IDENTIFYING DETERMINANTS OF PRO-ENVIRONMENTAL BEHAVIORS: A CASE FOR CLIMATE CHANGE

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Approval of the Graduate School of Social Sciences

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ABSTRACT

IDENTIFYING DETERMINANTS OF PRO-ENVIRONMENTAL BEHAVIOURS: A CASE FOR CLIMATE CHANGE

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The aim of the present study is in twofold: (1) to explore pre-service science teacher's knowledge about climate change, environmental attitudes (ecocentric and anthropocentric), epistemic beliefs regarding climate change, uncertainty beliefs about the reality of anthropogenic climate change and pro-environmental behaviors towards climate change and (2) to investigate the significant determinants of pro-environmental behaviors towards climate change. Data collected from 1277 pre-service science teachers through knowledge and confidence in one's knowledge about climate change scale, environmental attitude (ecocentric and anthropocentric) scale, topic specific epistemic beliefs scale, uncertainty beliefs scale and pro-environmental behavior scale and analyzed using path analysis.

Results indicated that ecocentric and anthropocentric attitudes, epistemic beliefs regarding climate change and uncertainty beliefs about the reality of anthropogenic climate change significantly predict pre-service science teachers' pro-environmental behavior towards climate change. However, knowledge about climate

change was not found to significantly predictor of pro-environmental behavior among pre-service science teachers.

Keywords: Knowledge, Confidence, Climate Change, Environmental Attitudes, Scepticism, Epistemic Beliefs, Environmental Education, Behavior.

ÖZ

FEN BİLİMLERİ ÖĞRETMEN ADAYLARININ ÇEVRE DOSTU DAVRANIŞLARININ BELİERLENMESİ: İKLİM DEĞİŞİKLİĞİ ÖRNEĞİ

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Bu çalışmanın amacı fen bilimleri öğretmen adaylarının iklim değişikliği hakkındaki bilgi ve bilgiye duydukları güvenin, çevreye yönelik tutumlarının, iklim değişikliğine dair epistemik inançlarının, insan kaynaklı iklim değişikliği hakkındaki belirsizlik inançlarının ve iklim değişikliğine yönelik çevre dostu davranışlarının araştırılması ve çevre dostu davranışlarının belirleyicilerini araştırmaktır. Çalışmanın değişkenlerini değerlendirmek için bilgi ve bilgiye duyulan güven anketi, çevreye yönelik tutum anketi, iklim değişikliğine ilişkin epistemik inançlar anketi, insan kaynaklı iklim değişikliği hakkındaki belirsizlik inançları anketi ve çevre dostu davranış anketleri 1277 fen bilgisi öğretmeniyle uygulanmıştır.

Çalışma sonucunda, fen bilgisi öğretmen adaylarının çevreye yönelik tutumlarının, iklim değişikliğine ilişkin epistemik inançlarının ve insan kaynaklı iklim değişikliği hakkındaki belirsizlik inançlarının çevre dostu davranışlarını istatiksel olarak anlamlı bir şekilde yordadığı bulunmuştur. Fakat bu öğretmen

adaylarının iklim değişikliği hakkındaki bilgilerinin çevre dostu davranışlarının önemli bir belirleyici olduğu bulunamamıştır.

Anahtar Kelimeler: Bilgi, Güven, İklim Değişikliği, Çevreye Yönelik Tutumlar, Belirsizlik, Epistemik İnançlar, Çevre Eğitimi, Davranış.

To My Parents

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CHAPTER 1

INTRODUCTION

For many years, although human beings have been facing serious environmental problems such as climate change, global warming, loss of biodiversity, air pollution, drought and water pollution, they show neither environmental responsible behaviors nor concern about environmental problems (World Commission On Environment And Development, [WCED] 1987). However, many of the researchers agreed that human actions and behaviors are playing serious roles in occurrence of such environmental problems (Dunlap, Van Liere, Mertig & Jones, 2000; Nordlund & Garvill 2002; Oskamp 2000; Schultz, Gouveia, Cameron, Tankha, Schmuck & Franěk, 2005). Climate change, among others, has been emerged as a major issue nowadays. It, in fact, occurs not only as a result of human actions, such as burning of fossil fuels and deforestation, but also as a consequence of natural processes, including volcanic factors and climatic trends (The Intergovernmental Panel on Climate Change, [IPCC] 2007). The document also reported that climate changes could have an influence on regional albedo, hydrology, and biogeochemical cycles (IPCC, 2007) as well as alter precipitation patterns, regional temperatures and more broadly the Earth's climate. According to another document (Environmental Protection Agency, [EPA] 2008), consensus of scientific evidences showed that climate change is a significant problem for humans and their wider environment, such as extreme weather conditions, rising sea levels, flooding and droughts, eventually threat the human health and life (IPCC, 2001).

Apart from, changes in the Earth's climate could have a multitude of socioeconomic impacts that can influence on people, societies and businesses at regional to global scales as well (IPCC, 2001). It was reported that melting ice leads to rising sea levels, influencing the all planet (IPCC, 2007). Moreover, sea levels will rise as the atmosphere warms and warm water expands. While sea level persists to rise, storm and flooding will pose threat for freshwater sources, coastal places and buildings (IPCC, 2007). People, who live in vulnerable areas to coastal storms, sea

level rise and drought, might be influenced by climate change (United Nations Development Programs [UNDP], 2010). In a similar way, some types of professions and industries such as outdoor tourism and agriculture would likely be influenced by climate change.

In addition, climate change has arisen over the last decade as a significant issue of globally social and political arena (Whitmarsh, 2011). This issue entered to political arena by key figures in the late 1980s, (e.g., Thatcher, 1988) and by the collaborative accession of both scientific and political representatives in the last generation of the IPCC's reports. Scientific and political consensus was convinced that climate change was seen as a major environmental problem and needed to be dealt with impacts of climate change on human and ecological life. Given scientific evidence that climate change involves major impacts on humans and is caused primarily by human activities, policy-makers have been faced with the imperative to act in terms of both adaptation to the already unavoidable impacts and mitigation to prevent more detrimental impacts (Environment Agency, 2001; IPCC, 2001).

Therefore, it was crucial that public should learn more about climate change to comprehend the causes and effects of changing climate. At this point, environmental education had an important role in both spreading of information about climate change and increasing of awareness of causes and effects among public (Wibeck, 2014). As mentioned in UNESCO, (2013; p. 11) "Education is an essential element of the global response to climate change. It helps young people understand and address the impact of global warming, encourages changes in their attitudes and behavior and helps them adapt to climate change related trends". In fact, climate change is a topic that has already been integrated in the science curricula or science education of some countries (e.g. Australia, United Kingdom). Some adaptations programs (Climate Change Adaptation Program [CCAP], 2014; Clean Air Agenda [CAA], 2011) also have been recommended to engage in climate change (United Nations Development Programs [UNDP], 2010). One of the recommendations was education for sustainable development which has been asserted to make a major support to cope with the challenges to mitigate effects of climate change (Wibeck, 2014). Education for sustainable development proposed raising awareness, obtaining new perspectives, values, knowledge, and skills, and formal and informal processes causing changed behavior in support of mitigation of climate change (Læssøe, Schnack, Breiting & Rolls, 2009).

However, although climate change has appeared over the past two decades as an important issue of global political and social significance, curriculum developers in Turkey did not give necessary importance to climate change in curriculums for students and teacher education curriculum (Ünlü, Sever & Akpınar, 2011). On the other hand, Turkish Climate Change Action Plan (2012) aimed to enhance discussions about adaptation of climate change and certificate programs about climate change in universities, incorporating courses about climate change at undergraduate and graduate curriculum and encouragement of graduate programs. Environmental issues like climate change are increasingly becoming part of science curricula, including Turkey (Lambert & Bleicher, 2013; Ministry of National Education [MoNE] 2005, 2013). Social responsibility for the environment has taken an important place in science education (Shepardson, Niyogi, Choi & Charusombat, 2011). Environmental education can be seen as the bridge between science education and social responsibility and is considered as one of the most important factors for preventing environmental problems (Wibeck, 2014). The underlying idea is that students who know more about the environment have a positive attitude toward it and are likely to behave in an environmentally responsible manner (Kuhlemeier, Van Den Bergh & Lagerweij 1999)

In accordance with the reform movements around the world, science education reforms in Turkey have supported the environmental conservation (MoNE, 2005, 2013). Accordingly, environmental education was integrated into previously developed science curricula and supported by informal education. Some environmental subjects, such as sustainable development, conservation behavior, climate change, recycling, water pollution, deforestation, ozone layer depletion, global warming, renewable and non-renewable energy sources, and biodiversity, are included in the previously developed curricula in attempt to raise environmentally informed individuals who will show pro-environmental behavior (MoNE, 2013). Environmental education intends to improve environmentally literate citizens who have the essential skills and concerns to tackle challenges and to take pro-environmental behavior towards environment (Hungerford & Peyton, 1976; UNESCO, 1980; Roth, 1992; MoNE, 2013).

To overcome the diverse effects of climate change, communicators, policy-makers and researchers meet a numbers of challenges to improve public awareness and stimulate pro-environmental behavior towards climate change (Lorenzoni, Cole

& Whitmarsh, 2007). Accordingly, several theories or models have been proposed in attempt to determine factors influencing individuals' pro-environmental behavior. Among them are the theory of reasoned action (TRA, Ajzen & Fishbein 1980), the theory of planned behavior (TPB, Ajzen, 1991), Schwartz's norm activation theory (NAM; Schwartz, 1977) the value belief norm theory (VBN; Stern, Dietz, Abel, Guagnano & Kalof, 1999) and Hines, Hungerford and Tomera' (1986) model of responsible environmental behavior.

For example, Ajzen and Fishbein's (1980) Theory of Reasoned Action posits that an individual's intention to perform (or not to perform) a behavior is the immediate determinant of that action (Ajzen, 1985) and demonstrates how attitudes towards an issue may be mediated into behavioral intentions and behavioral change (Ajzen & Fishbein, 1973). The theory takes into account individuals' beliefs and value systems about the potential behavioral change, and also the others' beliefs that individual should or should not act in the potential behavior (Ajzen & Fishbein, 1977). The TRA holds that personal beliefs about behavioral outcomes and personal evaluations of behavior outcomes decide the personal attitudes to the behavior and links attitudes and behavioral outcome by inserting the construct of intentions, and intentions directly lead to behavior. Another influencing theory is Ajzen's theory of planned behavior (Ajzen, 1985; 1991). It is an extension of TRA. Person's intention to do a particular behavior is a fundamental factor in the TPB. There are three conceptually independent predictors of behavioral intention known as the attitude toward the behavior, subjective norm and perceived behavioral control (Ajzen, 1985). It is stated as a general rule that the more favorable the attitude and subjective norm and the greater the perceived behavioral control, the stronger should be a person's intention to engage in a given behavior (Ajzen, 1985). The TPB also assumes that perceived behavioral control, in company with behavioral intention, can be utilized directly to predict behavioral achievement (Ajzen, 1991). Contrary to TRA, TPB includes perceived behavioral control refers to an individual's belief as to how hard it can be to realize the behavior (Ajzen, 1991).

Another theory, known as norm activation model (NAM), proposed by Schwartz and colleagues (Schwartz, 1977; Schwartz & Howard, 1981) to explain the relationship between moral norms and overt behavior. Pro-social behavior is expected to follow from personal norms (PN) reflecting 'feelings of moral obligation to perform or refrain from specific actions' (Schwartz & Howard, 1981, p. 191).

According to Schwartz (1977), PN are activated by four key situational variables. First, problem awareness (PA), which is defined as the extent to which someone, is aware of the adverse consequences of not acting pro-socially for others or for other things one values. Schwartz (1977) labeled this variable as awareness of need. Secondly, ascription of responsibility (AR) was reflecting feelings of responsibility for the negative consequences of not acting pro-socially. Third, outcome efficacy (OE) defined as the identification of actions to relieve the needs of others or things one values. Fourth, one should recognize own ability to provide relief. In the absence of PA, AR, OE and own ability, individuals will not carry out action because they are faced with moral norms and thus moral norms will not affect their behavior (Schwartz, 1977). Moral norms mediates the effects of PA, AR, OE and own ability on behavior (Van Liere & Dunlap, 1978).

As an extension of NAM, value-belief-norm theory (Stern, 2000) was proposed in attempt to explain how the conjunction of values, beliefs, personal norms stimulates individuals to act in pro-social behavior. In contrast to NAM, VBN theory links value theory, NAM theory and new environmental paradigm (NEP) with behavior (Schwartz, 1992, 1994; Stern & Dietz, 1994). In this theory, environmental concern is associated with egoistic and biospheric as well as social-altruistic value orientations. VBN theory links value theory, norm-activation theory, and NEP perspective through a causal chain of five variables leading to behavior: personal values (especially altruistic values), NEP, AC and AR beliefs about general conditions in the biophysical environment, and personal norms for pro-environmental action (Stern, 1999). Personal moral norms are the main basis for individuals' general predisposition to pro-environmental action. Personal norms are influenced by values, NEP, AC and AR beliefs (Stern, 2000). VBN theory proposes that AC and AR beliefs are dependent to NEP and value orientations (Stern, Dietz & Kalof, 1993). The different value orientations influence on people's awareness about environmental problems and pro-environmental behavior towards environment problems (De Groot & Steg, 2008). Having different value about environment issues cause differently acting towards environment. Stern and his colleagues' value-belief-norm theory advised that there are three value orientations in terms of egoistic, individual who preserve the environment because of concerning for herself or himself, biocentric, individual who protect the environment because of concerning all living things and also social-altruistic, person who protect the environment

because of concerning other people (Stern, 2000). Shortly, according to theory personal factors, such as personal values, NEP, AC, AR beliefs and moral norms shape pro-environmental behaviors towards environment issues (Stern, 1999).

Hines, Hungerford and Tomera (1986) and Hungerford and Volk (1990), have recommend that pro-environmental behavior is the current goal of environmental education. Although large amount of information exists about environmental behavior, it is not clear which variable or variables predict most influentially in motivating individuals to take responsible environmental action (Hines et al., 1986/87). The "Hines Model of Responsible Environmental Behavior" (Hines et al., 1986/87) along with the "Major and Minor Variables Involved in Environmentally Responsible Behavior" (Hungerford & Volk, 1990) are often cited as fundamental to understanding influences on citizenship behaviors during the educational process. Hines, Hungerford and Tomera's (1986) model proposed that knowledge of issues, knowledge of action strategies, locus of control, attitudes, verbal commitment, and individual's sense of responsibility were associated with environmental responsible behavior.

Related literature mentioned that some types of beliefs about of environmental issues may also determine whether individual act pro-environmentally for example, Uncertainty beliefs about environmental issues (Whitmarsh, 2011) and epistemic beliefs towards climate change (Bråten, Gil, Strømsø, Vidal-Abarca, 2009) have been reported to have an influence on whether people engage in environmental issues, including climate change. Bråten et al. (2009) found that epistemological beliefs towards climate change significantly and positively influenced on knowledge about climate change and interest to climate change. In other words, if individuals reported high level of knowledge and personal tendency to engage in climate change, they also would be more likely to think that knowledge about climate change should be tentative, complex, compared with multiple sources and personally constructed (Braten et al., 2009).

To sum up, the literature review on the determinants of an individual's pro-environmental behavior demonstrated that it is necessary to evaluate existing environmental attitudes, behavioral intentions, knowledge, uncertainty beliefs about climate change and epistemic beliefs to comprehend the relationship between these predictor variables and environmental behavior through environmental education.

The current study focus on two beliefs assumed to be associated with climate change; uncertainty beliefs and epistemic beliefs towards climate change.

Briefly, the literature on understanding of climate change demonstrated common awareness of the issue and a general concern, but limited behavioral response to climate change (Sever, 2013; The World Bank's World Development Report, [WDR] 2010; Kempton, 1997; Poortinga et al., 2011; Kollmuss & Agyeman, 2002). In line with these findings, utilizing knowledge about climate change, environmental attitudes (ecocentric & anthropocentric), epistemic beliefs regarding climate change and uncertainty beliefs about anthropocentric climate change, current study proposed a conceptual model in attempt to uncover probable predictors of pre-service science pro-environmental behavior toward climate change (see Figure 1.1). This model could be considered as a first attempt to illuminate the complex nature of pro-environmental behavior toward climate change by extending prior collaborates. The following structural model illustrated the assumed relationships among the constructs, based on the theoretical and empirical evidences gathered from the results of the previous studies. According to the current model, it was proposed that pre-service science teachers' knowledge about climate change would contribute to their environmental attitudes, epistemic beliefs regarding climate change, uncertainty beliefs regarding climate change and pro-environmental behavior towards climate change directly. In addition, knowledge about climate change would have indirect effects on epistemic beliefs about climate change through environmental attitudes; on uncertainty beliefs about climate change through environmental attitudes and epistemic beliefs; on pro-environmental behavior through environmental attitudes, epistemic beliefs and uncertainty beliefs. In particular, it was proposed that pre-service science teachers' environmental attitudes would be linked to their epistemic beliefs regarding climate change, uncertainty beliefs regarding climate change and pro-environmental behavior towards climate change directly. Environmental attitudes also would have indirect effect on uncertainty beliefs about climate change through epistemic beliefs and on pro-environmental behavior through epistemic beliefs and uncertainty beliefs. Then, epistemic beliefs were expected to be linked to uncertainty beliefs towards climate change and pro-environmental behavior directly. Epistemic beliefs about climate change moreover would have indirect effect on pro-environmental behavior through uncertainty beliefs. In addition, uncertainty beliefs regarding climate change would be liked to pro-environmental behavior towards

climate change directly. Thus, the current study illuminated to major predictors in creating pro-environmental behavior model associated with climate change issue while investigating prospective science teachers' knowledge and uncertainty beliefs about anthropogenic climate change and the complicated structure of their pro-environmental behaviors.

