaving in an Energy-Saving Way sub dimension contain 15 behaviour items. The items assess teachers' behaviour of energy-saving. The mean score of 3.83 over 5 with the standard deviation of .37.

Using Environmentally-Friendly and Recyclable Products

Using Environmentally-Friendly and Recyclable Products contain 6 behaviour items. The items in this sub-dimension are all about using sustainable, environmentally friendly and recyclable products. The mean score of 3.48 over 5 with the standard deviation of .62.

Following Environmental Publications or Broadcasts and Reacting to People Who Damage the Environment

Following Environmental Publications or Broadcasts and Reacting to People Who Damage the Environment contain 8 behaviour items. The items in this sub-dimension are all about following environmental publications or broadcasts and reacting to people who damage the environment. The mean score of 2.66 over 5 with the standard deviation of .69.

Investigating PSTs' Sustainable Consumption Behaviors In Terms of Independent Variables

In order to investigate whether there is a significant between male and female, independent sample t-test was performed, while one way ANOVA was performed to see if there is significant difference between grade levels. However, no significant difference was found in terms of gender [$t(174)= .253$, $p>.05$)] and grade levels [$F(3, 174)=1.871$, $p>.05$].

The Relationship between PSTs' Beliefs on ESD and their Sustainable Behaviors

Correlational analysis was performed to investigate the relationship between beliefs on ESD and behaviors for sustainable environmental education. According to the results of this analysis, there is a significant moderate positive correlation between PSTs' beliefs on ESD and behaviors for sustainable environmental education, $r = +0.39$, $n = 292$, $p = 0.00$ (see Table 5).

Table 5

Pearson correlation coefficient (r)

		Total score of ESDS
Total score of BSSEE	Pearson Correlation	+0.391**
	Sig. (2-tailed)	0.000
	N	292

The relationship between PSTs' Beliefs on ESD and Sustainable Behaviours on the basis of sub-dimensions

Correlational analyses were conducted to investigate the relationship between sub-dimensions of ESDS and sub-dimensions of BSSEE. Table 6 shows the Pearson correlation coefficients related to the sub-dimensions of ESDS and sub-dimensions of BSSEE. While small and moderate correlations were found between three sub-dimensions of ESDS and the three sub-dimensions of BSSEE, no statistically significant correlation was found between ESDS sub-dimensions and BSSEE sub-dimensions. The results were discussed below basing on the three BSSEE sub-dimensions.

Table 6

Pearson correlation coefficients related to the sub-dimensions of Beliefs on ESD and Sustainable Behaviours

			BSSEE sub-dimensions		
			1	2	3
			Behaving in an Energy-Saving Way	Following Environmental Publications or Broadcasts and Reacting to People Who Damage the Environment	Using Environmentally-Friendly and Recyclable Products
ESDS sub-dimensions	Beliefs on implementation of ESD	Pearson Correlation Sig. (2-tailed)	-.447(**) .000	.239(**) .000	.265(**) .000
	Beliefs on limitations of ESD	Pearson Correlation Sig. (2-tailed)	-.171(**) .003	.070 .235	.077 .190
	Beliefs on adequacy of ESD in Turkish education system	Pearson Correlation Sig. (2-tailed)	-.104 .077	.126(*) .031	.089 .130

Note: **p < 0.01; * p < 0.05

Behaving in an Energy-Saving Way versus ESDS sub-dimensions

According to the results, there is a moderate negative correlation between the Behaving in an Energy-Saving Way sub-dimension of BSSEE and Beliefs on implementation of ESD sub-dimension of ESDS, r = -0.44, n = 292, p = 0.00.

There is a small negative correlation between Behaving in an Energy-Saving Way sub-dimension of BSSEE and Beliefs on limitations of ESD sub-dimension of ESDS, r = -0.17, n = 292, p = 0.00.

Following Environmental Publications or Broadcasts and Reacting to People Who Damage the Environment versus ESDS sub-dimensions

According to the results, there is a small positive correlation between Following Environmental Publications or Broadcasts and Reacting to People Who Damage the Environment sub-dimension of BSSEE and Beliefs on implementation of ESD sub-dimension of ESDS, r = +0,24, n = 292, p = 0.00. Similarly, There is a small positive correlation between Beliefs on adequacy of ESD in Turkish education system of BSSEE and Beliefs on implementation of ESD sub-dimension of ESDS, r = +0,13, n = 292, p = 0.03.