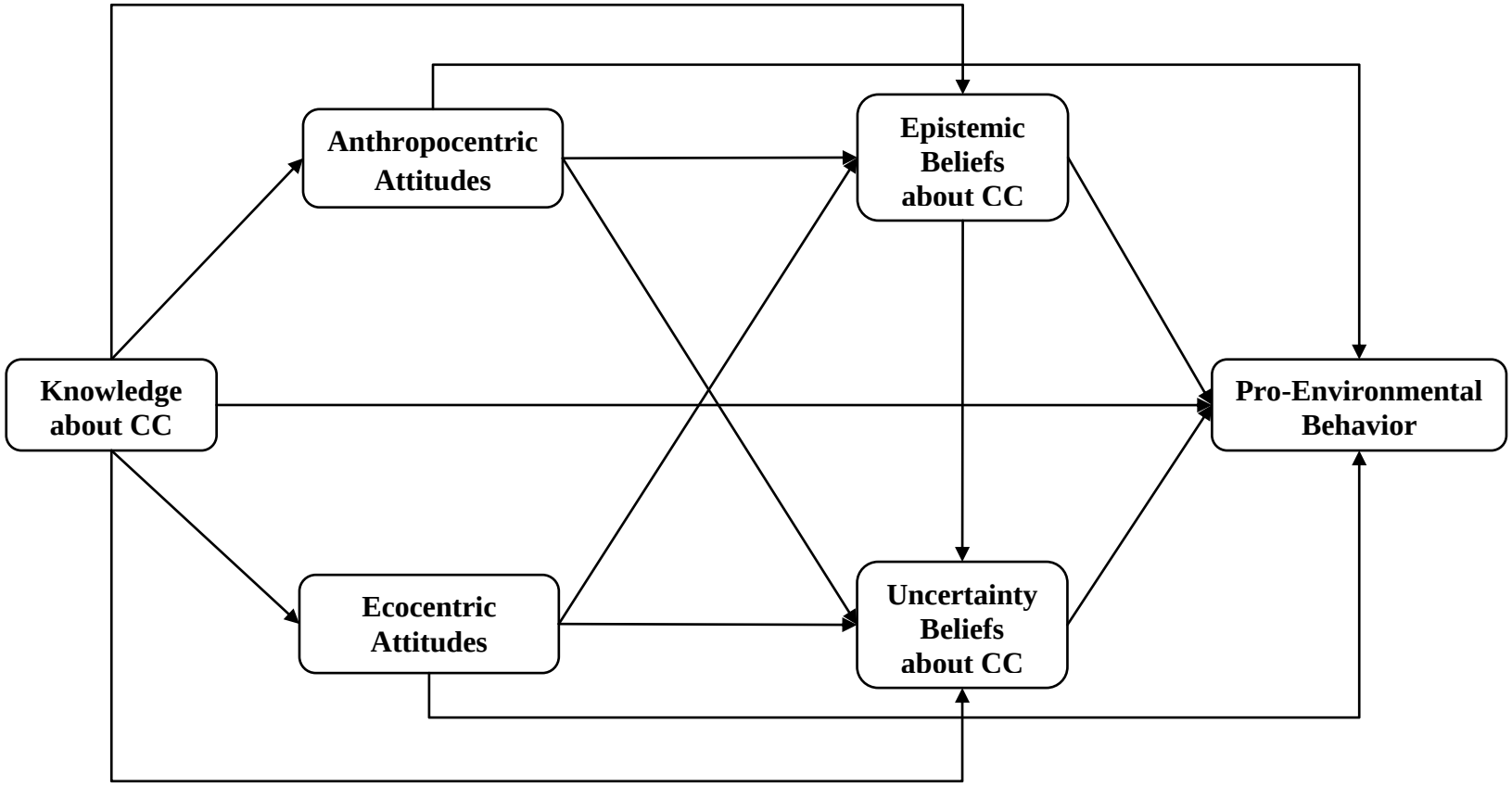

Figure 1.1 Proposed Model for pro-environmental behavior regarding climate change and related variables.

1.1. Research Questions

In this study, we sought to investigate the following main research question:

(1) How do the pre-service science teachers conceptualize 'climate change'?

(2) What are pre-service science teachers' environmental attitudes, knowledge and confidence in their knowledge about climate change, uncertainty beliefs about climate change, epistemic beliefs regarding climate change and pro-environmental behavior?

(3) How environment-related attributes (environmental attitudes, climate change knowledge, epistemic beliefs regarding climate change and uncertainty beliefs regarding climate change) influence pre-service science teachers' pro-environmental behaviors?

(4) What is the nature of direct and indirect relations among the underlying dimensions of prospective science teachers' knowledge about climate change, environmental attitudes, epistemic beliefs about climate change, uncertainty beliefs about climate change, and pro-environmental behavior?

1. 2. Significance of the study

Motivation of this research was coming from that climate change is, in any cases, poses a dangerous risk to human beings and their environment. However, climate change was a particularly complex and necessarily inter-disciplinary area of science in which traditional scientific assumptions of certainty and prediction are fundamentally challenged (Houghton, 2004). Moreover, climate change was not simply a scientific issue; it is an essentially cultural, political, social and moral one. The reasons, effects and solutions could not be isolated from public and human economies, their personal values and lifestyles (Poortinga & Pidgeon, 2003). Thus, uncovering the antecedents' of pre-service science teachers' pro-environmental behaviors regarding climate change will help not only science educators, but also politicians and municipalities gain an overview of current situation, and in this regard, it could be considered as a good starting point to take steps for mitigating the adverse effect of climate change by behaving an environmentally responsible manner.

Science education could play a significant role in improving understanding of the scientific process about environmental problems such as climate change (Lorenzoni et al., 2007). Accordingly, it was necessary to support the need for

educating younger generation about environmental issues. Long-term and deeply-rooted social change for sustainability could be improved progressively through education forming community values and environmental citizenship (Dobson, 2003). Consequently, pro-environmental behavior regarding climate change was one of the important thresholds of sustainable development especially in developing countries where comprehensive studies about pro-environmental behavior regarding climate change have not been observed (IPCC, 2007). Uncovering pre-service science teachers' value orientations and general beliefs about climate change could provide information about the existing situation, and also strengthen the efforts to promote environmentally literate teachers in Turkey. Explanation of pro-environmental behavior towards climate change for identified population can be considered as a first step in the modeling pro-environmental behavior towards climate change of people living in Turkey. In this aspect, the findings of present study could help educators and policy-makers better communicate for climate change. The results to be obtained from the study are expected to shed light on the theoretical and practical work in the field. Considering the interdisciplinary nature of climate change, adapted climate change survey could be applied to university students who study at different branches. The instrument used in the study allowed the examination of a variety of components of pro-environmental attributes towards climate change including climate change knowledge and one's confidence in own knowledge about climate change, environmental attitudes, epistemic beliefs regarding climate change, uncertainty beliefs regarding climate change and pro-environmental behavior towards climate change.

As previously mentioned, related literature on understanding of climate change demonstrated only common awareness of the issue and a general concern, but limited behavioral response to climate change (Sever, 2013; WDR, 2010; Kempton, 1997; Poortinga et al., 2011; Kollmuss & Agyeman, 2002). The current study, also aimed to fill this gap by clarifying factors influencing engagement in climate change. For example, if the changes in weather trends are any indication of climate change, the rising of average temperature all over the world will keep on; therefore, people will need to either adapt to or mitigate the impact of climate change Both behaviors (adaptation or mitigation) would needs individuals to act in environmentally responsible manner (Braun, 2012). However, there has been still lack of clear understanding of what contributes certain behaviors or how to influence behavior

(Kollmuss & Agyeman, 2002). Knowledge, beliefs and attitudes towards climate change are reported as crucial determinants of their pre-environmental behavior regarding climate change (Whitmarsh, 2005) and especially teachers' acceptance or rejection of climate change clearly influences the treatment of climate change in their instructional practice (Lambert & Bleicher, 2013). The data collected from current study would contribute to future discussion and decision-making about climate change by providing an insight into pre-service science teachers' understanding and response to the issue.

Moreover, for over a decade, researchers have studied generally on the public's understanding of climate change, (e.g. Etkin & Ho, 2007; Seacrest, Kuzelka & Leonard, 2000; Sterman & Sweeney, 2002, 2007), attitudes to various action strategies (e.g. Ohe & Ikeda, 2005) and barriers to public engagement in climate change (e.g. Lorenzoni, Nicholson-Cole & Whitmarsh, 2007). Findings from such studies have informed not only researchers in the area of environmental education, but also provide valuable information for science communication, and climate communication campaigns organized by states agencies, NGOs and the European Union (Wibeck, 2014).

Besides, for over 30 years, the level of public awareness and knowledge of the causes and effects of climate change have been improved in many countries, same increase in the public's behaviors and lifestyles towards climate change have not been observed (e.g. Whitmarsh, Seyfang & O'Neill, 2011). According to Kollmuss and Agyeman, (2002) proposed models of pro-environmental behavior neither well explain the specific type of behavior nor did they clarify the temporal aspect of most action. Kollmuss and Agyeman (2002) stated that this might be the underlying reason of *mind-behavior* gap. In line with this view, the current study may provide a new perspective regarding the mind-behavior gap.

The value of this research would be in offering practical support for trainer of science teachers and policy-makers in education area to understand the attitudes, beliefs and knowledge of science teachers in the issue of climate change and thus, develop applicable mitigation policies as well as education programs including sustainable development.

1. 3. Definition of Important Terms

Climate change: "A regional change in temperature and weather patterns. Current science indicates a link between climate change over the last century and human activity, specifically the burning of fossil fuels" (U.S. EPA, 2008, p. 19).

Pro-environmental behavior: It means "In order to combat the adverse effects of climate change pro-environmental behavior minimizes negative human-caused impacts on the environment" (Stern 2006, p. 326).

Ecocentric Attitudes: Ecocentric individuals value nature for its own sake and therefore, judge that nature deserves protection because of its intrinsic value (Thompson & Barton, 1994).

Anthropocentric Attitudes: The person having anthropocentrism (social-altruistic) environmental attitudes protect environment because of the long-term consequences it may have on other people (Schultz & Zelezny, 1999).

Environmental attitude: Attitude refers to set of values and feelings of concern for the environment and motivation for actively participating in environment improvement and protection (UNESCO, 1977).

Knowledge about climate change: It was composed of information about state, causes and consequences of climate change (Sundblad, Biel & Gärling, 2009).

Confidence in knowledge about climate change: It is the accuracy of our beliefs about own knowledge about climate change (Sundblad, Biel & Gärling, 2009).

Epistemic belief: The understanding about the nature of knowledge and knowing but not views about the nature of learning (Schommer & Easter, 2006).

Epistemic belief regarding climate change: Beliefs concerning knowledge and knowing about climate change (Braten et al, 2009).

Uncertainty beliefs about climate change: It is scepticism in individual's attitude towards climate change is seen as an important barrier to individual engagement (Corner, Whitmarsh & Xenias, 2012). It depends on approach to questioning truth claims and interrogating evidences (Whitmarsh, 2011).

CHAPTER 2

LITERATURE REVIEW

This chapter foregrounds to the issue of climate change and climate change education by giving special emphasis on uncertainty about anthropogenic climate change, epistemic beliefs regarding climate change, knowledge about climate change, environmental values predictors of pro-environmental behavior toward climate change as well as research attached to theoretical background of pro-environmental behavior. In the following sections, I review the results and findings of the former studies to look into larger psychological and sociological literatures to illuminate how pro-environmental behaviors towards climate change of prospective science teachers can be explained by predictors of related behavior. These findings generate a base for the research defined in following chapters.

2.1. Pro-Environmental Behavior

Fostering pro-environmental behavior has been an objective of environmental education (EE) from its starting, when in 1977 at Tbilisi, the Intergovernmental Conference on Environmental Education pronounced that in addition toits other objectives, environmental education ought to encourage "new patterns of behavior of people, social groups and public as a whole towards the environment; to give society and people with a chance to be actively engage in all levels in working toward determination of environmental issues" (UNESCO, 1977). As environmental issues get to be progressively complex and more comprehensively focused, the behavioral component of environmental education gets to be progressively remarkable (Hungerford & Volk, 1990). In the meantime, on the other hand, the charge to make new patterns of behavior and to empower public engagement poses quite a challenge (Kollmuss & Agyeman, 2002). Actually, generally, despite the fact that behavior change, critical thinking, problem solving and public engagement are frequently not emphasized; rather, focus has largely been on investigation of environmental problems, knowledge gain, ecological education and awareness building (Sia et al., 1985/86). It would be misleading, on the other hand, to recommend that this means

environmentally responsible behavior has had little attention in the thirty-seven years since Tbilisi. In reality, a rich and varied volume of investigation exists with respect to the nature of pro-environmental behavior and indeed, our perception of pro-environmental behavior has developed through the years to become progressively more complex.

Moreover, in 1990, Congress passed the National Environmental Education Act (NEEA) gave the responsibility of national leadership to increase environmental literacy to the United States Environmental Protection Agency (EPA). The aim of EPA was to "develop and support programs and related efforts, in consultation and coordination with other Federal agencies, to improve understanding of the natural and built environment, and the relationships between humans and their environment, including the global aspects of environmental problems." (cited in Potter, 2010, p.24). Consistently, national educator training program supported these goals of EPA by giving importance to educate public. A national educator training program supporting education professional, development of National EE standards for materials, students, teachers and non-formal programs, development of standards for accrediting college and university teacher preparation programs, education projects to meet the needs and desires of environmental educators for information and resources on evaluation and first EE research project to provide baseline literacy data for middle school students in the US was initiated. However, in 2008, the National Council for Science and the Environment (NCSE) recorded mostly common difficulties nationally and globally to realize EPA goals: "Preventing a global climate catastrophe, ensuring safe supplies of food and water, transforming our energy supply and reducing demand, managing ecosystems to minimize irreversible losses of biodiversity and protecting human health." (NCSE, 2008). In addition, they stated "To meet these challenges requires an educated public and a diverse and competent work force prepared for the rapidly changing world of the 21st century and education must be a critical element of a national strategy for environmental protection, a sustainable economy and a secure future." (NCSE, 2008).

In 2009, the 110th Congress accepted NEEA brought renewed focus to environmental protection topics, especially global warming and climate change. Maybe, this renewed issue in environmental protection workings is a chance for the Environmental education area to support the essential instruments to educate the public and get them engaged in the climate change issue. Maybe, it also provide a

chance to present regulation that will educate all levels of public about environmental, personal responsibility and actions for environmental protection and conservation in a holistic and systemic way(cited in Potter, 2010).

Research on the pro-environmental behavior in literature documented different models and theories. Numerous models were proposed up to now. First model based on a linear progression of environmental knowledge leading to environmental awareness and concern (environmental attitudes), which in turn was thought to lead to pro-environmental behavior (Marcinkowski, 2001; Culen, 2001; Hungerford & Volk, 1990).In other words, this model proposed that increasing in knowledge would directly cause to increase of environmental attitudes, which would also influence on environmental behavior.

Figure 2.1 Early models of pro-environmental behavior (adapted from Hungerford and Volk 1990, p. 258)

Ramsey and Rickson (1977) investigated positive correlation between knowledge and environmental attitudes with a sample of 482 high school seniors. According to K-A-B model formed in the study, improved knowledge leads to favorable attitudes in turn lead to pro-environmental behavior to support better environmental conditions. Culen (2001) discussed that if K-A-B model is true for human behavior, increasing of environmental knowledge and awareness in last 30 year time period result in a rising in environmental behavior in society. Zimmerman (1996) and Ballantyne (1996) also discussed that how environmental knowledge leads to environmental behavior needs to be described and proven. The K-A-B model was seen as starting point of exploratory research on responsible environmental behavior.

Although there were numerous researches studied diverse variables linked to responsible environmental behavior in addition to knowledge and attitude variables (Kollmus & Agyeman, 2002), also gain acceptance behavioral models of environmental education were proposed by Hines et al. (1986/87) and Hungerford and Volk (1990). This model identified factors of responsible environmental

behavior as: locus of control, personal responsibility, action skills, knowledge of action strategies and issues, and intention to act (Figure 2.2).

Specifically, in 1986, Hines, Hungerford and Tomera published their Model of Responsible Environmental Behavior which was based on Ajzen and Fishbein's theory of planned behavior (Hines et al., 1986–87). In their meta-analysis of 128 pro-environmental behavior researches, they found the following predictors of responsible pro-environmental behavior:

i. Knowledge of issues: In the light of the meta-analysis research of Hines, Hungerford and Tomera (1987), individuals, having knowledge of environment or aspect of environmental issue, were more likely to engage in responsible pro-environmental behaviors than individuals not having this knowledge.
ii. Knowledge of action strategies: When individuals know how they act to lower effect of their action on environment, they can show responsible pro-environmental behavior.
iii. Locus of control: This represents an individual's perception of whether he or she has the ability to bring about change through his or her own behavior. People with a strong internal locus of control believe that their actions can bring about change. People with an external locus of control, on the other hand, feel that their actions are insignificant, and feel that change can only be brought about by powerful others.
iv. Attitudes: The results of meta-analysis revealed the existence of a relationship between attitude and behavior, in that those individuals with more positive attitudes were more likely to have reported engaging in responsible environmental behaviors than were individuals with less positive attitudes but the relationship between attitudes and actions proved to be weak. Also, the research indicated that both of attitudes toward ecology and the environment as a whole and attitudes toward taking environmental action were related to behavior in an environmental context. Therefore, those individuals who state an intention to show some action related to the environment were more likely to have reported attaching pro-environmental behaviors than were individuals who had stated no such intentions.
v. Verbal commitment: Individuals who show sign of willingness to take action toward environment were likely to engage in pro-environmental behavior.

vi. Individual sense of responsibility: Individuals who felt some degree of personal responsibility toward the environment were more likely to have engaged in responsible pro-environmental behaviors than were individuals who held no such feelings of responsibility (Hines et al, 1986/87, p.6-7).

Although the framework is more sophisticated than Ajzen and Fishbein's (1980), the described elements do insufficiently explain pro-environmental behavior (Kollmuss & Agyeman, 2002). There were also more factors affecting pro-environmental behavior, called situational factors by Hines et al. (1986–87). These 'situational factors' include economic constraints, social pressures, and opportunities to choose different actions (Kollmuss & Agyeman, 2002)

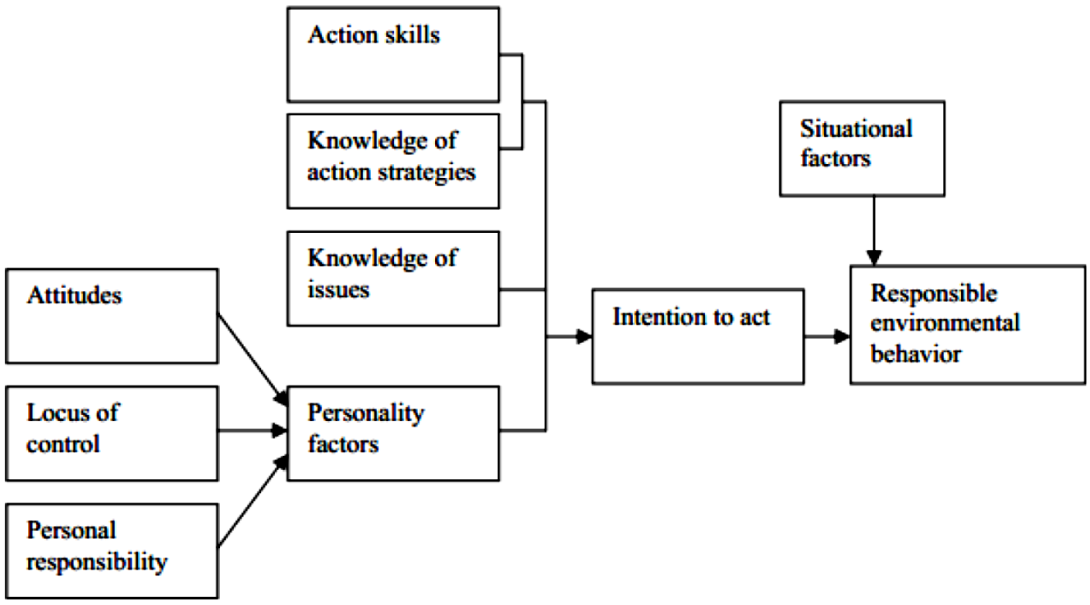

Figure 2.2.Models of predictor of environmental behavior (Hines *et al*., 1986, p. 7).

The value belief norm theory VBN is also reported as satisfactorily explaining the pro-environmental behavior (Stern et al. 1999; Stern, 2000).The VBN theory is primarily characterized by Schwartz's (1977) theory of Norms Activation. The theory connects value theory, norm-activation theory, and the New Environmental Paradigm (NEP) perspective through a causal chain of five variables leading to behavior: personal values (especially altruistic values), New Environmental Paradigm (NEP), awareness of adverse consequences(AC) and ascription of responsibility to self (AR) beliefs about general conditions in the biophysical environment, and personal norms for pro-environmental action (see Figure 2.3).The causal chain moves from relatively stable, central elements of

personality and belief structure to more focused beliefs about human-environment relations (NEP), their consequences, and the individual's responsibility for taking corrective action. This theory postulates that each variable in the chain directly affects the next and may also directly affect variables farther down the chain. Personal norms to take pro-environmental action are activated by beliefs that environmental conditions threaten things the individual values (AC) and that the individual can act to reduce the threat (AR). Such norms create a general predisposition that influences all kinds of behavior taken with pro-environmental intent. In addition, behavior-specific personal norms and other social-psychological factors (e.g., perceived personal costs and benefits of action, beliefs about the efficacy of particular actions) may affect particular pro-environmental behaviors.

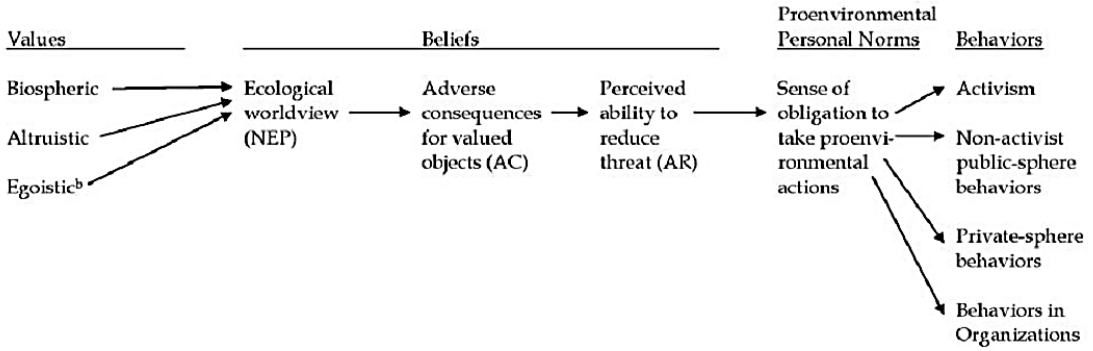

Figure 2.3. Theory of value belief norm (Stern, 2000, p. 84)

Researchers (Boldero, 1995; De Groot &Steg, 2007; Oreg& Katz-Gerro, 2006; Schultz et al., 2004; Thogersen & Olander, 2006) have shown that an individual's values, beliefs, and perceptions of social cues and behavioral expectations account for variance in a range of knowledge and behaviors regarding the environment. Slimak and Dietz (2006) proposed that the value-belief-norm (VBN) theory focuses on characteristics of individuals, and therefore can explain variance in risk perceptions across individuals. Although VBN theory did not attempt to account for the various characteristics of individuals and their behavior, it has not been widely validated and has not been incorporated into a larger theoretical network.

Another theory, the Theory of Reasoned Action (TRA; Ajzen & Fishbein 1980), depends on the hypothesis that a person usually acts in a responsible behavior if person take into account existing information and consider the effect of their actions (Ajzen & Madden, 1986).The theory postulates that immediate determinant of any behavior is the intention to perform the behavior in situation (Ajzen, 1985).

The stronger individuals have intention to act in sensible behavior, the more individuals are hoped to try, and therefore the higher probability that behavior will be acted (Ajzen & Madden, 1986). The TRA demonstrates how attitudes towards a topic may be mediated into behavioral intentions and behavioral change (Madden, Ellen & Ajzen, 1992). The TRA attach importance to people's beliefs and value systems about the possible behavioral change, and also the beliefs about how other people might consider the possible behavior (Ajzen, 1985). The TRA indicates two conceptually independent predictors of intention. One of them is an attitude toward the behavior means to how an individual evaluate the behavior positively or negatively. The second predictor of intention is subjective norm, a social factor, means to the perceived social pressure to realize or not to realize the behavior (Ajzen, 1985). Relative importance of attitude towards the behavior and subjective norm are considered collectively to decide behavioral intention (Madden, Ellen & Ajzen, 1992).

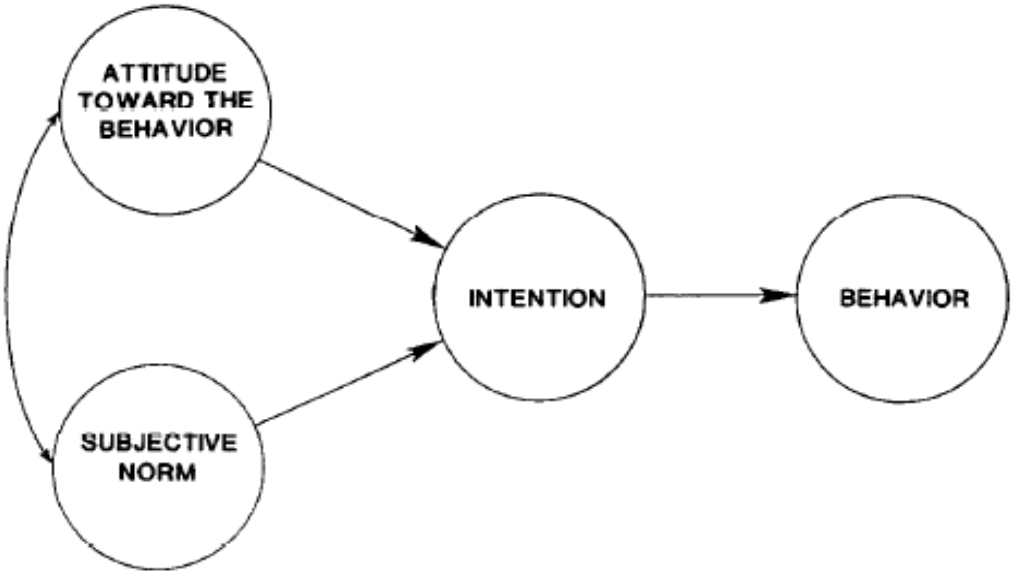

Figure 2. 4. The Theory of Reasoned Action (adapted from Ajzen & Madden, 1986, p. 454)

Ajzen (1985) expanded on the TRA with the Theory of Planned Behavior (TPB). Ajzen identified that determinants such as external barriers like opportunities and time, or personal constrains such as a lack of willingness, may inhibit the relationship between intention and behavior (Ajzen, 2002). All of these factors are named as the perceived behavioral control (PBC). The TPB therefore accepts that individuals behave with respect to both their intentions and perceptions of control

over a behavior (Ajzen, 1985). Potter (1996) defines that within the TPB, a personal decision about whether people can realize a specific behavior takes priority over any intention they may need to perform that behavior. He also described that the impacts between attitudes, subjective norms and perceived behavioral control can work in either direction (see Figure 2.4.).

Theory of Planned Behavior considered that behavioral intention is the primary antecedent of behavior which demonstrates how difficult individuals are voluntary to realize the behavior (Ajzen, 1985).According to the TPB, three determinants influence behavioral intention. The first determinant is attitudes toward the behavior, which present the overall assessment of realizing the behavior by the person (Madden, Eller & Ajzen, 1992). Attitudes are relied on expected beliefs about the likelihood that behavior will cause specific outcomes, and on assessments of the attractiveness of those outcomes (Ajzen&Fishbein, 1980). The second factor, subjective norms, infers to perceived social pressure to participate in the behavior. Subjective norms are depended on comprehensions of expectations of relevant reference social groups regarding the behavior and the motivation to obey with the reference social groups (Armitage & Conner, 2000). The third factor, perceived behavioral control (PBC), infers to an individual's belief as to how hard it can be to realize the behavior (Ajzen, 1991).

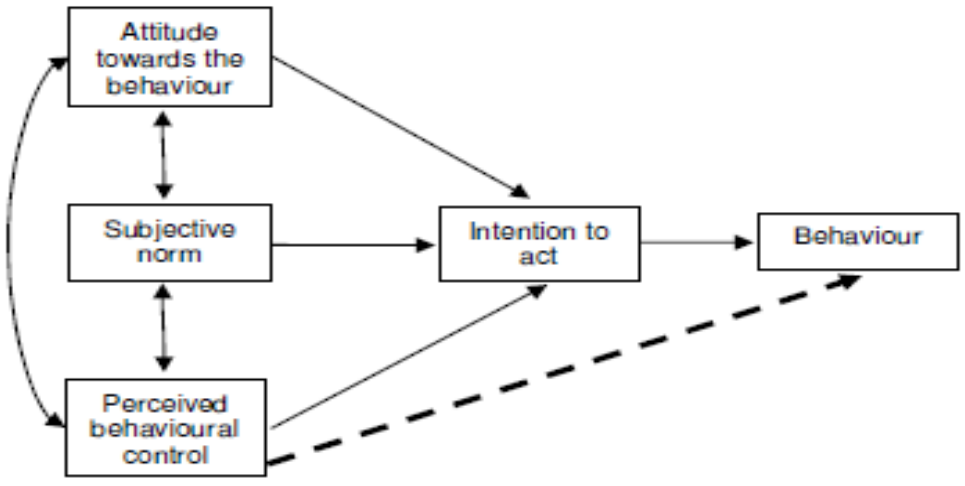

Figure 2. 5. Theory of planned behavior (adapted from Ajzen & Madden, 1986, p. 458)

Ultimately, while these models could adequately describe the correlates to pro-environmental behavior, they could not consistently predict when individuals would engage in pro-environmental behaviors verses when they would not, making it

difficult for environmental educators and other conservation professionals to know in what area to focus their attention in attempts to affect change. While the above models and conceptual frameworks include the primary correlates associated with pro-environmental behavior, they are not all inclusive. Research has been conducted around many other variables in order to better explain pro-environmental behaviors. These factors include, but are not limited to, group, individual and issue locus of control, perceived willingness to commit, attitude towards various targets and behaviors, personal responsibility, number of memberships, number of years spent at residence, political viewpoint and affiliation, age, income and other demographics, environmental sensitivity, active caring and altruism, neighboring and community involvement, and various communication topics (Hines et al., 1986/87; Hungerford & Volk 1990; Sia et al., 1985/86; Stern et al., 1993). The consequence of the inconsistency in correlation and predictions has been a sense of skepticism among researchers about the causal processes through which any given variable influences pro-environmental behavior (Bamberg, 2003). Actually, when we look at the theories and models explaining pro-environmental behavior, there is no single and general model or theory that explaining pro-environmental behavior. Despite the fact that environmental education studies has supplied us with a collection of potentially useful predictors of pro-environmental behavior, researchers cannot make consensus about predictors and have little explanation of why some predictors are successful and others are not to predict pro-environmental behavior (De Groot & Steg, 2007).

Influenced by previously mentioned models, this study proposed a conceptual model involving knowledge about climate change, epistemic beliefs towards climate change, uncertainty beliefs about the reality of anthropogenic climate change, environmental values, pro-environmental behavior. In the following part, studies clearly focused on climate change issue among different cultures and sample groups were summarized to better grasp the concept of climate change, behaviors towards climate change and what factors affecting on behavior towards climate change.

2.2. Research on Climate Change

There has been growing interest about climate change issue among environmental researchers. Such studies fold in four categories some researchers focus on understanding of students, other researchers focus on understanding of undergraduates and public about climate change and other group of researchers

investigated on understanding of pre-service and in-service teachers about climate change.

Studying with 51 secondary students Shepardson, Niyogi, Choi & Charusombat (2011) identified their conceptions of global warming and climate change from three different schools in the Midwest, USA by collecting qualitative data. To collect data from sample, the global warming and climate change assessment instrument which consisted of five items: four open-ended items and one draw-and-explain item was used. Despite scoring responses as "wrong" and "true", written prompts was used to elicit students' responses. Open ended items were used to investigate the students' conceptions of the relationships between cause and effect of climate change and global warming. Last item investigated students' ideas about how natural process and human activities influence on carbon dioxide level in atmosphere. It was reported that students had different sophistication of conceptions about global warming and climate change. Their conception about effects of global warming and climate change on humans was that global warming and climate change wouldn't have a major effect on people or society. On the hand, some students attributed the increasing of carbon dioxide to vehicles and factories and believed that global warming caused by increasing of carbon dioxide would cause human deaths as a result of heat, floods and drought. Lastly, while they believed that people should drive less, reduce the pollution and number of factories emitting carbon gases, they did not relate their daily life and future activities with climate change and global warming. Consequently, it was suggested that teaching global warming and climate change and integrating of them in curriculum was significant to increasing of students' understanding the influence of climate on people and society and influence of people on climate.

Liarakou, Athanasiadis and Gavrilakis (2011) investigated 626 secondary school students' beliefs about the greenhouse effect and climate change by using a closed form questionnaire consisting of statements regarding the causes, impacts and solutions for global environmental issues. The results of the study revealed that eleventh students had better information level about climate change than eighth graders. Students had misconceptions about cause-effect relationship between greenhouse effect and ozone layer depletion. Although students had fairly informed about effects of climate change, they did not have clear ideas about solutions and some causes of climate change. Moreover, students' information about climate

change stemmed from generally television. It was found that students did not suggest the renewable sources as solution towards climate change despite wind and solar energy potential of their island. Finally, engagement in Environmental Education programs positively influenced on their ideas about climate change.

Studying with 379 Spanish secondary school students, Punter, Ochando-Pardo and Garcia (2011) identified their ideas about causes and consequences of climate change. A questionnaire was used to collect information about causes and consequences of climate change, sources of information, responsibility of students towards climate change and solutions to the climate change. The findings of the study indicated that students related misuse of factories and vehicles with climate change problem but they did not relate household energy use with climate change problem obviously. As previously detected, students confused the hole in the ozone layer with environmental problems. When they described the climate change, they used melting poles, higher average temperature and natural disasters consequences of climate change. It could be implied from this study that contribution of unconscious usage of electricity in household to climate change, socio-economic and health consequences would be emphasized in curriculum because of less attention of the students about these issues.

More recently, Kim, Jeong and Hwang (2012) conducted a study to investigate the predictors of pro-environmental behavior of 189 American undergraduate students and 144 Korean students. Based on Fishbein and Ajzen's (1972) TPB scale, they also measured perceived severity, perceived susceptibility, and self-efficacy. Also, participants' age and gender, and their political ideology were obtained. Political ideology and gender were reported significant predictors of pro-environmental behaviors. Liberal participants were more likely to show positive attitudes towards global climate change than conservative participants. Also, women and more liberal participants were more likely to be tended engage in pro-environmental behaviors for American participants. However, for Korean participants, gender and political ideology were not significant to predict pro-environmental behavior.

In a similar context, Bråten and his colleagues was interested in epistemic beliefs of undergraduate students regarding climate change issue (Bråten et al., 2009). They explored and compared the dimensionality of personal epistemology with respect to climate change across the contexts of Norwegian and Spanish

students and examined relationships between topic-specific epistemic beliefs and the variables of gender, topic knowledge, and topic interest in the two contexts with a sample of 225 Norwegian and 217 Spanish undergraduates enrolled in psychology or education courses. A multiple-choice test including 17 items was developed to measure prior knowledge about the topic of climate change; a scale composed of 12 items was developed to evaluate the participants' their personal interest in climate change topic and engagement in behavior concerning climate change; Topic-Specific Epistemic Beliefs Questionnaire (TSEBQ) composed of 49 items was designed to evaluate participants' personal epistemology concerning climate change. Participants were more interested in climate change and owned more sophisticated beliefs concerning certainty, justification and source dimension of epistemic beliefs. This indicated that interested participants with climate change saw main source of knowledge about climate change as experts, knowledge claims about climate change should be assessed through critical reasoning and compared by using of multiple knowledge sources and composed of only one correct answer. However, participants were more knowledgeable about climate change owned low level of beliefs concerning certainty and source dimension of epistemic beliefs. More knowledgeable participants viewed them as main source of knowledge and believed that knowledge about climate change is conditional and tentative. Another epistemic beliefs research came from Strømsø, Bråten and Britt (2010) who investigated whether epistemic beliefs affect students' evaluation of documents about climate change with a sample of 126 undergraduate students at a large university in southeast Norway. To evaluate participants' topic knowledge about climate change, a multiple-choice test composed of 17 items was developed. In addition, Topic-Specific Epistemic Belief Questionnaire (TSEBQ; Bråten et al., 2009) composed of 24 items was used to assess students' personal epistemology about climate change and two separate texts about different aspects of climate change were used in the study. It was reported that epistemic beliefs about knowledge of climate change statistically significant negatively predicted students' judgments of texts' trustworthiness. Participants trust that knowledge assertions should be seriously assessed logically and by using rules rated in science texts. Moreover, participants used the criteria of their own opinion, author and content for judging trustworthiness and saw personal judgments and interpretations to be main sources of knowledge about climate change to trust the two texts less than students relying more on external authority. Participants had a

tendency to see knowledge about climate change as theoretical and complex and this framework caused scepticism towards climate change among participants. It could be inferred that epistemic beliefs towards climate change improved scepticism beliefs about climate change among students.

Corner, Whitmarsh and Xenias (2012) investigated undergraduates students' (*N*=173*)* uncertainty, scepticism and attitudes towards climate change before and after reading two newspaper editorials that made opposing claims about the reality and seriousness of climate change (designed to generate uncertainty). Participants were randomly assigned to one of two experimental conditions (88 in the scientific uncertainty condition, 85 in the political/moral uncertainty condition). New Ecological Paradigm (NEP; Dunlap et al. 2000) scale composed of 15 items was used in order to evaluate the environmental attitude towards climate change. Uncertainty Belief Scale (Whitmarsh, 2011) composed of 17 items was used to assess the scepticism towards climate change. Also, basic demographic questions were used to collect information about age, gender, political affiliation (if any) and membership of any environmental organizations from participants. It was reported that 'Scepticism' in public attitudes towards climate change is seen as a significant barrier to public engagement. Also, in both groups, attitudes towards climate change became significantly more sceptical after reading the editorials. Although only NEP score was a significant predictor of skepticism, political affiliation, membership of environmental organization, age and gender were non-significant predictors of climate change scepticism.

Surveying 1218 Americans, Bord, O'Connor and Fisher (2000) studied on whether actual knowledge about global climate change independently predicts global climate change beliefs and behavioral intentions. It was concluded that knowing about causes of climate change is the most effective predictor of intention to take voluntary actions and political actions towards climate change. They also reported that general environmental beliefs and perception towards climate change help to explain behavioral intentions. General environmental concern or concern for the negative impacts of climate change was not sufficient to motivate people to advocate programs organized to mitigate climate change. Therefore, real knowledge about climate change was needed in order to convert public concern and awareness about climate change to public pro-environmental actions towards climate change. In

addition, knowledge about causes of climate change had an effect on beliefs that climate change occurs.

Another survey study about the effects of climate change knowledge sources on beliefs, knowledge and misconceptions regarding climate change was conducted by Stamm, Clark and Eblacas (2000) in the US (*N*=512). They found that public was aware in general meaning of climate change but possessed limited understanding of its causes, effects and possible solutions. Researchers reported common misconceptions and uncertainties are sourced by mass media and interpersonal communications. Although mass media and interpersonal communications about climate change caused the some popular and general misconceptions and misunderstand about climate change issue, these source of knowledge about climate change improved the spread of knowledge and awareness about climate change among people.

In their study, Nilsson, Borgstede and Biel (2004) investigated how values, organizational goals and norms affect willingness to admit climate change policy measures within organizations. The sample of study was consisting of 356 decision maker from public and private sectors in urban area of Sweden. To measure the environmental value orientation, Schwartz Value survey (1992) was used. Moreover, four items was used to determine organizational norms and normative beliefs. Also, 22 items measuring willingness to admit strategies to reduce negative climate change effects were used. The results demonstrated that environmental values were significant agents of willingness to admit climate change policy measures among decision makers in public sector but not private sector.

Lorenzoni, Nicholson-Cole and Whitmarsh (2007) explored barriers affecting engagement climate change among the UK public with 589 people via postal survey and 24 people via semi-structured interviews. They found that common barriers emerged at individual and social levels. Results of their study indicated that lack of knowledge, uncertainty and skepticism about climate change, distrust in information sources, social norms and expectations, lack of political action and lack of action by business and industry played a vital role in engaging with climate change. Moreover, it was reported that lack of knowledge about climate change and distrust to information sources about climate change might contribute to sense of uncertainty about climate change. Although individuals saw climate change as caused by human-induced factors, they felt that individual behaviors have little influence on whole

climate change factors. They concluded that effective climate change management needed long term perspective and systematic changes to engage with actions towards climate change. Therefore, it was implied that science education (formal and professional) was needed in order to create individuals having values, knowledge about climate change and being environmental citizenship. It was found that despite get as resources of primary sources as scientists' explanations about climate change and greenhouse effect, public was confused about climate change and greenhouse effect. It was claimed that not only political effects on sources of knowledge about climate change also uncertainties in scientific reports and explanations resulted in ambivalent beliefs about climate change. Moreover, climate change issue was a complex phenomenon with common effects on society; therefore, it was convenient to cause uncertainty beliefs about climate change among individuals.