Using Environmentally-Friendly and Recyclable Products versus ESDS sub-dimensions

According to the results, There is a small positive correlation between Using environmentally-friendly and recyclable products of BSSEE and Beliefs on implementation of ESD sub-dimension of ESDS, r = +0,27, n = 292, p = 0.00.

Discussion

The purpose of this study was to investigate PSTs' beliefs on ESD, sustainable behaviors and relationship between them. This research was carried out in order to investigate the extent to which PSTs are aware of this consciousness, considering the teacher competencies within ESD. Since many environmental problems we face today have great importance in terms of science education. In this study, we can say that PSTs are aware of importance of ESD. In several studies, similar findings were obtained (e.g., Boon, 2011; Corney, 2006; Ko, & Lee, 2003; Sagdic & Sahin, 2016; Summers, Corney, & Childs, 2004). For example, Sagdic and Sahin (2016) assessed Turkish elementary teachers in the context of ESD and found that teachers are regarded ESD as consistent with their own teaching field.

One important issue that is worthy of this research is that implication of the study are in accordance with Turkey's Sustainable Development Report prepared by Ministry of Development (2012). In this report, importance of including sustainability and studies related the topic was stated with following sentence "courses should be prepared and integrated into the curriculum to develop students' sustainable consumption understandings and to increase their environmental awareness". Namely, if we evaluate that pre-service teachers are ready to teach sustainability, the aim of science education can be achieved when they become teachers.

Another important issue that is worthy of this research is that results of the study also have parallels with teacher competencies included in the framework of ESD. Considering teacher competencies all over the world, firstly it can be said that a science teacher should have this awareness to help raise awareness of future generations (UNECE, 2011). Additionally, in many institution or reports, importance of teacher competencies was stated. For instance, a national report prepared in the United States mentions the competencies teachers should have to prepare students for a sustainable future (Washington State OSPI, 2008). In Washington State, it is stated that for a sustainable world, students should be prepared by all teachers as responsible citizens (Washington State OSPI, 2008, p.7). Additionally, ESD is an undeniable necessity of the 21st century and science teachers need to have the competences in the field of ESD to understand social, environmental, economic, cultural multi-dimensional, complex problems and to educate students as decision-makers in the future solution of these problems (Karaarslan, 2016).

One of the aims of the study is to determine levels of pre-service science teachers' sustainable behaviors. We examined awareness stage of the PSTs who has an ecological footprint on nature. In this study, considering results of awareness stage of the PSTs, their sustainable behaviors are at good level. These good results can provide positive contributions to their students when they become teacher. Because science education, which is closely related to the development of technology and science, must therefore be a follower of all scientific events in the world. Although these developments are beneficial to human life, they also cause some damages on the world. These developments, especially the damage to the environment is too high to be underestimated. For example, there are very big companies who manage food production in the world (Karaarslan, 2016), many new agriculture technologies are provided such as pesticide productions, fertilizers, new seed varieties and these technologies form social problems in the world (Meadows, Randers & Behrens, 1972).

Additionally, every individual brings domestic wastes in daily life. Conservation, consumption, the use of energy and waste disposal in the household and travel are behaviors people affect environment in their life. Besides all these events, the damage to the economy and the social structure is very high. For example, during the period from the production stage of a meat process to the consumption stage, the economy also is affected seriously (transportation, freezing, etc.).

One more result obtained in the study is that there is no significantly difference in terms of gender and grade levels. Similarly, no significantly difference was found some studies support this result (e.g., Keles, 2017). Especially, gender may not affect ethical decision making (MORI, 2000; Sikula & Costa, 1994; Tsalikis & Ortis-Buonafina, 1990). On the other hand, in some researches, significant difference were reported in favor of female (e.g., Engels & Jacobson 2007; Goldman, Yavetz & Pe'er 2006; Koos 2011, Şener & Hazer, 2007; Zelezny, Chua, & Aldrich, 2000). For example, in studies conducted by Koos (2011) and Zelezny et al. (2000), females are more concerned about environment than male counterparts, findings of Roberts' (1996) study showed that consumption behaviors performed by females are more responsible than males. In addition, in this study no significant difference was found in terms of gender level, while some studies showed that pre-service science teachers' sustainable consumption behaviors vary significantly depending on grade level (e.g., Keles, 2017). Although Keles (2017) stated that when grade level increase, scores of sustainable consumption behavior also increase because of courses pre-service science teachers take related to environmental education and sustainable development during their education period, this situation can't be effective in all of the educational institutions. Probably, environmental education or education for sustainable development can provide positive attitude or pre-service science teachers' consciousness, knowledge, attitude, and behaviors about sustainable life can change during their education (Keles, 2017). However, in the literature, results of many studies showed there is gap between attitude toward sustainable behavior and performing behavior (e.g., Vermeir & Verbeke, 2006). For example, brand familiarity, convenience, quality and price are still the most important decision criteria for people (Carrigan & Attalla, 2001; Weatherell, Tregear, & Allinson, 2003). Consequently, it is possible that knowledge, consciousness or attitude may not translate behaviors every time.