To evaluate degree of exposure to climate change information and policy support for climate change, Dietz, Dan and Shwom (2007) conducted a study with 316 Michigan and Virginia residents. Climate change policy preferences developed by O'Connor and colleagues (1999, 2002), was used to assess participants' general support for the environment and environmental policies. Fifteen items from Schwartz's (1992) value scale were used to assess the four major value clusters. Five-item subset of the widely-used New Ecological Paradigm scale (NEP) (Dunlap & Van Liere, 1978) that measures environmental beliefs about the Earth and human-environment relationships was included in the survey. To assess degree of exposure to climate change information, respondents were asked whether they had obtained climate change information in the prior year from seven sources: newspaper articles, magazine articles, books, television shows, movies, internet websites, and discussions with family or friends. Six survey items developed by O'Connor and colleagues' (1999) were designed to measure beliefs about the possible negative consequences of climate change to individuals and other species. Five items were constituted to assess normative beliefs about climate change. The results of the study demonstrated that although participants supported the sustainable energy strategies instead of fossil fuels, participants were not willingness to pay a gas tax. Without economic burden, participants supported all other mitigation policies. It was reported that personal values, future orientation and political affiliation were strong predictors of policy support. In addition, liberal participants were more likely to demonstrated greater environmental trust, NEP, future orientation, altruism, and less traditional

values. Also, women were more likely to possess ascription of consequences, environmental trust, altruism, traditionalism and less egoism. Results of this study showed that public uses newspaper articles, magazine articles, books, television shows, movies, internet websites, and discussions with family or friends as the source of knowledge about climate change. It is reported that source of knowledge about climate change moderately correlated with participants seeing themselves as informed about climate change. Another study about source of climate change knowledge was conducted in the USA by Wilson (2000) to determine which sources used as information sources about climate change. It was reported that television has been used as the primary source of knowledge about climate change for the public. Although journalists used newspaper as primary source, society used interviews with scientist and scientific journals as second and third sources of knowledge.

Sunblad, Biel and Garling (2008) studied on knowledge and confidence in knowledge about climate change among 107 experts, 119 journalists, 279 politicians, and 1466 laypersons in Sweden by measuring participants knowledge and confidence in own knowledge about climate change with a bipolar questionnaire including 22 true and 22 false statements and confidence level for each statement. They reported that low level of knowledge and confidence in one's knowledge about climate change might have important effect on their actions towards climate change. Results of the study revealed that individuals having low level of knowledge and confidence in knowledge about climate change need to improve their knowledge to demonstrate pro-environmental attitudes and beliefs towards climate change. Also, it was concluded that beliefs about consequences of climate change are significant predictor of policy attitudes. Pro-environmental behavior was predicted by concern about consequences of climate change and negative consequences for human beings. Therefore, knowledge about consequences of climate change was expected to have positive influence on intentions on change behavior. Moreover, if individuals had low level of confidence in their knowledge about climate change and high level of concern about climate change, they would participate in improving their knowledge about climate change. In summary, this process might be concluded that both knowledge and confidence in knowledge about climate change will increase. As a result, individuals demonstrated more pro-environmental behavior. Moreover, Sundblad, Biel and Garling (2008) concluded that common misconceptions in knowledge about climate change and uncertainty in society stemmed from source of

knowledge about climate change such as mass media and scientists. Journalists disagreed and confused knowledge about climate change because of scientific discussions about climate change and lacking of consensus about the reality of human-induced climate change. Also, they reported that journalists improved the sense of uncertainty with their information in society.

Adger, Dessai, Goulden,·Hulme, Lorenzoni, Nelson, Naess, Wolf, Wreford. (2009) examined social limits to adaptation to climate change in terms of diverse values, uncertainty around future foresight of risk, social and personal factors and knowledge about climate change. Decision makers holding values towards climate change were seen as important limits to adaptation to climate change if social goals and values for adaptation are diverse from small scale to large scales. Another critical proposition was uncertainty about climate change. Uncertainty about climate change was associated with nature of scientific knowledge of future climate change and status of scientific predictors. Also, diverse cultures and organizational cultures evaluated climate change issue in different ways. These differences among scientific knowledge claims and status of scientific predictors caused diversity in values and made a problematic situation on adaptation to climate change. Individuals' and communities' knowledge and experience about current climate change shaped their understanding of future climate change and changed uncertainty beliefs towards climate change. It was asserted that values, cultural and societal norms, uncertainty beliefs, preferences, perceptions of self-efficacy, perceptions of risk, knowledge, experience, and habitual behavior were perceived to be determinants of behaviors towards climate change. Also, it was suggested that pro-environmental, ecocentric and altruistic orientations can give rise to actions around long term sustainability.

Chen (2012) studied on effect of knowledge about climate change on consumers' pro-environmental behavior in Taiwan with 757 participants and data was collected by using stratified sampling in Taiwan. It was reported from the study that there is no significant difference on respondents' values and their pro-environmental behavior according to their knowledge level about climate change. However, there was a significant difference on respondents' environmental attitudes, personal norms, awareness of consequences, and ascription of responsibility to self and biospheric values according to their knowledge level about climate change. Knowledge of the causes of climate change was a powerful predictor of behavioral intentions to acting a more pro-environmental manner to combat climate change,

independently of beliefs about the consequences (O'Connor Bord & Fisher, 1999). For education policy makers, it was also important to know whether or not knowledge of climate change will lead to pro-environmental behavior.

Masud, Akhtar, Afroz, Al-Amin and Kari (2013) investigated whether knowledge, awareness and risk perception of climate change have a significant effect on attitudes and pro-environmental behavior towards climate change for 400 people in Malaysia. They reported a model explaining the pro-environmental behavior with knowledge, attitudes, awareness and risk perception about climate change. Results of the study revealed that awareness, knowledge and risk perception about climate change positively influence on the formation of favorable attitudes towards action for climate change. Also, results showed that there is mediated relationship through attitudes between awareness, knowledge, risk perception and pro-environmental behavior. According to results of this study, people were more likely to show pro-environmental behaviors only if they had sufficient knowledge about adverse impacts of climate change.

Islam, Barnes and Toma (2013) investigated which determinants influence on climate change scepticism among 533 specialist dairy farmers in Scotland. A constructed questionnaire was used to determine farmers' climate change scepticism, demographic characteristics, personal experiences, contact with information and communication sources, and personal values. It was reported that scepticism was significantly and negatively affected by farmers' use of media, environmental values, education, and experience with disease and pest infestations and also positively affected by farmers' age, economic status and economic values. These results demonstrated that richer people might disprove climate change have uncertainty beliefs about reality of anthropocentric climate change because of their luxury lifestyle based on high energy consumptions. Also, informed and experienced farmers about climate change had tendency to admit the reality anthropocentric climate change.

McCright (2010) investigated effect of gender on climate change knowledge and concern in the American public by using 8 years of Gallup data on climate change knowledge and concern in the US general public. It was reported that women possess greater scientific knowledge about climate change than do men despite expectations from scientific literacy research. The results of the study indicated that men see as more knowledgeable about climate change issue. However, women

expressed more scientifically certain knowledge about climate change than men. Also, it was inferred that women underestimated their knowledge about climate change more than do men and women had less self-confidence on their knowledge about climate change than men. Moreover, women expressed slightly greater concern about climate change than do men.

Bradbury (2012) conducted a study investigating the political ideology affect willingness to change behavior to improve the environment with a sample composed of 1002 United States residents. The findings of this study demonstrated that political ideology was not a significant determinant of how willing participants were to modify some of the things they do to assist improve the environment. Also, it was reported that the more participants thought something can be done to mitigate global climate change; the more willingness participants were more likely to be to change more behavior towards climate change.

Whitmarsh conducted a series of study related to climate change issue. One of these studies, Whitmarsh (2005) conducted a study with a population of 1040 participants in UK and examined which factors influence on scepticism about reality of human-induced climate change. One of these agents affecting on scepticism beliefs about climate change issue was source of knowledge. It was reported that individuals are ambivalent about climate change issue and they cannot make decision to accept and reject the human-induced climate change (Poortinga & Pidgeon, 2003). Qualitative research in this study demonstrated that uncertainty about human-induced climate change may come from a number of sources containing conflicting, unreliable scientific proofs, misleading sources of knowledge about climate change (e.g., media, own memory, politicians, campaign groups; Whitmarsh, 2005). In addition, participants stated that heterogeneity in public attitudes towards climate change stem from variety of media and interpersonal sources of knowledge about climate change. While individuals distrusted political sources, they trusted more community members and scientists' explanations about climate change. They saw political sources as including widespread discontent about climate change issue. It was concluded that knowledge about climate change is shaped by values, beliefs and trusted sources of knowledge about climate change. Source of knowledge about climate change was a critical issue in formation of public knowledge and confidence in their knowledge about climate change (Wilson, 2000). Hence, if individuals did not trust source of knowledge about climate change issue, they could not be

confident in their knowledge and felt ambivalent in their knowing about climate change (Whitmarsh, 2005). Moreover, climate change issue was a complex phenomenon with common effects on society; therefore, it was convenient to cause uncertainty beliefs about climate change among individuals (Lorenzoni, Nicholson-Cole & Whitmarsh, 2007). Scientific explanations and investigations included doubtful and complicated evidences about climate change causes, situation and next effects on environment and living things. Some researchers has shed on light on how these evidences and sources of knowledge about climate change resulted in uncertainty beliefs about climate change and distrustful attitudes towards human induced climate change issue among public. In a separate study, Whitmarsh (2008) investigated on the scepticism of climate change as a key impediment to personal engagement and explored whether relevant experiences of flooding and air pollution influence individuals' knowledge, attitudes, risk perception and behavioral responses to climate change with a sample of 589 British people. A structured questionnaire composed of quantitative and qualitative questions about climate change was used to measure awareness, knowledge, perceived threat, uncertainty beliefs and behavioral response as well as questions on other environmental concerns, experience of air pollution and flooding and values measured by using New Environmental Paradigm scale (Dunlap et al., 2000). Results of interviews with participants experienced of air pollution demonstrated that the air pollution experiences of participants influenced on their behavior and understanding towards climate change. Participants owning biospheric values believed that anthropogenic climate change is real, considered it personally very significant and possessing threat to participants. Therefore, participants were willingness to take action in response to anthropocentric climate change. Also, environmental values were strong predictors of uncertainty beliefs and engagement in action towards climate change. In other study, Whitmarsh (2009) explored the prevalence, nature and determinants of impact-oriented and intent-oriented action in response to climate change with a sample of 589 people from a county in southern England. A structured questionnaire was used to determine general environmental concerns, awareness, knowledge, attitudes, and intent-oriented behavior in relation to climate change, environmental values and impact-oriented actions and demographic measures. It was reported that moral obligation, pro-environmental value and knowledge about cause of climate change were significant positive predictors of impact oriented action towards climate change. Demographic

variables, risk perception and individual responsibility were non-significant. Also, participants' scepticism beliefs had statistically significant negative effect on intent-oriented action towards climate change. Moreover, environmental values positively determined intent-oriented action. Recent study by Whitmarsh (2011) investigated dimensions, determinants and changes over time on scepticism and uncertainty beliefs about climate change with 589 participants in 2003 and 551 participants in 2008 from public in the UK. Pro-environmental behavior were measured by using pro-environmental behavior scale developed by Whitmarsh and O'Neill (2010) and including 24 items about low and high environmental impact actions in four behavioral domains: domestic energy/water use, waste behavior, transport, and shopping. Environmental values were measured by using the New Environmental Paradigm scale (Dunlap et al., 2000). Scepticism Scale, developed by Whitmarsh (2005), was used to evaluate participants' ignorance and lack of knowledge about climate change. Also, participants' knowledge about climate change was assessed by using self-assessed knowledge questions about climate change. It was reported that while scientific consensus and political and media messages demonstrate to be increasingly certain, public attitudes and behaviors towards climate change do not demonstrated to be similar tendency and scepticism beliefs about the reality of anthropocentric climate change maintained constant between 2003 and 2008. Moreover, skepticism beliefs were significantly predicted by individuals' environmental and political values but not predicted by public's education and knowledge about climate change. Having pro-environmental values and liberal political affiliation were found to be the strongest determinant of certainty about climate change. Also, men and older people were more sceptical than women and younger people.

Whitmarsh conducted another study with her colleagues. Poortinga, Spence, Whitmarsh, Capstick and Pidgeon (2011) investigated public scepticism about anthropogenic climate change and how climate sceptical beliefs are associated with a range of socio-demographic, personal values, and voting intention variables among 1822 British people in 2010. A range of items was included in the survey that could be used as indicators of climate scepticism. Personal values were measured using the short version of the Schwarz Value Survey (SVS; Schwartz, 1992). Climate change scepticism were particularly common among older individuals from lower socio-economic backgrounds who are politically conservative and hold traditional values;

while it was less common among younger individuals from higher socio-economic backgrounds who hold self-transcendence and environmental values. Uncertainty beliefs about climate change and its potential impacts might still be a major barrier to engagement into climate change. In addition, results revealed that self-transcendence, traditional, and environmental values are significantly related with public views towards anthropogenic climate change. Climate change scepticism was particularly widespread among participants who are politically conservative and hold traditional values; while less widespread among participants who hold self-transcendence and environmental values. General distrust in environmental science, expertise and communication, unwillingness to change their behavior (Stoll-Kleemann et al., 2001), or despondency brought about by feelings of helplessness and lack of control (Lorenzoni et al., 2007) and disinterested or bored by the topic (Kerr, 2009) were seen as psychological determinants for not engaging with climate change. Also, it was found that climate scepticism was not common in Britain.

Some studies also conducted with both pre-service and in-service teachers. Relatively few studies explored climate change views of pre-service science teachers. For instance, Lambert and Bleicher (2013) examined 154 pre-service teacher's understanding of climate change during science method course. Views on Climate Change (VCC) instrument composed of 43 items was constructed to measure participants' perspectives on their self-reported knowledge of climate change, evidence (or indicators) of climate change, causes of climate change, scientific consensus, impacts of climate change, actions or solutions, influence of politics on the issue of climate change and trust of sources of information. The results of the study showed that participants concerned about climate change were higher knowledgeable about climate change than doubtful and disengaged participants. Also, their perceptions on the evidence for climate change, consensus of scientists, impacts of climate change and influence of politics were changed significantly. Consequently, curriculum and instruction were significant predictors in improving understanding of climate change and developing beliefs about climate change. Also, this study demonstrated that scepticism among teachers was changed by appropriate science method course and importance of environmental literacy about climate change.

Liu, Wang, Nam, Bhattacharya, Karahan, Varma, and Roehrig (2012) studied on 19 middle and high school teachers' attitudes and beliefs about climate change by

using a survey measuring attitude and beliefs about climate change, open ended questions measuring knowledge about climate change, NEP scale (Dunlap & Van Liere, 1978; Dunlap, Van Liere, Mertig, & Jones, 2000) measuring teachers' beliefs about relationship between human and Earth. This study was part of a three-year professional development project funded through the NASA (National Aeronautics and Space Administration) Innovations in Climate Education program (NICE) and examined teachers' beliefs about climate change and how these beliefs related to content knowledge and classroom practices. They reported that attitudes and beliefs were not strong indicators of teachers' level of climate change knowledge. In addition, it was implied from the study that skeptical attitudes of teachers stemmed from lack of knowledge about climate change and misunderstanding of causes and effects of climate change. Also, they reported that teacher' attitudes towards climate change influenced their decision making in implementing climate change education.

Although there are studies focusing on global warming issue, there are relatively few studies in Turkey clearly focus on climate change issue. For example, a cross cultural study conducted by Sever (2013) compare of science teacher candidates' (N=14) thoughts about global warming in Turkey and the UK via semi-structured interviews. It was reported that teacher candidates studying in both countries mostly use examples of the results and effects of global warming and not make complete theoretical definition of global warming. While teacher candidates who are studying in Turkey stated the reasons of the global warming as industrialization and maltreatment of people to the nature, teacher candidates studying in United Kingdom gave the first place to fossil fuel consumption. Almost all of teacher candidates perceived global warming as common environmental problem of the humanity. Teacher candidates studying both in Turkey and in United Kingdom followed news about global warming firstly from Internet sources and secondly from TV programs. Also, most of the teacher candidates expressed trying to take precautions about global warming. While teacher candidates studying in Turkey took precautions by giving importance to recycling, teacher candidates in United Kingdom paid attention to transportation in order to avoid fossil fuel consumption. Findings of the study revealed that neither teacher candidates in Turkey nor those in United Kingdom have adequate awareness and knowledge about global warming. Lastly, one of the main problems in Turkey was the lack of knowledge and consciousness of the consequences of behavior and so Turkish science teacher

candidates did not show needed pro-environmental behavior towards environmental problems such as air pollution, global warming and climate change.

2.3. Research on Environmental Issues

In the foremost study Stern and Dietz (1994) suggested three different bases for environmental attitudes in their Value Belief-Norm theory of environmental attitudes which is an extension of Schwartz's (1977) Norm-Activation model. Stern, Dietz and Kalof (1993) stated that according to Schwartz's (1977) Norm-Activation model of altruism, if individual is aware of harmful consequences (AC) of her/his pro-environmental behaviors to others and if that person ascribes responsibility (AR) to herself/himself because of changing harmful environmental condition then that pro-environmental behaviors become more reasonable. Moreover, Stern and his colleagues' value-belief-norm theory recommended that there are two additional value orientation to altruism such as; egoistic, individual who protect the environment because of concerning for herself or himself, biocentric, individual who protect the environment because of concerning all living things and also social-altruistic, person who protect the environment because of concerning other people. For long time period, researchers have focused on the individuals' value orientations (Dietz, Kalof, & Stern, 2002; Thompson & Barton, 1994; Nordlund & Garvil, 2003; Schultz, 2001). The majority of these investigations indicated the existence of either two or three different value orientation.

Thompson and Barton (1994) suggested that there are at least two values (i.e., eco-centric and anthropocentric) underling support for environmental problems and issues. Thompson and Barton asserted that although individuals owning anthropocentric and ecocentric value show pro-environmental behavior towards environment, they have incentives and orientations for preserving environment. For instance, ecocentric preserved environment because nature was valuable and was worth to preserve not considering the economic and benefits for human life. On the other hand, anthropocentric individuals conserved environment to its value for human life and sustaining and improving the standard of human life, human comfort and health (Thompson & Barton, 1994). Anthropocentric values were similar to Stern et al. egoistic and social-altruistic values, while ecocentric values were similar to biospheric values. In order to investigate the difference between eco-centrism and anthropocentrism Thompson and Barton developed a 25 item five Likert-type scale

to measure anthropocentric and eco-centric attitudes of adults (N= 115, 58 females and 51 males, average age of 43 years). Also, general apathy toward environment and self-reported conserving behavior were investigated in this study. To evaluate the behaviors towards the environment, participants were answered to frequency of given conserving behaviors question. The asked conserving behaviors were recycling cans, reusing plastic bags, using public transportation instead of car and avoiding using aerosol sprays whether the participant was membership in ecologically-oriented organizations or not. Also, open-ended question was asked to participants to examine two most important reasons for being concerned about the environment. The results of study showed that more ecocentric individuals have tendency to show less apathy about environment, more conservation behaviors, and membership of environmental organizations and gave more open-ended eco-centric reasons for their care about environment. On the other hand, more anthropocentric individuals had tendency to show more general environmental apathy and less conserving behavior. In the later part of the study, Thompson and Barton (1994) replicated the first study with different sample including 71 college students (42 were women, 29 were men, average age of 19 years) who enrolled in an introductory psychology course. The aim of the second study with different sample was to enhance the reliabilities of existing scale by adding new items. The second form of scale measuring eco-centrism, anthropocentrism and general apathy of individuals was used to enhance reliability of the scale and also composed of adding 8 new items and also dropped 3 items from the first form of scale. As in the first study, eco-centric individuals were significantly interested in conservation behaviors and had a membership of the environmental organization and also eco-centrism were significantly were correlated with environmental apathy. While eco-centric individuals had more tendency to show conserving behavior, anthropocentric individuals expressed less conserving behavior. Unlike the first study, anthropocentrism was not figure out to be related to any of these variables. It was reported that when egocentrism results were replicated, anthropocentrism results were not replicated. The possible reasons of the different results could also be seen as differences in age, socio-economic status, values and knowledge about environmental issues between two samples.

Schultz et al. (2005) examined the values and their relationship to environmental concern and conservation behavior in six countries: Brazil, Czech Republic, Germany, India, New Zealand, and Russia. It was obtained a minimum

sample size of 120 from each country to maintain enough power. University students participated in the study in the social or behavioral sciences. Environmental behavior scale was used to measure environmental behavior of participants. NEP scale, was developed by Dunlap and Van Liere (1978), was used to determine environmental attitude. Environmental concern scale, was developed by Schultz (2001), was used to identify egoistic, altruistic and biospheric environmental concerns of participants. Schwartz Value Survey (1992, 1994) was used to measure environmental value of participants. The findings of this study demonstrated that there was great contribution for the cultural generalizability of the relationship between values and attitudes and on the framework of environmental concern. Moreover, findings showed that the positive relationship between self-transcendence and environmental behavior and negative relationship between self-enhancement and environmental behavior support evidence for norm activation. Also, biospheric concerns correlated positively and significantly with self-transcendence and negatively with self-enhancement. Egoistic concerns were negatively related to environmental behaviors, whereas biospheric environmental concerns were positively correlated with behaviors.

Steg, Dreijerink and Abrahamse (2005) conducted a study to investigate factors influencing the acceptability of energy policies aimed to reduce the emission of CO_2 by households by using the value–belief–norm theory of environmentalism with a sample of 112 Dutch respondents. A questionnaire composed of questions about values, acceptability of energy policies, personal norms, new environmental paradigm scale and demographics was administered to collect data. It was reported that all variables were significantly related next agents in casual chain according to VBN theory. Biospheric values were also significantly related to feelings of moral obligation to reduce household energy consumption when intermediate variables were controlled for. Furthermore, as hypothesized, personal norms mediated the relationship between AR and acceptability judgments, AR beliefs mediated the relationship between AC beliefs and personal norms, AC beliefs mediated the relationship between NEP and AR beliefs, and NEP mediated the relationship between values and AC beliefs.

Steg and De Groot conducted a series of study related to environmental issues. One of these studies, De Groot and Steg (2008) conducted a study to explore whether an egoistic, altruistic, and biospheric value orientation can indeed be

distinguished empirically by using an adapted value instrument and whether these value orientations are differently and uniquely related to general and specific beliefs and behavioral intention in the line with VBN theory by making a series of experimental studies. The reliability and validity of the value instrument was supported. For first study 112 respondents from Groningen, for second study 490 respondents from Austrian, Czech, Italian, Dutch and Swedish and for third study 184 undergraduates from University of Groningen were enrolled. All studies replicated the distinction into three value orientations, with sufficient internal consistency. Results indicated that values had a significant effect on the explanation of both variables. The results revealed that altruistic and biospheric value orientations explained environmental beliefs and behavioral intentions when especially occurred when altruistic and biospheric goals conflict. Also, it was reported that the egoistic and biospheric value orientations could support to the explanation of NEP. It was concluded in the light of the results that the value instrument could be useful to better comprehend relationships between values, beliefs, and intentions related to environmentally significant behavior.

Another study conducted by Steg and De Groot (2010) to explore the predictors influencing pro-social intentions by using NAM by a series of experimental studies. It was hypothesized that four variables influence pro-social intentions or behaviors: (1) personal norms (PN), reflecting feelings of moral obligation to engage in pro-social behavior, (2) awareness of adverse consequences (PA) of not acting pro-socially, (3) ascription of responsibility (AR) for the negative consequences of not acting pro-socially, and (4) perceived control over the problems. In first study, the effect of PA on AR, PN and intention was examined by administering questionnaire to 74 respondents. Specifically, it was examined what extent information about health problems related with emissions of particulate matters by diesel-driven vehicles affect perceived responsibility to diminish these problems, feelings of moral obligation to support to solutions to diminish these problems, and intention to engage in actions to diminish emissions of particulate matters. Two interpretations of the NAM were reported in first study that a higher PA resulted in a stronger AR and AR fully mediated the effect of PA on PN. In second study, the effect of PA and outcome efficacy (OE) on PN and pro-social intention was examined by administering questionnaire to 102 citizens of Groningen. It was examined in this study to what extent PA and OE affect individuals' intention

to demonstrate to prevent the establishment of methadone point in their neighborhood. As expected according to NAM, PA affected OE, and both of PA and OE affected on PN and intention. Also, OE partly mediated effect of PA on PN. There was an interaction effect. While both PA and OE were low, PN were weakest but no effect on intentions. In third study, it was aimed to replicate study 1 and study 2 in what extent PA and OE influenced PN and individuals' willingness to ban products that are produced by children by administering 92 undergraduates from University of Groningen. In third study, it was reported consistently with NAM that PA influenced on OE and PA and OE influenced on PN and intention in the expected chain. Interestingly, OE did not mediate the effect of PA on PN in third study. It was concluded in the light of the results of three studies that problem awareness, responsibility and outcome efficacy had important place in the development of PN and various types of pro-social intentions in the social as well as environmental domain.

Studying with 304 undergraduate students from the University of Groningen, De Groot and Steg (2010) investigated the predictive power of egoistic, altruistic and biospheric value orientations and the six types of self-determined motivations (i.e. intrinsic motivation, integrated regulation, identified regulation, introjected regulation, external regulation, and motivation) in explaining pro-environmental intentions. Schwartz's value scale developed by De Groot and Steg (2010) was used to measure value orientations; motivation toward the environment scale was used to measure self-determined motivational types; two instruments were used to measure pro-environmental behavior. First instrument was to measure consumer task developed by Verplanken and Holland (2002) and second one was to measure participants' donation intention developed by De Groot and Steg (2008). It was reported that there was a medium to strong correlations between biospheric values and self-determined motivational types (intrinsic motivation, integrated regulation, identified regulation and introjected regulation). In addition, there was significantly negative correlation between biospheric values and a motivation. On the other hand, there was a negative correlation between the egoistic value orientation and intrinsic motivation, integrated regulation, identified regulation and introjected regulation. Conversely, the egoistic value orientation was positively correlated to the less autonomous, extrinsic motivational types. It was concluded that supporting intrinsic

motivation and integrated regulation, or by lowering a motivation and external regulation cause improvement in pro-environmental behavior.

Xiao and McCright (2012) conducted a study examining gender differences in environmental behaviors with a sample of 1430 participants. The environmental module in the 2010 General Social Survey was used in order to assess participants' pro-environmental behavior, social, demographic and political variables and biographical availability. The results of the study demonstrated that women showed stronger pro-environmental attitudes and values and more frequently engage in private environmental behaviors (e.g., recycling), but they did not have tendency to engage in public environmental behaviors (e.g., joining a protest about an environmental issue) when they were compared with men. Living with other adults and not having a paid job also increased the probability of women's participation in private behaviors.

On the contrary, McDonald and Hara (1994) investigated gender differences in environmental concern among college students with a sample of 233 males and 306 females. It was reported that males had tendency to showed environmental concern than females. Moreover, they added that gender was a weak predictor of environmental concern. There was a requirement for studies explaining environmental literacy between males and females.

2.4. Research on Environmental Issues in Turkey

For years several researchers interested about environmental issue. Most of these studies conducted in Turkey about how misconceptions of students and undergraduates about environmental issues can be overcame and how attitudes and knowledge about environmental attitudes can be improved among students and undergraduates. For example, Alp, Ertepinar and Tekkaya (2006) conducted a study to investigate 6th, 8th and 10th grade students' environmental knowledge and attitudes in Turkey; the effect of the grade level and gender on students' environmental knowledge and attitudes; how environmentally responsible behavior is related to environmental knowledge, affects, behavioral intentions, and demographic variables with a sample consisting of 1977 students from urban schools. Children's Environmental Attitudes and Knowledge Scale were administered to students from 22 randomly selected schools in urban areas. Results of the study revealed that grade level had an effect on their environmental knowledge

and attitudes. While there was significant effect of gender on environmental attitudes, the gender effect on environmental knowledge was not statistically significant. 10th grade students had more knowledge about environmental issues than 8th grade and 6th grade students, and 8th grade students had more knowledge about environmental issues than 6th grade students. 10th grade students had fewer attitudes towards environment than 8th and 6th grade students and 8th grade students had fewer attitudes towards environment than 6th grade. It was reported that behavioral intentions, environmental affects, gender, and age could be predictors of environmentally responsible behavior. Despite no directly influence of environmental knowledge on behaviors, its effect on behavior was mediated by behavioral intentions and environmental affect.

Alp, Ertepinar, Tekkaya and Yilmaz (2008) conducted a study to investigate elementary school students' environmental knowledge and attitudes, the effects of socio-demographic variables on environmental knowledge and attitudes, and how self-reported environmentally friendly behavior is related to environmental knowledge, behavioral intentions, environmental affects, and the students' locus of control with a sample of 1140 students from 18 randomly selected elementary schools. Children's Environmental Attitudes and Knowledge Scale and Locus of Control scale were used to collect data. It was reported that a sample of elementary students of Ankara revealed low level of knowledge, but high level of environmental attitude. Female students had higher attitudes towards environment than male students. Moreover, the results indicated that behavioral intentions, environmental affects and locus of control were found as significant predictors of self-reported environmentally friendly behavior. However, knowledge on environmental issues did not significantly effect on elementary school students' behaviors toward the environment.

Tuncer, Tekkaya, Sungur, Cakiroglu, Ertepinar and Kaplowitz (2009) conducted a study assessing the relationship of pre-service teachers' environmental knowledge, attitude, and concerns about environmental problems, attending in outdoor activities, parents' interest and joining in environmental activities with a sample of 684 (427 females and 249 males) pre-service teachers at one of the largest public university of Turkey. The questionnaire included the closed-ended questions was used to collect data about the environmental knowledge, attitudes, uses and concerns. The questionnaire was composed of totally 45 items, five-point Likert type

scale and a part about demographic information. It was reported that the largest majority (90%) of respondents answered the definition of biodiversity correctly when evaluating environmental knowledge. The least correctly responses (34%) were collected about motor vehicles and contributions of them to carbon monoxide and also two thirds of respondents had wrong answer to questions that described factories and business as main source of carbon monoxide. Respondents had an ecocentric worldview in terms of environmental attitudes because they highly thought that animals and plants have as much right as human to exist. The results revealed that respondents are interested in relationship between human and environment because they thought that if people diminish the environment, they should be responsible for their behavior. However, it was reported that pre-service teachers are not very concerned about environmental issues. In addition, results of the study indicated that despite no correlation between environmental knowledge and attitudes, there was a significant positive correlation between environmental knowledge and environmental concern and environmental action. Female respondents had more score three of four items for environmental literacy. Findings showed that female pre-service teachers in Turkey were more positive towards environment and took their responsibilities about environmental use than male pre-service science teachers.

In their study, Teksoz, Tekkaya and Erbas(2009) researched the regional differences on students' awareness and optimism level with a sample of 4942 (2290 girls and 2652 boys) 15 year-old students at 7^{th} , 8^{th} , 9^{th} ,10^{th} and 11^{th} grade levels and from seven different region of Turkey and also used the data of Programme for International Students Assessment (PISA) 2006. Frequency distributions and multivariate analyses of variance were used to analyze data. Results indicated that there were regional differences among their environmental awareness, concern and optimism. Although students from Southeast and East Anatolia, the least industrialized regions of the country, indicated highest optimism level for the next 20 years, they had a lower environmental awareness and concern. While the students from Mediterranean region revealed the least responsibility toward the environment, students from Aegean region revealed more. Despite their lower level of optimism towards environment, students living in Marmara region had the highest level of concern towards environment because of being an industrial, commercial and tourism region. Therefore, people living in Marmara region were more pessimists

about future of the environment because of coming across environmental problems in daily life.

Ozden (2008) investigated student teachers' awareness of individual responsibilities about environmental issues with a sample of 830 student teachers (344 girls, 486 boys) from different majors at Adiyaman University by using questionnaire composed of 30 items. Questionnaire was used to collect data about awareness of individual responsibilities about environmental issues, ideas on the solutions about environmental problems, ideas of the effect of environmental issues in life. Also, the effect of gender and grade level on attitudes of participants toward environmental problems was investigated in this study. The results revealed that female student teachers had higher mean score on each dimension of questionnaire than male student teachers. Moreover, the fourth year student teachers had more positive environmental attitudes than first year student teachers. It was implied that courses about environmental problems and issues during training had influence on environmental attitudes.

Onur, Sahin and Tekkaya (2011) studied on Turkish elementary school students' value orientations, attitudes and concern towards the environment with a sample of 952 students (448 boys, 492 girls and 12 participants who failed to report their gender) from public schools located in rural areas of north-eastern Turkey (i.e. Black Sea region). In the study, the eco-centric, anthropocentric and apathy attitudes towards environment was measured by environmental attitudes and apathy scales developed by Gagnon, Thompson and Barton (1994), value orientations were measured by environmental motive concern scale developed by Schultz (2001) and feelings of concern towards environmental problems were measured by environmental concern scale developed by Coyle (2005). It was reported that environmental attitudes based on the relative importance of individuals attributing to themselves, other people, or all living things. These different bases between environmental attitudes might influence on prediction of environmental concern and statistically significant agents of pro-environmental behaviors. It was concluded that elementary school students was highly concerned and had ecocentric values. While students having high level of anthropocentric attitude towards environment had tendency to demonstrate high level of environmental apathy, students having biospheric attitude towards environment tended to show low level of egoistic concerns. Also, findings recommend that girls are statistically significant more

concerned about environmental problems and value nature more for its own sake than boys.

Ozturk (2009) investigated epistemological beliefs of pre-service teachers, relationship between pre-service teachers' epistemological beliefs and environmental literacy and predictors of pre-service teachers' intentions to act environmental behavior with a sample of 560 pre-service teachers from a public university in Ankara. Also, the effect of gender, grade level, and academic major on environmental literacy of pre-service teachers was examined. Epistemological Belief Questionnaire developed by Schommer, (1990) and adapted by Yilmaz-Tuzun and Topcu (2007) was used to measure pre-service teachers' epistemological beliefs. Environmental Literacy Questionnaire was used to measure four dimension of environmental literacy in terms of knowledge (11 items), attitudes (7 items), uses [behavior] (19 items), and concerns (8 items) about the environment. The results demonstrated that pre-service teachers possess multidimensional epistemological beliefs. Also, innate ability and quick learning dimension of epistemological beliefs significantly related with behavior dimension of environmental literacy. While innate ability, quick learning dimensions of epistemological beliefs and environmental concern, attitude significantly predicted environmental behavior, knowledge was not found as a significant predictor of environmental behavior. Also, gender, academic major and grade level significantly affected on environmental literacy of pre-service teachers. Ozturk, Yilmaz-Tuzun and Teksoz (2013) tried to explain environmental literacy through demographic variables with a sample composed of 560 pre-service teachers enrolled in different academic majors. The results of the study demonstrated that women were found to be more likely to show pro-environmental behavior and concern than men. However, men were found to be more likely to have more environmental knowledge than men. Environmental activism was differentiating characteristic between males and females. It was proposed that although women were more tended to engage in environmental behaviors and showed high level of concern, they did not showed high level of activism.

Ozkan, Tekkaya and Cakıroglu (2011) examined the relationships among epistemological beliefs, environmental concerns, and values with a sample of 103 (95 females and 8 males with a mean age of 22) first, second, third, and fourth year pre-service early childhood teachers. The epistemological belief questionnaire (Ozkan, 2008), composed of 26 items, originally developed by Conley, Pintrich,

Vekiri, and Harrison (2004), was used to evaluate epistemological beliefs of participants. The environmental motives scale (Schultz, 2001), including 12 items, was used to distinguish between different environmental attitudes in terms of self, other people and the biosphere. The inventory of values (Stern, Dietz, & Guagnano, 1999) including 15 items was utilized to measure human values. Participants' justification beliefs were sophisticated and they believed that knowledge should be structured by critically evaluating evidence and ideas of authority. The results showed that there were significant relationships among the dimensions of epistemological beliefs and values. Also, environmental motives were related with values. However, it was not found any significant association between epistemological beliefs and environmental motives. The findings showed that participants having egoistic values approves the right to use and managing environment for self and tend to believe less evolving and changing nature of science. Participants possessing egoistic value orientation had a tendency to own naive epistemological beliefs.

Sahin (2013) conducted a study explaining elementary teacher candidates' energy conservation behaviors by using VBN theory.Theory with a sample of 512 students at Faculty of Education from two public universities in Turkey. Of the participants, 35.5% studied at the early childhood education program, 30.9% in the elementary science education program, and 27.7% in the elementary mathematics education program. The rest of participants were enrolled in graduate program under the department of elementary education. The results of the study demonstrated that VBN theory explain teacher candidates' energy conservation behaviors. It was reported that energy conservation behaviors were accounted by personal norms, egoistic and biospheric value orientations. Also, it was stated that egoistic and biospheric value orientations explained consumer behavior more than personal norms. Moreover, the model of the study demonstrated that these teacher candidates had a feeling of moral obligation, developed a sense of responsibility, and were aware of the consequences to human and non-human living things in the context of energy conservation. While egoistic value orientation significantly and negatively contributed the energy conservation behaviors, biospheric value orientation significantly and positively contributed the energy conservation behaviors.

Sener and Hazer (2008) conducted a study investigating values and sustainable consumption behavior of women with a sample of 600 women in Ankara.

In order to measure values of participants, a list of 23 values from five value types from Schwartz's model and Turkish terminology of Kusdil and Kagitcibasi (2000) was used. Adapted form of environmentally friendly behaviors instrument was used to measure the sustainable consumption behaviors and was developed by Thøgersen and Ölander (2002). It was reported that participants paid attention to avoiding costly behaviors and gave more importance to the 'self-transcendence' values than 'self-enhancing' values. As a result, the values of this sample of Turkish women were related to their behaviors.

In their study, Teksoz, Sahin and Tekkaya-Oztekin (2011) suggested an environmental literacy model to determine how environmental attitudes, environmental concern, environmental responsibility, environmental knowledge and outdoor activities related to each other with a sample of 1345 university students. To collect data from this sample, environmental literacy survey (Kaplowitz and Levine, 2005) was used. The survey consisted of three parts about respondents' environmental attitudes (10 items), responsibility (19), and concerns (9 items) and 5-point Likert-type questions. In addition, survey included some questions about whether they participate in outdoor activities or not, information about gender, field of the study and class standing of respondents. It was reported that high levels of environmental knowledge foster university students' concern, attitudes and personal responsibility toward protection of the environment. Also, environmental knowledge had significant indirect relationships with environmental responsibility and attitudes. In addition, while environmental attitudes held significant association with environmental responsibility, environmental concern was found to be a significant predictor of environmental attitudes and outdoor activities. It was implied that individuals' positive attitudes and concern toward environmental issues can foster their personal responsibility in taking the essential actions to form a sustainable future in the light of the associations between the psychological variables in this study.