In the third aim of the study, we examined relationship between PST' beliefs on ESD and their sustainable behaviors and moderate level was obtained between them. This result may appear to constitute a contrast with previous studies or some behavioral theories. But in the present study, direct relationship was searched. In fact, according to many behavioral theories which investigate factors affecting individuals' behaviors, behaviors can be accounted by beliefs indirectly. For example, one of the theories is value belief norm theory (VBN) developed by Stern, Dietz, Abel, Guagnano, & Kalof, (1999) explains many behavioral antecedents of nonactivist environmentalism. This theory links three theories (the New Environmental Paradigm (NEP), value theory, and norm-activation theory) with five variables leading to behavior through a causal chain: personal norms for pro-environmental action, personal values, the New Environmental Paradigm (NEP), awareness of consequences (AC), ascription of responsibility (AR) beliefs related to biophysical environment' general conditions (Stern, 2000). Among variables, NEP, AC and AR consist of belief dimension. Variables involved in the chain affect following variable and this effect may also be reversed. The model describing this relationship for the full understanding of the meaning is shown below in Figure 1. Accordingly, in this theory behaviors are affected by beliefs indirectly through personal norms.

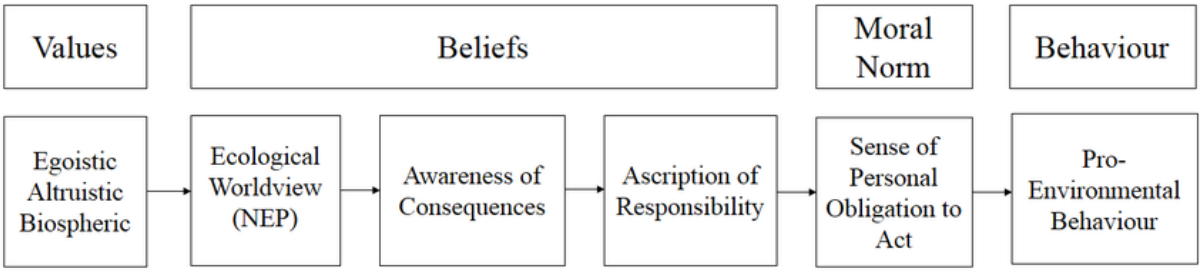

Figure 1. Value-Belief-Norm Theory (adapted from Stern, 2000)

One of the researchers who tested the VBN theory is Steg, Dreijerink and Abrahamse, (2005) who investigated which factors influence the acceptability of energy policies. They collected data with 300 people who live different locations in Groningen in Netherlands. To see relationship between their beliefs and behaviors, regression analysis was performed variables in the chain with preceding variable. As a result, they obtained relationship between beliefs and behaviors indirectly through personal norms explaining like that. Beliefs accounted for 32% of the variance in personal norm and personal norm accounted for 29% of the variance in behaviors.

In further or curriculum studies, similar studies could be conducted since the number of studies is not enough. Besides, researchers can extent this study by using experimental studies. For example, sustainability in higher education can be pointed pedagogically and it should be overemphasized that how students gain this awareness. Additionally, in present study, data were collected by using quantitative research methods. Researchers can extend the study by using qualitative or mixed methods to reach results in detail. At all the education level, the number of courses related to ESD should be increased at science education curriculum. Although we laid emphasis on relationship between science education and ESD, researchers can extend their studies as interdisciplinary approach in education (e.g., Sağdıc & Sahin, 2016).