2.5. Conclusions from Literature Review

As acknowledged by Leiserowitz, Maibach, Roser-Renouf, and Smith(2012), there was no a considerable consensus about the reality of anthropogenic climate change despite recent findings from environmental research about evidence in climate change. Current researches and pro-environmental behavior models

demonstrated that improving of public knowledge about climate change is not adequate to activate public to take pro-environmental action towards climate change (Whitmarsh, 2008). It was not enough for individuals to know about climate change to perform pro-environmental behavior towards climate change. In order to be meaningfully engaged on the issue, the public needed to care about it, be motivated and be able to take action (Whitmarsh, 2005).Any effort to understand and respond towards climate change should begin with education (Potter, 2010). Unfortunately, public today shared a relative lack of literacy with regard to environmental issues (Short, 2010). Also, climate change issues created a significant topic for both science and environmental education and how to understand and respond to climate change is a major part of the new science standards all over the world (Whitmarsh, 2011). The standards recommend that students understand the possible impacts of climate change and make determinations about how to mitigate climate change causes and effects for human beings and environment (United Nations Development Program, 2010). Moreover, this educational goal was especially urgent considering today's students will be adult and more affected by climate change. The outcome of today's decisions about climate change and received decisions about climate change may have an effect throughout their lifetimes. To inform students about climate change issue, teachers play a critical role in educating future generations about environmental issues such as climate change (Liu et al., 2012). Students' perspectives and point of views about climate change generally was affected by teachers' beliefs about climate change (Duschl, 1990). Also, teaching strategies of teachers often align with teachers' knowledge and beliefs (Waters-Adams, 2006) in order to achieve effective classroom practice for climate change education. For this reason, investigating the nature of teachers' attitudes, beliefs and knowledge about climate change is critical issues in environmental education. Thus, it is critical to facilitate social change with the proper communication such as environmental education and science education, because correct information effectively drives change in behavior and policy support towards climate change. In order to modify attitudes and behavior, it is important to comprehend the channels via which the teachers perceive information, as well as the teachers' mental models and levels of understanding, particularly its interests, values and concerns (Bostrom & Lashof, 2007; Dunwoody, 2007). Since teachers may hold strong and vastly different attitudes towards critical issues, it is important to know teachers' existing attitudes.

CHAPTER 3

METHOD

This chapter begins with the design of the study followed by the background characteristics of population and sample. The chapter proceeds to review of instruments used in the study, with then the procedure, and the data analysis is given. The chapter ends with assumptions and limitations, as well as internal and external validity associated with the study.

3.1 Design of the Study

This study is a correlational study due to the nature of research questions addressed, hypothesizes generated at the outset, description of the sample and population, data collection procedures, statistical techniques used to analyze data, and generalizations of the study findings. In the present study, path analysis was used to test the likelihood of a causal connection among knowledge about climate change, environmental attitudes, epistemic beliefs regarding climate change, uncertainty beliefs regarding climate change and pro-environmental behaviors towards climate change. Based on the previous research, hypotheses were generated and a model was proposed to explain the associations among variables of interest (see figure 1.1.). A flowchart provided below (Figure 3.1) described the procedure followed during the study. A table provided below (Table 3.1) presented the summary of research design during the study.

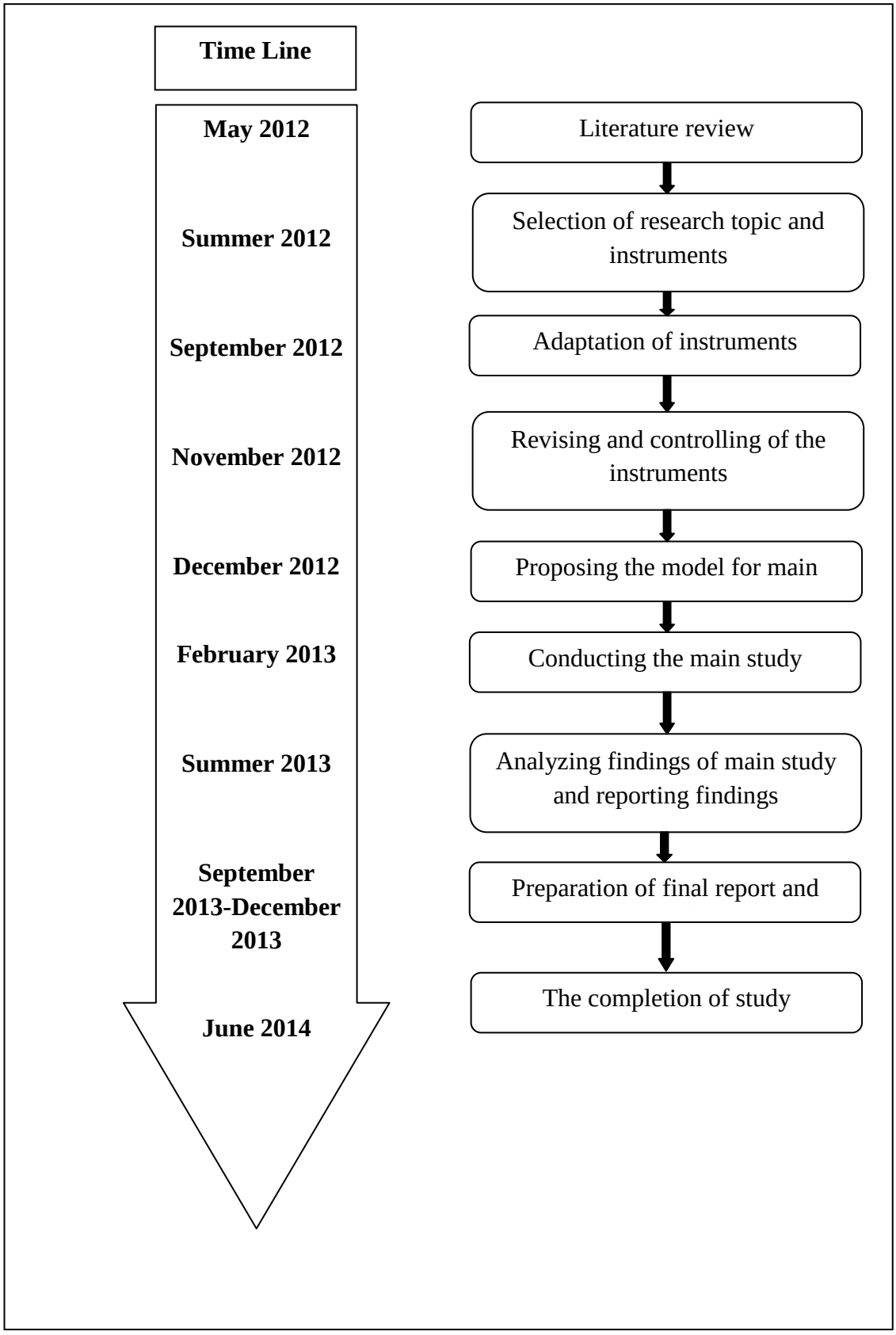

Figure 3.1.An Overview of study's timeline

Table 3.1 Summary of the research design

Research Questions	**Aim**	**Instruments**
1. How do the pre-service science teachers conceptualize 'climate change'?	To determine pre-service science teachers' beliefs regarding climate change and source of information they use.	i. Self-assessment scales regarding climate change background
2. What are pre-service science teachers' environmental attitudes, knowledge and confidence in their knowledge about climate change, uncertainty beliefs about climate change, epistemic beliefs regarding climate change and pro-environmental behavior?	To determine pre-service science teachers' knowledge, epistemic beliefs and uncertainty beliefs regarding climate change, environmental attitudes and pro-environmental behaviors.	i. Knowledge and confidence in knowledge about climate change scale ii. Pro-environmental behavior scale iii. Environmental attitudes iv. Topic specific epistemic beliefs questionnaire v. Uncertainty beliefs scale
3. How environment-related attributes (environmental attitudes, knowledge about climate change, epistemic beliefs regarding climate change and uncertainty beliefs regarding climate change) influence pre-service science teachers' pro-environmental behaviors?	To explore whether pre-service science teachers' pro-environmental behaviors are predicted by their ecocentric and anthropocentric attitudes, knowledge about climate change, epistemic beliefs regarding climate change, uncertainty beliefs about climate change.	i. Knowledge and confidence in knowledge about climate change scale ii. Pro-environmental behavior scale iii. Environmental attitudes iv. Topic specific epistemic beliefs questionnaire v. Uncertainty beliefs scale
4. What is the nature of direct and indirect relations among the underlying dimensions of pre-service science teachers' knowledge about climate change, environmental attitudes, epistemic beliefs about climate change, uncertainty beliefs about climate change, and pro-environmental behavior?	To investigate relationships among pre-service science teachers' knowledge about climate change, environmental attitudes, epistemic beliefs about climate change, uncertainty beliefs about climate change, and pro-environmental behavior.	i. Knowledge and confidence in knowledge about climate change scale ii. Pro-environmental behavior scale iii. Environmental attitudes iv. Topic specific epistemic beliefs questionnaire v. Uncertainty beliefs scale

3.2 Population and Sample

This research was desired to be a national study and the target population was defined as all pre-service science teachers studying at public universities in Turkey. Accessible population, however, was identified as pre-service science teachers who studying in seven geographical region of Turkey (Aegean Region, Black Sea Region, Central Anatolia Region, Eastern Anatolia Region, Marmara Region, Mediterranean Region, and Southeastern Anatolia Region). To obtain a representative sample of the population 12 public universities were selected by cluster random sampling. To reach the representative sample of this study, cluster random sampling integrated with convenience sampling was used to obtain the sample. Finally, the sample of the study was consisted of nearly 1277 pre-service science teachers.

Among them 271 pre-service science teachers were freshman, 268 pre-service science teachers were sophomore, 524 pre-service science teachers were junior and 201 pre-service science teachers were senior. There were totally 888 (69.5%) females and 385 (30.1%) males in the sample (see table 3.2)

Table 3.2 General Characteristics of the Sample

	Frequency (f)	**Percentages (%)**
Gender		
Female	888	69.5
Male	385	30.1
Missing	4	.3
Educational level		
Freshman	271	21.2
Sophomore	268	21.0
Junior	524	41.0
Senior	201	15.7
Missing	13	1.0

Table 3.3 presents information concerning participants' socio-economic status (SES). Parents' Educational level and employment status were considered as indicators of SES level. As shown in the table, 43.6% percent of mothers graduated from primary school, while 15.2% graduated from secondary school. About 13% had attained high school education. In addition only 6.5% of mothers reported to have graduated from university and 0.9% of mothers had earned a Master's/ doctorate degree.

While 31.4% of fathers had attained primary school education, 17.9% graduated from middle school. Nearly 28.0% graduated from high school. Of the fathers, 17.5% indicated a Bachelor's degree. Only 1.5% of fathers reported to have graduate degree (master's/doctorate). Furthermore, there were 257 illiterate mothers and 44 illiterate fathers in the sample. As far as parents' work status are concerned, majority of pre-service science teachers reported their mothers (84.7%) as housewife, followed by was indicated as white-collar (7%), and blue-collar (3.7%). About 3.8% of mothers were reported as self-employed. As the statistics show, majority of the mothers were unemployed in contrast to fathers. On the other hand, only 5.6% of fathers were reported to be unemployed. Of the employed fathers, 11.5% were farmer, 31.1% were self-employment while 25.8% were white-collar and 24.1% were blue-collar. Table 3.4 represents information concerning geographical characteristics of the sample.

Table 3.3 Socio-economic Status of the Sample

Education level	Mother		Father	
	f	**%**	***f***	**%**
Illiterate	257	20.1	44	3.4
Primary School	557	43.6	401	31.4
Middle School	194	15.2	228	17.9
High School	166	13.0	357	28.0
Undergraduate	83	6.5	223	17.5
Graduate	11	.9	19	1.5
Missing	9	.7	5	.4
Occupation				
Housewife	1081	84.7	-	-
White collar	89	7.0	330	25.8
Blue collar	47	3.7	308	24.1
Self-employed	49	3.8	397	31.1
Farmer	-	-	147	11.5
Unemployed	-	-	71	5.6
Missing	11	.9	24	1.9

Table 3.4 Geographical Characteristics of the Sample

	Geographical Provinces						
Measures	Marmara	Central Anatolia	Aegean	Mediterranean	Black Sea	Eastern Anatolia	South-eastern Anatolia
Distribution of pre-service science teachers: %							
Girls	72.4	71.5	68.9	76.3	62.3	71.7	67.2
Boys	27.6	28.1	31.1	22.7	37.1	27.8	32.8
Missing	-	0.4	-	1	0.6	0.4	-
Total	7.7	20.6	12.8	7.6	13.1	17.5	20.7

3.3. Data Collection Instruments

The data was collected by having pre-service science teachers' complete questionnaires regarding their pro-environmental behaviors, environmental attitudes, epistemic beliefs about climate change, and uncertainty beliefs about the reality of anthropocentric climate change and knowledge and their confidence in this knowledge. Accordingly, the present study relied on 6 sources of data: Demographical Questionnaire, Uncertainty Scale, Pro-Environmental Behavior Scale, Knowledge and Confidence in Knowledge about Climate Change Scale, Topic Specific Epistemic Beliefs Questionnaire, and Environmental Attitudes Scale. This part begin with brief information about adaptation of instruments, followed by detailed description of instruments and the results of confirmatory factor analyses conducted to measure fitness of data for the present study.

While adopting instruments into different language from original language, adaptation process requires culturally and psychologically suitable words in translation into the second language instead of words in a simple literal translation of the instrument (Hambleton et al, 2005). In this study, during adaptation process of the scales, which were used in study, cultural context of Turkey were taken in account and suitable words in terms of cultural and psychological were tried to be used. Translated version of the instrument was examined by two instructors from the Faculty of Education – science education department for its content validity. They also judged the quality of items concerning clarity, sentence structure, and comprehensiveness. In addition, the grammar structure of the translation was examined by three of the instructors from Academic Writing Center of Middle East Technical University. According to the suggestions of instructors from both faculty of education and Academic Writing Center, the instrument was revised. Also, more

than one translator translated and controlled the words and expressions of statements in used scales in the present study. Then, pilot study was conducted on a sample of 252 pre-service science teachers in two universities located in the same geographical region. Regarding the results of pilot study, necessary corrections and revisions were performed, such as retranslating of some of the items and selection of culturally understandable words. The last version of survey was administered to selected sample by using optical form.

During adaptation of instruments, data were entered in SPSS program. Confirmatory factor analysis was made using LISREL program to evaluate how well items of scales fit to the proposed latent factors of study scales. Before conducting factor analysis and calculating reliability coefficients, negatively worded items were reverse scored because this subscale included both positively and negatively worded items. Fit indexes of goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), root mean square error of approximation RMSEA), and standardized root mean square residuals (SRMR) values were presented in scale descriptions.

3.3.1 The Demographical Survey

This questionnaire was used to gather personal characteristics data concerning pre-service teachers' gender, class level and socio-economic status. The SES items investigated mother education level, father education level, mother occupation, father occupation.

3.3.2 Pro-Enviromental Behaviour Scale

Pro-Enviromental Behaviour Scale, which is a five point rating scale (5= always, 4= frequently, 3= sometimes, 2= rarely, 1= never), was used to evaluate university students' behaviors pertaining to sustainability (Mertig, 2003). The original version of the scale consisted of 14 items assessing university students' pro-enviromental responsible behaviours. This scale was translated and adapted to Turkish by Sahin, Ertepinar and Teksoz (2012). Similarly, the scale was composed of 14 items. Internal reliability of the scale was found as .86. This scale is known to be highly predictive of behaviors towards environment.

Confirmatory factor analysis was conducted using LISREL 8.80 program. Table 3.7 shows the Pro-Environmental Behavior Scale items with their respective loadings, as derived from LISREL analysis. Also, all loadings are .35 or greater than

the cut-off .30. The cut-of .30 for factor loading of CFA was suggested by Roberts and Bacon (1997).

Then, confirmatory factor analysis was conducted after reliability analyses. Four indexes, namely Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residuals (SRMR), Goodness of Fit Index (GFI), and Comparative Fit Index (CFI) were presented as fit statistics. The Root Mean Squared Error of Approximation (RMSEA) values below .06 and the Root Mean Square Residuals (SRMR) values below .08 are accepted as good fit values. Moreover, Goodness of Fit Index (GFI) greater than .90 and Comparative Fit Index (CFI) higher than .90 indicate a good fit to the data (Tabachnick & Fidell, 2013).

In order to validate factor structure for the present study, CFA was conducted for the scale. The CFA results obtained from each section is presented in Table 3.19**.**

Table 3.5 CFA Results before Item Deletion

Scale	RMSEA	SRMR	GFI	CFI
Pro-environmental behavior	.11	.078	.87	.89

As shown in Table 3.5, the fit indices revealed that the model fit for environmentally responsible behavior scale was not acceptable in main study. Considering reliability analyses and confirmatory factor analyses results, two of the items from environmentally responsible behavior scale, which did not contribute well to the total variability and had very low factor loading, were deleted and a second CFA was conducted on the remaining data for the main study.

Table 3.6 CFA Results and Reliability Coefficient of the Main Study

Scale	RMSEA	SRMR	GFI	CFI	Reliability
Pro-environmental behavior	.043	.029	.98	.99	.84

As shown in the table above, fit indices indicated a good model fit for the scale. Also reliability coefficients presented in Table 3.6 were in acceptable ranges. Final form of the pro-environmental behaviour scale was composed of 12 items.

Table 3.7 Pro-Environmental Behavior Items with Loadings from CFA

Item Description	**Loading**
Deliberately purchased food produced locally rather than imported products.	.36
Attended a protest march or a demonstration for environmental reasons.	.57
Purchased products packaged in reusable or recyclable containers.	.61
Avoided buying from a company which shows disregard for the environment.	.58

Picked up litter or trash.	.59
Recycled glass bottles, aluminum cans or paper.	.51
Tried to use less energy (electricity, water etc.)	.41
Made an effort to use less water when brushing my teeth or bathing.	.35
Considered politicians' positions related to environmental issues when voting or supporting.	.51
Chose to read publications that focus on environmental issues.	.68
Encouraged people involved in a destructive environmental behavior to stop that activity.	.70
Encouraged others to take an action on behalf of the environment.	.67

3.3.3 Knowledge and Confidence in One's of Knowledge about Climate Change

It was prepared to investigate the knowledge and confidence in one's own knowledge about climate change among experts, journalists, politicians, and laypersons (Sundblad, Biel & Garling, 2008). This scale was a bipolar scale. First polar was designed to measure knowledge of individuals about climate change and second polar was designed to measure confidence of individuals' knowledge about climate change. In the first polar, individuals assess statements about climate change as true or false. Then, individuals rate their answers in first polar according to their confidence level which was composed of a six-point rating scale ranging from "6 = very certain" to "1 = very uncertain". The sale composed of three domains concerning current climate state, causes, and consequences of climate change. Knowledge of climate state was assessed by 8 statements, causes by 12 statements, and consequences by 24 statements. Knowledge of 3 different types of consequences was assessed: weather consequences (6 statements), sea and glaciers consequences (12 statements), and health consequences (6 statements). The knowledge and confidence in one's knowledge of climate change and consist of 22 true and 22 false statements. The true statements were based on expert reports with a high likelihood of being true. The main source of questions was IPCC (2001a, 2001b). False statements were either contrasts to the true statements or well-known misunderstandings prevalent in society. The purpose of the false statements was to counteract a response set to answer true to all statements. For each statement, there was one box for true and one for false to be checked by the participants. Confidence was assessed on a six-point rating scale ranging from "6 = very certain" to "1 = very uncertain".