One more suggestion for future researchers is to determine factors affecting sustainable behaviors affected by some factors such as cultural, social, cognitive and psychological factors (Ajzen & Fishbein 2005; Heimlich & Ardoin 2008). There are a variety of theories or models explaining the factors that affect individuals in their pro-environment behavior. These attempts focused on two major streams: socio-psychological theories and the role of socio demographics (Dietz, Stern, & Guagnano, 1998; Sahin, 2016). Many researches focused on first stream showed consistent effects for age and education, however, it showed less consistent effects in terms of other variables (Van Liere & Dunlap, 1980), while studies of social-psychological constructs such as beliefs, attitudes, and values succeed in terms of predicting pro-environmental behaviors (Boldero, 1995). These are some of the theories or models that fit these streams in literature: Linear model of knowledge-attitude-behaviour, Model of responsible environmental behavior (REB) (Hines, Hungerford, & Tomera, 1987), new environmental paradigm (NEP) (Dunlap, Liere, Van, Mertig, & Jones, 2000), norm activation theory (NAM) (Schwartz, 1977), theory of planned behavior (TPB) Ajzen, 1991), theory of reasoned action (TRA) (Ajzen & Fishbein 1980), and value belief norm theory (VBN) (Stern, 2000). In the next studies, researchers can contribute the literature by testing these theories in the scope of ESD.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I., & Fishbein, M. (2005). The influence of attitudes on behavior. *The handbook of attitudes*, *173* (221), 31.

Ajzen, I., & Fishbein, M.. (1980). *Understanding Attitudes and Predicting Social Behavior*. USA: Prentice-Hall,

Boldero, J. (1995). The prediction of household recycling of newspapers: The role of attitudes, intentions, and situational factors. *Journal of Applied Social Psychology*, *25*(5), 440-462.

Boon, H. (2011). Beliefs and education for sustainability in rural and regional *Australia. Education in Rural Australia, 21*(2009), 37-54.

Brundtland, G. H. (1987). World commission on environment and development: Our common future. *World Commission for Environment and Development*.

Brundtland, H. G. (1985). World Commission on environment and development. *Environmental Policy and Law*, *14*(1), 26-30. https://doi.org/10.1016/S0378-777X(85)80040-8

Burmeister, M., & Eilks, I. (2012). An example of learning about plastics and their evaluation as a contribution to Education for Sustainable Development in secondary school chemistry teaching. *Chemistry Education Research and Practice*, *13*(2), 93-102. doi: 10.1039/c1rp90067f

Büyüköztürk, S. (2003). *Handbook of Factor Analysis for Social Sciences*. (3rd press). Pegema Press, Ankara.

Carrigan, M., & Attalla, A. (2001). The myth of the ethical consumer–do ethics matter in purchase behaviour?. *Journal of consumer marketing*, *18*(7), 560-578.

Chen, M. F. (2015). An examination of the value-belief-norm theory model in predicting pro- environmental behaviour in Taiwan. *Asian Journal of Social Psychology*, *18*(2), 145- 151. https://doi.org/10.1111/ajsp.12096

Corney, G. (2006). Education for sustainable development: An empirical study of the tensions and challenges faced by geography student teachers. *International Research in Geographical and Environmental Education, 15*(3), 224-240.

Council for Environmental Education (1998) *Education for Sustainable Development in the Schools Sector: A Report from the Panel for Education for Sustainable Development,* Reading: Council for Environmental Education

Demirci Güler, M.P. and Ö. Afacan, 2012. A study on developing a behaviour scale towards sustainable environmental education. *Journal of Baltic Science Education*, 11(3), 224-235.

Dietz, T., Stern, P. C., & Guagnano, G. A. (1998). Social structural and social psychological bases of environmental concern . *Environment and Behavior*, *450*(22), 1-17.

Dunlap, R. E., Liere, K. D. Van, Mertig, A. G., & Jones, R. E. (2000). Measuring Endorsement of the New Ecological Paradigm : A Revised NEP Scale. *Journal of Social Issues*, *56*(3), 425-442. https://doi.org/10.1111/0022-4537.00176

Engels, C. A. & Jacobson, S. K. (2007). Evaluating long-term effects of the golden lion tamarian environmental education program in Brazil. *Reports & Research, 38*(3), 3-14.

EPA (2004). *Inventory of US greenhouse gas emissions and sinks*, 1990-2002.

Feng, Z.-H., Zou, L.-L., & Wei, Y.-M. (2011). *The impact of household consumption on energy use and CO2 emissions in China*. *Energy*, *36*(1), 656-670. https://doi.org/10.1016/j.energy.2010.09.049

Ferreira, J. A., Ryan, L., & Tilbury, D. (2006). *Whole-school approaches to sustainability: A review of models for professional development in pre-service*

teacher education. Australian Research Institute in Education for Sustainability (ARIES) for the Australian Government Department of the Environment, Water, Heritage and the Arts. Sydney: ARIES

Fraenkel, J., Wallen, N., & Hyun, H. (2011). *How to Design and Evaluate Research in Education* (8th ed.). New York: McGraw Hill.

Goldman, D., Yavetz, B., & Pe'er, S. (2006). Environmental literacy in teacher training in Israel: Environmental behavior of new students. *The Journal of Environmental Education*, *38*(1), 3-22.

Guangcheng, F. U., & Junyan, D. U. (2010). Low Carbon Lifestyle and Consumer Behavior The Concept of Low-carbon Lifestyle. In *Proceedings of 2010 International Symposium on Low-carbon Economy and Technology Science* (pp. 80-84).

Heimlich, J. E., & Ardoin, N. M. (2008). Understanding behavior to understand behavior change: A literature review. *Environmental education research*, *14*(3), 215-237.

Hickey, R., Whitehouse, H., & Evans, S. (2010). *Preservice teachers' perceptions of sustainability as' professional practice'*. AAEE National Conference committee.

Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1987). Analysis & Synthesis of Research on Responsible Env Behavior. *Journal of Environmental Education*, *18*(2), 1-8.

Intergovernmental Panel on Climate Change (IPCC). (2014). *Fifth assessment report: Climate change 2007*. Cambridge, United Kingdom: Cambridge University Press. Retrieved from http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml.

IPCC, (2007). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Inter- governmental Panel on Climate Change.* Geneva: IPCC.

Karaarslan, G. (2016). *Science Teachers As ESD Educators: An Outdoor ESD Model For Developing Systems Thinking Skills*, PhD Thesis, Middle East Technical University, Institute of Social Sciences, Ankara, Turkey

Keleş, Ö. (2017). Investigation of Pre-Service Science Teachers' Sustainable Consumption Behaviors in Terms of Some Variables. *European Journal of Sustainable Development*, *6*(3), 321-332.

Ko, A., & Lee, J. (2003). Teachers' perceptions of teaching environmental issues within the science curriculum: A Hong Kong perspective. *Journal of Science Education and Technology, 12*(3).

Koos, S. (2011). Varieties of environmental labeling, market structures, and sustainable consumption across Europe: A comparative analysis of organizational and market supply determinants of environmentallabeled goods. *Journal of Consumer Policy, 34*, 127-151.

Living Planet Report. (2014). https://doi.org/ISBN 978-2-940443-37-6

McMichael, A.J., Haines, A., Slooff, R., Kovats, S. (1996). *Climate Change and Human Health. An Assessment by a Task Group on Behalf of the World Health Organization the World Meteorological Organization and the United Nations Environment Pro- gramme*. World Health Organization, Geneva, Switzerland.

Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. (1972). *The limits to growth*. New York: Universe Books.

Ministry of Development (2012). *Turkey's sustainable development plan. Claiming the future.* Ankara: Ministry of Development.

Ministry of Education (Milli Eğitim Bakanlığı) (2013). *İlköğretim Fen ve Teknoloji Dersi (6, 7 ve 8. Sınıflar) Öğretim Programı*. Ankara.

Ministry of Education (Milli Eğitim Bakanlığı) (2017). *Fen Bilimleri Dersi Öğretim Programı, (İlkokul ve Ortaokul 3, 4, 5, 6, 7 ve 8. Sınıflar*). Ankara.

MORI, (2000). "*European attitudes towards corporate social responsibility*". Research for CSR Europe, MORO, London.

Nordlund, A. M., & Garvill, J. (2002). Value Structure Behind Proenvironmental Behavior. *Environment and Behavior*, *34*(6), 740–756. https://doi.org/10.1177/001391602237244

Roberts, J. A. (1996). Will the real socially responsible consumer please step forward? *Business Horizons, 39*, 79-83.

Sagdıç, A. & Şahin, E. (2016). An assessment of Turkish elementary teachers in the context of education for sustainable development. *International Electronic Journal of Environmental Education*, *6*(2), 141-155.

Sağdıç, A., & Şahin, E. (2015). Beliefs on education for sustainable developmnet: Scale development study. *Journal of Kirsehir Education Faculty*, *16*(3), 161-180.