The instrument was translated and adapted into Turkish by Hiğde and Oztekin (2013a). Translated version of the instrument was examined by instructors from the faculty of education – science education department for its content validity. They also judged the quality of items concerning clarity, comprehensiveness and grammar structure. The data obtained from study were first entered to PASW and then confirmatory factor analysis was conducted using LISREL. Table 3.10 shows the Knowledge and Confidence in One's Knowledge about Climate Change Scale items with their respective loadings, as derived from LISREL analysis. Also, all loadings are .45 or greater than the cut-off .30. The cut-off .30 for factor loading of CFA was suggested by Roberts and Bacon (1997). In order to validate factor structure for the present study, CFA was conducted for the scale. The CFA results obtained from each section is presented in Table 3.8**.**

Table 3.8 CFA Results before Item Deletion

Scale	RMSEA	SRMR	GFI	CFI
Knowledge	.099	.21	.91	.91

As shown in Table 3.8, the fit indices revealed that the model fit for knowledge part of the scale was not acceptable in main study. Considering reliability analyses and confirmatory factor analyses results, five of the items from knowledge and confidence in one's knowledge of climate change scale, which did not contribute well to the total variability and had very low factor loading, were deleted and a second CFA was conducted on the remaining data for the main study.

Table 3.9 CFA Results and Reliability Coefficient of the Main Study

Scale	RMSEA	SRMR	GFI	CFI	Reliability
Knowledge	.087	.17	.92	.94	.61

As shown in the table above, fit indices indicated a good model fit for each sub-scale. Also, reliability coefficients presented in Table 3.9 were in acceptable ranges. Final form of knowledge and confidence in one's knowledge of climate change scale was composed of 13 items. This scale was composed of two polar which are knowledge about climate change and confidence in one's knowledge about climate change.

Table 3.10 Knowledge about Climate Change Items with Loadings from CFA

Item Description	Loading
The blanket of snow in the Northern hemisphere has decreased approximately 10% since the 1960s.	.45
The blanket of snow in the Northern hemisphere is currently approximately the same as in the 1960s.	.46
The number of storms and floods has increased prominently in the past 100 years.	.63
A cause of the rising sea level is the melting of glaciers and snow	.58
The ice mass of the Arctic is expected to increase in the next 100 years.	.47
It is probable that an increasing number of mosquitoes and ticks within 50 years will cause more cases of human diseases in Sweden, due to the climate change.	.56
The climate change will increase the risk in Sweden for diseases transferred by water (i.e., diarrhea) during the next 100 years.	.63
It is probable that the mortality by lung edema and heart problems during heat waves in Sweden will increase during the next 50 years.	.50
The climate change is mainly caused by increased concentration of greenhouse gases.	.73
The increase of skin cancer is mainly caused by climate change.	.45
The climate change is mainly caused by the ozone hole.	.67
The increase of air pollution is one of important reasons of climate change.	.50
The global sea level has risen approximately 0.2 meters the past 100 years.	.51

3.3.4. Environmental Attitudes Scales

Environmental Attitudes Scales were developed by Gagnon Thompson and Barton (1994) to assess participants' ecocentric and anthropocentric attitudes and general apathy toward environmental issues. Environmental attitudes scale was composed of three dimensions which were ecocentric, anthropocentric and general apathy. The internal reliabilities of these three dimensions were assessed with Cronbach's alpha: 0.63 for ecocentrism, 0.58 for anthropocentrism, and 0.83 for general environmental apathy. Ecocentric attitudes were measured with ten items reflecting the intrinsic value of nature, feelings of relaxation being in nature and being aware of a relation between humans and nature. Regarding the assessment of anthropocentric attitudes, most of the thirteen anthropocentrism items emphasize a concern associated with the decreased quality of human life as a result of environmental degradation. Eleven items were used to measure the environmental apathy toward environment. These items emphasize a lack of interest in the environmental issues and an idea that environmental threats have been exaggerated. The items on environmental attitudes and general apathy were rated on a 5-point Likert scale (1, strongly disagree; 2, disagree; 3, undecided; 4, agree; 5, strongly agree). Items in the scale were translated and adapted into Turkish by Eryiğit (2010).

For this study, only items belong to ecocentric (concern for all living things) and anthropocentric (concern for humans) dimensions were adapted. After the adaptation and translation of the instrument, it consisted of 23 items. Confirmatory factor analysis was conducted to validate factor structure for the present study. Table 3.12 shows the Environmental Attitude Scale items with their respective loadings, as derived from LISREL analysis. Also, all loadings are .39 or greater for items ecocentric and anthropocentric dimensions. Factor loadings were well above the cut-off .30 which was suggested by Roberts and Bacon (1997).

Table 3.11 CFA Results and Reliability Coefficient of the Main Study

Sub-Scale	RMSEA	SRMR	GFI	CFI	Reliability
Ecocentric attitude	.063	.036	.97	.97	.82
Anthropocentric Attitude	.054	.036	.97	.98	.84

The internal consistency of ecocentric attitudes and anthropocentric attitudes item sets was reported as 0.82 and 0.84, respectively assessed with Cronbach's alpha. These values indicate an acceptable measure of internal consistency for the related constructs.

Final form of the environmental attitudes scale was composed of ecocentric and anthropocentric dimensions and 23 items. Ecocentric dimension was composed of 10 items. Anthropocentric dimension was composed of 13 items.

Table 3.12 Environmental Attitude Scale Items with Loadings from CFA

Dimension	Item Description	Loading
Ecocentric	One of the worst things about overpopulation is that natural areas are getting destroyed for development.	.47
	I can enjoy spending time in natural settings just for the sake of being out in nature.	.57
	Sometimes it makes me sad to see forests cleared for agriculture.	.54
	I need time in nature to be happy.	.65
	Sometimes when I am unhappy I find comfort in nature.	.68
	It makes me sad to see natural environments destroyed.	.60
	Nature is valuable for its own sake.	.54
	Being out in nature is a great stress reducer for me.	.70
	One of the most important reasons to conserve is to preserve wild areas.	.39
	Plants, animals have as much right as humans to exist.	.42
Anthropocentric	The worst thing about the loss of the rain forest is that it will restrict the development of new medicines.	.59
	The thing that concerns me about deforestation is that there will not be enough lumber for future generations.	.43
	One of the most important reasons to keep rivers and lakes clean is so that people can have a place to enjoy water sports.	.51
	One of the best things about recycling is that it saves money	.52
	The most important reason for conservation is human survival	.58
	Nature is important because of what it can contribute to the pleasure and welfare of humans.	.64
	We need to preserve resources to maintain a high quality of life.	.59
	One of the most important reasons to conserve is to ensure a continued high standard of living.	.66
	Continued land development is a good idea as long as a high quality of human life can be preserved.	.51
	Yaşam tarzımı değiştirmek zorunda olmadığım sürece çevreyi korumak için elimden gelenin en iyisini yaparım.	.55
	Wild animals that provide meat for people are the most important species to protect.	.56
	Animals could be used in scientific experiments to save human life	.52
	Humans have the right to modify the natural environment to suit their needs.	.39

3.3.5. Topic Specific Epistemic Beliefs Questionnaire (TSEBQ)

The Topic Specific Epistemic Beliefs Questionnaire (TSEBQ; Bråten et al., 2009), which is a ten point scale ranging from "10 = strongly agree" to "1 = strongly disagree", was used to elicit the epistemic beliefs of university students in relation to climate change.The original version of the scale consisted of 49 items assessing four hypothesized epistemic beliefs, namely, certainty of knowledge about climate change (12 items), simplicity of knowledge about climate change (12 items), source of knowledge about climate change (12 items), and justification for knowing about climate change (13 items). Cronbach's α for items loading on Certainty of Knowledge About Climate Change, Simplicity of Knowledge About Climate Change, Source of Knowledge About Climate Change, and Justification for Knowing About Climate Change were .70, .60, .71, and .71, respectively.

This scale was translated and adapted to Turkish by Hiğde and Oztekin (2013b) to assess the epistemic beliefs of pre-service science teachers about climate change. After the adaptation and translation of the instrument, CFA was conducted to evaluate how well items of scales fit to the proposed latent factors of TSEBQ. Results of the pilot study suggested reliable and valid Turkish version of TSEBQ consists of 19 items. Some items in pilot study did not show acceptable factor loadings in any dimensions of the scale and lower factor loadings than cut point of .30. The cut point of .30 for factor loadings in CFA was suggested by Roberts and Bacon (1997). Also, according to *t*-values of CFA, the non-significant items were eliminated. Table 3.13 indicates description of the subscales as well as some sample items for each subscale after pilot study.

Table 3.13 Subscales of TSEBQ

Subscale	**Subscale description**	**Sample item**	**n**	**α**
Certainty	This dimension ranges from the belief that absolute truth exists with certainty to the belief that knowledge is tentative and evolving.	The knowledge about climate is constantly changing.	4	.60
Simplicity	This dimension ranges from the belief that knowledge is an accumulation of facts to the belief that knowledge is characterized as highly integrated concepts (i.e., from discrete, concrete, knowable facts to relative, contingent, contextual knowledge).	Within climate research, facts are more important than theories.	5	.61
Source	This dimension ranges from the belief that knowledge originates outside the self and resides in external authoritative sources from which it can be transmitted to the belief that self is a knower with the ability to construct knowledge in interaction with others.	When I read about issues related to climate, I try to form my own understanding of the content.	4	.64
Justification	This dimension concerns how individuals evaluate knowledge claims, ranging from the belief that knowledge can be justified on the basis of what feels right, first-hand experience, authority, etc. to the belief that rules of inquiry or reason should be used, that one must personally evaluate and integrate sources, critically assess expert opinions, etc.	To check whether what I read about climate problems is reliable, I try to evaluate it in relation to other things I have learned about the topic.	6	.60

After pilot study for TSEBQ consisting of 19 items, confirmatory factor analysis was made for main study to measure fitness of data for the present study. Confirmatory factor analysis was conducted using LISREL. Table 3.16 shows the Epistemic Belief about Climate Change Scale items with their respective loadings, as derived from LISREL analysis. Also, all loadings are .33 and greater than the cut-off point .30. The cut-off .30 was suggested by Roberts and Bacon (1997). Factor 1 represents Certainty dimension, Factor 2 represents Simplicity dimension, Factor 3 represents Source dimension and Factor 4 represents Justification dimension.

Then, confirmatory factor analysis was conducted after reliability analyses. Four indexes, namely Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residuals (SRMR), Goodness of Fit Index (GFI), and Comparative Fit Index (CFI) were presented as fit statistics. The Root Mean Squared Error of Approximation (RMSEA) values below .06 and the Root Mean Square Residuals (SRMR) values below .08 are accepted as good fit values. Moreover, Goodness of Fit Index (GFI) greater than .90 and Comparative Fit Index (CFI) higher than .90 indicate a good fit to the data (Tabachnick & Fidell, 2013).

As shown in Table 3.14, the fit indices revealed that the model fit for epistemic beliefs questionnaire was not acceptable in main study. Considering reliability analyses and confirmatory factor analyses results, one of the items from source of knowledge about climate change sub-scale, which did not contribute well to the total variability and had very low factor loading, were deleted and a second CFA was conducted on the remaining data for the main study.

Table 3.14 CFA Results of Main Study

Scale	RMSEA	SRMR	GFI	CFI
TSEBQ	.10	.12	.85	.46

In the main study, the results in the following table were obtained in terms of CFA fit indices and reliability coefficients for TSEBQ after eliminating of one item from source of knowledge about climate change sub-scale (see Table 3.15).

Table 3.15 CFA Results and Reliability Coefficient of the Main Study

Scale	RMSEA	SRMR	GFI	CFI	Reliability
TSEBQ	.054	.046	.95	.96	.81

Table 3.16 TSEBQ Items with Loadings from CFA

Dimension	Item Description	Loading
Certainty	The knowledge about issues concerning climate is constantly changing.	.40
	Theories about climate can be disproved at any time.	.54
	What is considered to be certain knowledge about climate today, may be considered to be false tomorrow.	.33
	The results of climate research are preliminary.	.61
Simplicity	Within climate research, facts are more important than theories.	.74
	Within climate research, accurate knowledge about details is the most important.	.84
	Within climate research, accurate knowledge about details is the most important.	.40
	Within climate research, many things hang together.	.65
	Knowledge about climate is primarily characterized by a large amount of detailed information.	.62
Source	To gain real insight into issues related to climate, one has to form one's own personal opinion of what one reads.	.67
	My own understanding of issues concerning climate is at least as important as the knowledge that exists about them in various texts.	.60
	When I read about issues related to climate, I try to form my own understanding of the content.	.63
Justification	When I read about climate problems, I trust the results of scientific investigations more than the viewpoints of ordinary people.	.56
	I understand issues related to climate better when I think through them myself, and not only read about them.	.66

To find out whether what I read about climate problems is trustworthy, I try to compare knowledge from multiple sources.	.63
When I read about climate problems, I have most confidence in knowledge that confirms what I have seen with my own eyes.	.74
To be able to trust knowledge claims in texts about issues concerning climate, one has to check various knowledge sources.	.67
To check whether what I read about climate problems is reliable, I try to evaluate it in relation to other things I have learned about the topic.	.59

Final form of Turkish version of TSEBQ was composed of 18 items and four belief dimensions about knowledge about climaet change. Factor 1 represents Certainty dimension composed of 4 items, Factor 2 represents Simplicity dimension composed of 5 items, Factor 3 represents Source dimension composed of 3 items and Factor 4 represents Justification dimension composed of 6 items.

3.3.6. The Uncertainty Scale

The Uncertainty scale, which is a five point Likert scale ranging from "5 = strongly agree" to "1 = strongly disagree", was used to assess pre-service science teachers' uncertainty about the reality of anthropogenic climate change. The uncertainty scale was originally developed by Whitmarsh (2005) to assess public scepticism about the reality of anthropogenic climate change. The original version of the scale consisted of 37 items assessing one hypothesized skeptical view about anthropogenic climate change. Uncertainty scales are composed of two dimensions which are disinterest in climate change dimension and scepticism dimension. Disinterest in climate change dimension includes items about individuals see climate change as irrelevant to them and they do not make any action to influence on climate change. Scepticism dimension include items about rejection of human effect on climate change. Whitmarsh reported internal consistency reliabilities as 0.66 for scepticism dimension of uncertainty scale.

The instrument was translated and adapted into Turkish by Higde and Oztekin (2013b). The results of the pilot study demonstrate that uncertainty scale was composed of 23 items and two dimensions which were disinterest in climate change and scepticism dimensions. Disinterest in climate change dimension included 11 items. Scepticism dimension included 12 items.

The data obtained from main study were first entered to PASW and then confirmatory factor analysis was conducted using LISREL. Table 3.19 shows the Uncertainty Scale items with their respective loadings, as derived from LISREL analysis. Also, all loadings were .35 or greater than the cut-off point .30. Roberts and Bacon (1997) suggested cut-off point as 0.30 for factor loadings of CFA.

Then, confirmatory factor analysis was conducted after reliability analyses. Four indexes, namely Root Mean Square Error of Approximation (RMSEA), Root Mean Square Residuals (SRMR), Goodness of Fit Index (GFI), and Comparative Fit Index

(CFI) were presented as fit statistics. The Root Mean Squared Error of Approximation (RMSEA) values below .06 and the Root Mean Square Residuals (SRMR) values below .08 are accepted as good fit values. Moreover, Goodness of Fit Index (GFI) greater than .90 and Comparative Fit Index (CFI) higher than .90 indicate a good fit to the data (Tabachnick & Fidell, 2013).

Table 3.17 CFA Results before Item Deletion

Scale	RMSEA	SRMR	GFI	CFI
Uncertainty scale	.070	.091	.84	.92

As shown in Table 3.17, the fit indices revealed that there was an acceptable model to data fit for uncertainty scale. Considering reliability analyses and confirmatory factor analyses results, 6 of the items from uncertainty scale, which did not contribute well to the total variability and had very low factor loadings, were deleted and a second CFA was conducted on the remaining data. After deletion of 6 items, the second CFA revealed a good model fit for scale (see Table 3.18), these problematic items were not included and remaining 17 items were used to assess pre-service science teachers' uncertainty about the reality of anthropogenic climate change.

Table 3.18 CFA Results and Reliability Coefficient after Item Deletion

Scale	RMSEA	SRMR	GFI	CFI
Uncertainty scale	.055	.057	.92	.96

The internal consistency for disinterest in climate change and scepticism dimensions of uncertainty scale items sets was reported as 0.82 and 86, respectively assessed with Cronbach's alpha. These values indicate an acceptable measure of internal consistency for the related construct.

Final form of uncertainty scale was composed of 17 items and two dimensions. First dimension is disinterest dimension composed of 6 items about individuals' relation with climate change. Second dimension is scepticism composed of 11 items about individuals' skeptical beliefs towards anthropogenic climate change. Factor loadings obtained in CFA were given in the following Table 3.19.

Table 3.19 Uncertainty Scale Items with Loadings from CFA

Dimension	Item Description	Loading
Disinterest to climate change	It is already too late to do anything about climate change.	.68
	Human activities have no significant impact on global temperatures.	.72
	Nothing I do makes any difference to climate change one way or another.	.68
	I tend to consider information about climate change to be irrelevant to me.	.72
	There is no point in me doing anything about climate change because no-one else is.	.67
	Nothing I do on a daily basis contributes to the problem of climate change.	.43
Scepticism	Climate change is something that frightens me. (R)	.35
	I am uncertain about whether climate change is really happening.	.72
	The evidence for climate change is unreliable.	.54
	Claims that human activities are changing the climate are exaggerated.	.72
	There is too much conflicting evidence about climate change to know whether it is actually happening.	.45
	The effects of climate change are likely to be catastrophic. (R)	.64
	Recent floods in this country are due to climate change. (R)	.45
	It is too early to say whether climate change is really a problem.	.72
	The media is often too alarmist about issues like climate change.	.60
	Flooding is not increasing, there is just more reporting of it in the media these days.	.64
	I do not believe climate change is a real problem.	.71

(Note: R means reverse items)

3.4 Procedure

At the beginning of the presents study, it was started with the identification of the research problem. Then, scales for the present study was selected. To use these scales, essential permission for using the scale from the authors was granted. After that the translation and adaptation period were started. During the adaptation and translation period, translations were controlled by Academic Writing Center to make correct and culturally suitable tranlation. To control suitability of the scales to science education, faculty members of science education were consulted. After that, the scale was ready to collect data from pre-service science teachers. The research was conducted ethically following the protocols approved by the Human Research Ethical Committee and students' participation in the search was voluntary.

Stated differently, The necessary permissions both from the Research Center for Applied Ethics of Middle East Technical University and administarion of selected public universities were allowedin order to conduct human subject research. Then, 4 page optic form of instrument were administered to 1500 pre-service science teachers in the 2012-2013 semester at public universities of Turkey. A total of 11 public universities involved in the study. All data collection process was carried out by the researcher. It took roughly one hour for participants to complite the questionnaires. All the explanations and directions were provided by the researcher in every classroom. Instructor support was needed in order to keep the class concentrated on questionnaires. The students were told that their responses will be kept confidential and they were told to complite the questionnaires sincerely. It is also said that this is a voluntary participating study. Any student unwilling to participate was not forced to fill out the questionnaires. No major problem was encountered during the administration of the questionnaires.