Sahin, E. (2016). Household Energy Conservation From Elementary Science Teacher Candidates' Perspective. *College Student Journal*, *50*(2), 302–313.

Sandell, K., Ohman, J., & Ostman, L. (2005). *Education for sustainable development: Nature, school and democracy*. Lund, Sweden: Studentlitteratur

Schipper, L., Bartlett, S., Hawk, D., & Vine, E. (1989). Linking Life-Styles And Energy Use: A Matter Of Time. *Annual Review of Energy and the Environment*, *14*(1), 273–320. https://doi.org/10.1146/annurev.energy.14.1.273

Schwartz, S.H. 1977. *Normative influence on altruism. In Advances in experimental psychol- ogy*, (10. ed). L. Berkowitz, 222–75, New York, NY: Academic Press.

Sener, A. & Hazer, O. (2008). Values and sustainable consumption behaviour of women: a Turkish sample. *Sustainable Development, 16*(5), 291-300.

Sikula, A. and A.D. Costa (1994). "Are Women more Ethical then Men", *Journal of Business Ethics, 13*(11), 859-871.

Skamp, K., Boyes, E., & Stanisstreet, M. (2013). Beliefs and Willingness to Act About Global Warming : Where to Focus Science Pedagogy? *Science Education*, *97*(2), 191–217. https://doi.org/10.1002/sce.21050

Steele F. (2010). *Mainstreaming education for sustainability in teacher education: Enablers and constraints* . Canberra, Australia : Australian Research Institute in Education for Sustainability .

Steg, L., Dreijerink, L., & Abrahamse, W. (2005). Factors influencing the acceptability of energy policies: A test of VBN theory. *Journal of Environmental Psychology*, *25*(4), 415–425. https://doi.org/10.1016/j.jenvp.2005.08.003

Stern, P. C. (2000). Toward a Coherent Theory of Environmentally Significant Behavior. *Journal of Social Issues*, *56*(3), 407–424. https://doi.org/10.1111/0022-4537.00175

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., & Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human Ecology Review*, *6*(2), 81–97. https://doi.org/10.2307/2083693

Stratton, S., Hagevik, R., Feldman, A., & Bloom, M. (Eds.). (2015). *Educating science teachers for sustainability*. Springer.

Summers, M., Childs, A., & Corney, G. (2005). Education for sustainable development in initial teacher training: issues for interdisciplinary collaboration. *Environmental Education Research, 11*(5), 623–647.

Summers, M., Corney, G., & Childs, A. (2004). Student teachers' conceptions of sustainable development: the starting-points of geographers and scientists. *Educational Research, 46*(2), 163–182.

Tsalikis, J. and M. Ortiz-Buonafina, (1990). "Ethical Beliefs' Differences of Males and Females", *Journal of Business Ethics, 9*(6), 509-517.

UNECE (2011). Learning for the future. Competences in education for sustainable development. Retrieved from

http://www.unece.org.unecedev.colo.iway.ch/fileadmin/DAM/env/esd/01_Typo3site/ExpertGroupCompetences.pdf

UNEP. (2007). Global Environment Outlook (GEO 4): Environment for Development. UNEP (United Nations Environment Programme): Valletta.

UNESCO (1997). Thessaloniki Declaration. Gland: UNESCO.

UNESCO. (2006). United Nations decade of education for sustainable development 2005-2014, UNESCO. International implementation scheme. Paris, France: UNESCO

United Nations Framework Convention on Climate Change (UNFCCC), 1992. Rio de Janeiro, Brazil.

United Nations General Assembly. Transforming our world: the 2030 Agenda for Sustainable Development. New York: United Nations, 2015. http://www.un.org/ga/search/view_doc. asp?symbol=A/RES/70/1&Lang=E (accessed Aug 1, 2016).

United Nations. Sustainable Development Goals. New York: United Nations, 2015. http://www.un.org/sustainabledevelopment/ summit/ (accessed Sept 11, 2015)

Van Liere, K. D., & R. E. Dunlap (1980). The social bases of environmental concern: A review of hypotheses, explanations, and empirical evidence. *Public Opinion Quarterly 44,* 181-197.

Vermeir, I., & Verbeke, W. (2006). Sustainable food consumption: Exploring the consumer "attitude-behavioral intention" gap. *Journal of Agricultural and Environmental ethics*, *19*(2), 169-194.

Wals, A. E. J. (2011). Learning our way to sustainability. *Journal of Education for Sustainable Development, 5*(2), 177-186.

Washington State OSPI (2008). *Report on environmental and sustainability education. Standards for Washington state students*. Retrieved from http://www.k12.wa.us/EnvironmentSustainability/pubdocs/ESEStandardsReportFTF06-30-08.pdf.

Weatherell, C., Tregear, A., & Allinson, J. (2003). In search of the concerned consumer: UK public perceptions of food, farming and buying local. *Journal of rural studies*, *19*(2), 233-244.

Winter, C., & Firth, R. (2007). Knowledge about education for sustainable development: Four case studies of student teachers in English secondary schools. *Journal of Education for Teaching, 33*(3), 341-358.

Wu, X., Lu, Y., Zhou, S., Chen, L., & Xu, B. (2016). Impact of climate change on human infectious diseases: Empirical evidence and human adaptation. *Environment International*, *86*, 14-23. https://doi.org/10.1016/j.envint.2015.09.007

Zachariou, A., & Valanides, N. (2006). Education for sustainable development: The impact of an out-door program on student teachers. *Science education international, 17*(3), 187-203.

Zelezny, L. C., Chua, P.-P. & Aldrich, C. (2000). Elaborating on gender differences in environmentalism. *Journal of Social Issues, 56*, 443-457.

International Electronic Journal of Environmental Education
Vol.8, Issue 2, 2018, 105-122
RESEARCH ARTICLE

Fen Bilgisi Öğretmen Adaylarının Sürdürülebilir Kalkınma İnançlarının ve Davranışlarının Belirlenmesi

Hüseyin ATEŞ*,
Ahi Evran University, Kırşehir, TURKEY

Kibar Sungur GÜL
Nevşehir Hacıbektaş University, Nevşehir, TURKEY

Özet

Açlık, obezite, sağlıksızlık, temiz su ve doğadaki biyolojik çeşitliliğin yok edilmesi gibi sürdürülebilirlik sorunları bu yüzyılda artmıştır. Tüm dünyada, toplantılar, paneller ve zirveler düzenlenmektedir; Bu alanda uzman olan araştırmacılar yıllardır bu sorunların üstesinden gelmenin yollarını araştırmaktadırlar. Son zamanlarda, özellikle sürdürülebilir kalkınma eğitiminin önemi 1992'de Rio'da düzenlenmiş Sürdürülebilir Kalkınma için Eğitim Paneli veya Selanik Deklarasyonu gibi bazı raporlarda dikkat çekmiştir ve bir çok çalışma bu alana odaklanmıştır. Bu sorunların üstesinden gelmek için, birçok araştırmada, sorunlara yol açan temel nedenlerin belirlenmesi üzerine çalışılması gerektiği belirtilmiştir. Ancak, Öğretmenler genellikle sürdürülebilir gelişmenin soyut ve kavramsallaştırılması zor olduğunu kabul etmişlerdir. Özellikle fen eğitiminde sürdürülebilir kalkınma bilinci önemli rol oynamaktadır. Fen bilgisi öğretmenleri veya yakın gelecekte öğretmenlik yapacak olan fen bilgisi öğretmen adayları, bu tip zorlukların üstesinden gelebilmek adına profesyonel destek yoluyla gerekli yeterliliğe sahip olmalıdır. Sonuç olarak, bu araştırmada, fen bilgisi öğretmen adaylarının sürdürülebilir kalkınma inançlarının ve davranışlarının belirlenmesi amaçlanmıştır. Araştırmanın sonuçları, fen bilgisi öğretmen adaylarının sürdürülebilir kalkınma eğitiminin öneminin farkında olduklarını ve sürdürülebilir davranışlarının iyi düzeyde olduğunu göstermiştir. Ayrıca inanç ve davranışları arasındaki ilişkinin orta düzeyde olduğu bulunmuştur.

Anahtar Kelimeler: Sürdürülebilir Kalkınma Eğitimi, Sürdürülebilir Davranış, Fen Bilgisi Eğitimi

ISSN: 2146-0329
***E-mail:** huseyinates_38@hotmail.com
**** A part of this study was presented in II. International Congress Students Engagement in School: Perspectives of Psychology and Education – Motivation for Academic Performance hold in Lisbon/Portugal between 11th and 13th of July 2016.**