3.5. Analysis of Data

PASW and LISREL statistical programs were used to make statistical analysis. By using descriptive and inferential statistics, the collected data were statistically analyzed. Descriptive statistics included mean, standard deviation, frequency, minimum, maximum of the all instruments in the present study were presented as descriptive statisticwhile inferential statistics comprised path analysis was used to examine the link

between pro-environmental behaviour, scepticism about climate change, epistemic beliefs about climate change, value orientations, attitudes towards climate change and knowledge about climate change.

3.6 Assumptions and Limitations of the Study

3.6.1 Assumptions of the Study

1. The administration of the Questionnaireswere done under standard conditions.
2. The items of scales were answered sincerely by the subjects of the study.
3. Pre-service sience teachersdid not interact with each other during the instruments' administration.

3.6.2 Limitations of the Study

The current research study has some limitations to take into account in any attempt to generalize the results.

1. This study is limited to pre-service science teachers attending to public universities located in Turkey. Data from different kind of universities (private) and sample (background) might provide different results.
2. The number of items found in the questionnaire may not be sufficient to grasp the students' pro-enviromental behaviours and related attributes.
3. The data might not represent the complete objectivity because of using self-report measure. Future inquiries threfore use qualitative data collection procedures such as interviews to validate and get an in-depth understanding of the observed relationships.
4. Behavior was not actual and behavior scale emphasized on behaviors regarding general environmental issues instead of especially emphasizing on climate change

3.7 Internal Validity of the Study

Internal validity of the study refers to the differences on the dependent variable obtained in a research study is due to the independent variable, and not causing from any other unrelated variables (Fraenkel & Wallen, 2006). In this part, the ways of deailing with threats to internal validity were discussed in this section.

In the present study, instrument decay, data collecter characteristics and data collector bias, are not considered to be a threat to internal validity. Because, most of data collection were realized by researchers. Generally, instrument decay are revealed in

observational studies when the insturments is administered to same participants many times. In current study, ınstrument were used just one time and at the same time. The data collection insturment was composed of self-report items and all scoring were made by optical mark reader machine. Data collector bias occurs when data collection and scoring procedure were made by data collector and data can be change unconsciously to obtain certain results.

This study correlational study and data were collected one times for each group. In addition, no intervention takes place in data collection procedure. Therefore, maturation, attitude of subjects, regression, history, maturation and implementation threats to internal validity are not discussed in this part.

In the correlational studies, relationships of participants' characteristics were investigated and the received relationhip can be defined by any other characteristics. This threat to internal validity is known as subject characteristics in correlational research (Fraenkel & Wallen, 2006). In the present study, the obtained relationships might be explained by any other characteristics of subjects such as income level of participants.

The particular locations in which data are collected, or in which an intervention is carried out, may create alternative explanations for results and this is called location threat (Fraenkel & Wallen, 2006). Most of the data collection was made by researchers and clasrooms were controlled for holding similar conditions. Although the instruments were administered to participants in their own classrooms, location can be threat to internal validity of the present study due to existing different conditions among universities in different regions, interms of resources, physical conditions.

Another threat to internal validity for the present study is testing because in correlational studies participants' responses to a instrument can be influenced by previous and other related insturments which participants administered preciously. In this study, the instruments were used only once and at the same time, so the testing threat cannot be taken into account.

Although the subject of the study is selected carefully, it is common to lose some as the study progresses. This is known as the mortality threat (Fraenkel & Wallen, 2006). Regarding the current study, the some of the dean of a faculty in a university

refused to participate in the study. In addition, the instruments were administered to the volunteers. Therefore, this situation affects the correlations in the study and mortalitiy can be threat to internal validity for the present study.

3.8 External Validity of the Study

External validity can be defined as the generalizability of the findings of the research studies (Fraenkel & Wallen, 2006). In this study, the sample was intended to be defined randomly but due to the administrative restrictions, this would not be possible. Therefore, the representativeness of the sample might be influenced by the sample selection. On the other hand, there are 53 universities which includes elementary science education department and data were gathered from 11 universities. Although, the selection of the sample was convenient, the large sample size enables the generalizability of the findings.

CHAPTER 4

RESULTS

This chapter consists of the results belong to descriptive and inferential statistics. In the descriptive statistics part, self-assessment regarding climate change background, mean scores, standard deviation, minimum and maximum values and frequency analyses were used. Inferential statistics, on the otherhand, included correlation analysis among pro-evironmental behviour, knowledge about climate change, confidence in kowledge about climate change, environmental attitudes, epistemic beliefs regarding climate change, uncertainty beliefs regarding climate change and path analysis.

4.1. Descriptive statistics

4.1.1. Self-Assessment Regarding Climate Change Background

In this part, results regarding intent oriented behavior, responsibility of climate change, source of information about climate change, general attitude towards climate change, beliefs and opinions about consequences about climate change were presented.

In order to collect information about general attitudes, beliefs and opinions about climate change**,** teacher candidates were asked several questions.Responses revealad that almost all of the participant claimed tohave heard climate changebefore **(**98.2%), and thought thatpattern of weatheris generally changing (92.2%).On the other hand, while 72% of participants agreed with the idea that 'things can be done to mitigate the effects of climate change',7.6% thought nothing can be done to mitigate the effects of climate change. Besides, while 69.5% of participants believed that things can be done to tackle climate change, only7.2% thought nothing can be done to tackle climate change.Apart from, majority of participants percieved climate change as one of the most important problemsare faced by people (72.6%). Although acknowledging that climate change is an important problem,they believed that there are more important problems than climate change (22.8%). A few , on the other hand, claimed that climate change is not an important problem 2.0%and that climate change is not a problem at all 0.4%.As far as

teacher candidates opinions about negative consequences of climate change on living things,great majority indicated their agreement on that climate change negatively affect on all human beings (92.9%). Relatively few argued that climate change negatively influencebeachfront (1.8%), third world (1.0%) as well as poor people (2.0%).

Taken together, self reported responses indicated that pre-service science teachers in our sample wereaware of climate changeand concern about disastrous effect of climate change on all human beings. Although preservice science teachers have not regularly taken any action ot of concern for climate change so far, they thought that things can be done to mitigate the effect of climate change.

In order to collect to information about participants' behavior, the question of whether they regularly take any action out of concern for climate change. Specifically only more than a third of survey teacher candidates (39%) said 'yes' to the question of 'Have you ever taken, or doyou regularly take, any action out of concern for climate change?'. While half of the respondents stated that they have not take any action out of concern for climate change.

Pre-service science teachers' responses to the question of 'Who do you think should have the main responsibility for tackling climate change?' was presented in Table 4.1.Most of the participants shared the idea that all people should take the responsibility of tackling climate change (91.6%) followed by the idea that not only environmental organizations (85.5%) and individuals (84.2%), but also business and industry (79.1%) should take the responsibility to tackling climate change. While 21% remain undecided, less than half (34.3%) indicated that the local governments take the responsibility to tackle climate change.

On a self-reported basis, to the question of "What do you think how much informed you are about climate change issue?" only 3.8% reported to be very informed on climate change. Slightly less than half stated that they had either "sufficiently or moderately informed" about climate change. While 5.9% claimed to know "practically nothing" about climate change, 0.6% were found to be uninformed about climate change issue.

Table 4.1 Frequency Distributions of Participant Agreement with Responsibility Statements and Corresponding Item Means and Standard Deviations

Items	SA	A	U	D	SD	M	StD
International organizations (e. g. the UN, UNESCO)	44.6	29.6	14.3	5.5	6.0	4.01	1.16
The national government	42.1	35.1	13.9	5.4	3.5	4.07	1.04
Local government	34.3	32.7	21.0	7.3	4.8	3.84	1.12
Business and industry	54.7	24.4	9.5	5.6	5.9	4.17	1.17
Environmental organizations /lobby groups (e. g. Worldwide Fund for Nature)	65.4	20.1	5.5	3.6	5.4	4.36	1.10
Individuals	63.7	20.5	6.0	4.2	5.6	4.33	1.12
All people	78.4	13.2	4.3	1.9	2.2	4.64	.83

(Note: SA strongly agree, A agree, U undecided, D disagree, SD strongly disagree, M mean, StD* standard deviation)

4.1.2. Source of Information about Climate Change

Preservice science teachers mentioned various sources of information about climate change. As presented Figure 4.1, majority of participants identified television (86.1%) and internet (75.2%) as main sources of information. About 61.9% wrote that most of their learning about climate change took place in school/university education. Friends and environmental groups were also frequently mentioned. Government institutions supplying energy (8.5%), local municipalities (7.8%) and government agencies (7.2%) were rarely mentioned. A few also mentioned public libraries (4.7%) as a main source of information.

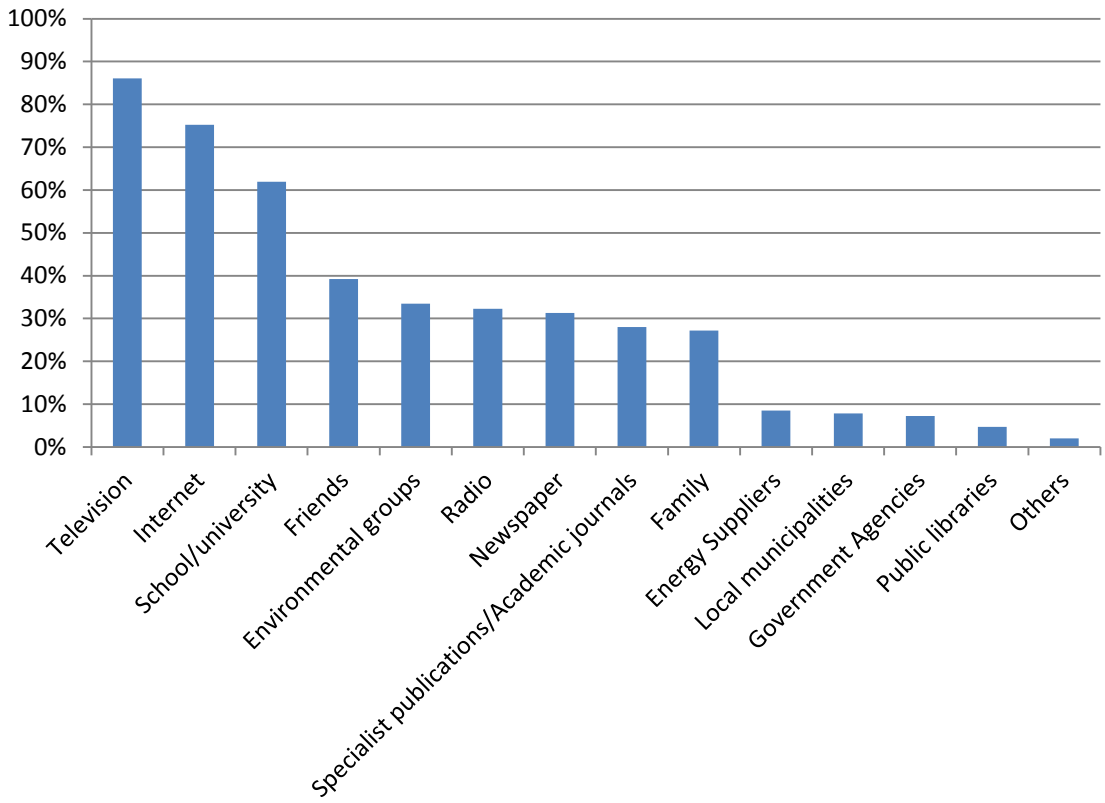

Figure 4.1 Sources of information about climate change

In this following part, results regarding descriptive statistics, in particular, mean scores, standard deviation, minimum and maximum values and frequency analyses obtained from participants responses to the pro-environmental behaviour scale, knowledge about climate change and confidence in knowledge about climate change scale, environmental attitudes scale, topic specific epistemic belief scale, uncertainty beliefs scale were reported.

4.1.3. Preliminary data analyses regarding constructs of the study

The minimum and maximum values, means, standard deviations, number of missing cases, skewness, and kurtosis values were inspected for the quantitative variables that would be subjected to factor analyses. The minimum and maximum values, means, and standard deviations of each of the variables were reasonable and within expected values. For reasonable and expected values for skewness index less than 3.0 and kurtosis index less 10 do not create a problem for univariate normality (Kline, 2005). Skewness index ranged from -2.75 to 2.075 while kurtosis index was within the

range of -1.960 and 7.915. Therefore, there seems to be no serious problem with univariate normality. Percent of missing cases ranged from 0.1% to 4.3%. If the percent of missing cases is below 5% of the sample, the method used for handling missing data does not make a serious effect on the data set (Tabachnick & Fidell, 2001). Missing cases was below 5%; maximum missing case was 4.3%. Missing values were replaced by multiple imputation with expected maximization (EM). Multiple imputation uses matching response patterns in the data and replaces missing values for several variables simultaneously (Schumacker & Lomax, 2004). After imputation, skewness index were in the range of -2.752 to 2.085 while kurtosis index ranged from -1.959 to 8.284. Based on skewness and kurtosis values for all constructs, all values are in acceptable ranges (between -2, +2). They were all normally distributed.

Descriptive statistics, means and standard deviations, skewness and kurtosis values for pro-environmental behavior, knowledge about climate change and confidence about climate change, ecocentric and anthropocentric attitudes, epistemic beliefs regarding climate change, uncertainty beliefs regarding climate change and political view are indicated in Table 4.2.

Table 4.2 Means, Standard Deviations, Skewness and Kurtosis Values for Scales

	Mean	SD	Skewness	Kurtosis
Pro-environmental Behavior	3.40	0.67	-0.07	-0.16
Knowledge About Climate Change	9.85	1.96	-0.64	0.40
Confidence in Knowledge About Climate Change	3.66	0.66	-0.78	1.41
Ecocentric Attitude	4.31	0.57	-0.96	0.92
Anthropocentric Attitude	3.24	0.75	-0.94	1.17
Epistemic Beliefs About Climate Change	7.43	1.09	-0.22	-0.03
Uncertainty Beliefs About Climate Change	2.52	0.74	0.85	1.05
Political View	3.21	0.94	-0.03	-0.50

In the following part, pro-environmental behavior, knowledge about climate change and confidence in knowledge about climate change, ecocentric and anthropocentric attitudes, epistemic beliefs regarding climate change, uncertainty beliefs regarding climate change with respect to gender and total sample were presented in the given sequences.

4.1.4. Pro-Environmental Behavior Scale

It is a self-reported questionnaire, assessing the participants' pro-environmental behavior with a 5 point scale ranging ways to never. Table 4.3 presented mean scores and standard deviations of pro-environmental behaviors with respect to gender.

Table 4.3 Mean and Standard Deviation of Pro-Environmental Behavior Scale With Respect To Gender and Total Sample

	Gender	**M**	**SD**
	Female	3.37	.65
	Male	3.47	.72
Total		3.40	.67

As reported in Table, the overall mean score pro-environmental behavior scale is slightly higher than the mid-point of 3, indicating that participants of this study had relatively low tendency to behave in an environment responsible manner. With respect to gender, however, males, compared to females, gained higher scores which implies males' higher tendency to behave in responsible manner towards environment. Table 4.4 showed frequency distribution of items in pro-environmental behavior scale and mean scores and standard deviation of each item in pro-environmental behavior scale. In analysing data, we elected to collapse strongly agree and agree into one category.

Table 4.4. Frequency Distributions of Participant Agreement with Pro-Environmental Behavior Statements and Corresponding Item Means and Standard Deviations

Items	**Always**	**Frequently**	**Sometimes**	**Rarely**	**Never**	**M**	**StD**
Deliberately purchased food produced locally rather than imported products.	18.6	44.1	27.9	7.5	2.0	3.70	.92
Attended a protest march or a demonstration for environmental reasons.	7.8	13.9	15.7	25.1	37.6	2.29	1.31
Purchased products packaged in reusable or recyclable containers.	15.0	32.6	30.9	16.4	5.2	3.36	1.08
Avoided buying from a company which shows disregard for the environment.	17.5	34.8	27.3	15.2	5.2	3.44	1.10
Picked up litter or trash.	16.3	31.1	29.3	16.2	7.1	3.33	1.14
Recycled glass bottles, aluminum cans or paper.	22.6	38.9	22.5	11.9	4.2	3.64	1.08
Tried to use less energy (electricity, water etc.)	32.9	40.9	18.0	6.4	1.8	3.97	.96
Made an effort to use less water when brushing my teeth or bathing.	39.9	37.9	13.8	5.8	2.6	4.07	1.00
Considered politicians' positions related to environmental issues when voting or supporting.	20.8	29.9	28.7	13.2	7.4	3.43	1.17
Chose to read publications that focus on environmental issues.	13.2	31.9	34.0	17.6	3.4	3.34	1.02
Encouraged people involved in a destructive environmental behavior to stop that activity.	18.0	36.1	29.2	13.5	3.1	3.52	1.03
Encouraged others to take an action on behalf of the environment.	14.5	30.9	30.2	16.8	7.6	3.28	1.13
Total Scale						3.40	.67

Pre-service science teachers tended to engage in pro-environmental behavior, among them are using less water and energy, doing recycling and considering the politicians' position to environmental issue when voting and supporting. For example, great majority of participants reported that they (77.8%) frequently or always made an effort to use less water when brushing their teeth or bathing. In addition, great majority (73.8%) stated that they frequently or always tried to use less energy (electricity, water etc.).On the other hand, they were least likely to attend a protest march or a demonstration for environmental reasons (62.7%) when "rarely" and "never" choices were evaluated together. Participants also mentioned that more than one third of them (44.1%) frequently recycled glass bottles, aluminum cans or paper and more than one third of them (38.9%) frequently purchased food produced locally rather than imported products. More than one third of participants (36.1%) declared that they frequently encouraged people involved in a destructive environmental behavior to stop that activity. Slightly more than one third of participants (34.8%) frequently had a tendency to avoid buying from a company which shows disregard for the environment. While nearly one third of participants (32.6%) frequently purchased products packaged in reusable or recyclable containers, less than one third of participants (30.9%) sometimes. While slightly more than one third of participants (34%) sometimes read publications that focus on environmental issues, less than one third of participants (31.9%) frequently did. In addition, more than one fourth of participants (31.1%) reported that they frequently picked up litter or trash. Nearly equal percentages of participants for frequently (30.9%) sometimes (30.2%) choices stated that they were likely to encourage others to take an action on behalf of the environment. More than one fourth of participants (29.9%) reported that they frequently considered politicians' positions related to environmental issues when voting or supporting.

4.1.5. Knowledge and Confidence in Knowledge about Climate Change Scale

Knowledge and confidence in pre-service science teachers' own knowledge of climate change together with the confidence that they show in their knowledge of climate change was assessed through knowledge and confidence in knowledge scale. It is a 13 item in a bipolar scale. While first part measured the participants' knowledge on climate change issue and second part assessed the confidence level of participants on

their knowledge. Knowledge statements from several domains (causes, sea and glacier consequences, health consequences and weather consequences of climate change) were selected (Table 4.5). As seen from the table, the mean proportion of correct answers exceeded chance level (.50) (Sundblad, Biel & Gärling, 2008).Knowledge was highest for causes, followed by sea and glacier consequences and health consequences. Knowledge was the least for weather consequences.

As far as confidence level was considered, pre-service science teachers were found to have higher confidence in knowledge of causes, followed by confidence in knowledge of weather consequences, health consequences and sea and glacier consequences. In addition, pre-service science teachers were rather confident in their knowledge as mean value of 3.66 is slightly higher than the midpoint of 3.5.Also,the confidence level of three is fairly certain and four is more certain than uncertain.

Table 4.5 Mean and Standard Deviation of Knowledge and Confidence about Climate Change Scale With Respect To Gender and Total Sample

		Knowledge		**Confidence**	
	Gender	**M**	**SD**	**M**	**SD**
	Female	.65	.115	3.68	.647
	Male	.66	.128	3.63	.704
Total		.65	.119	3.66	.664

In short, pre-service science teachers appeared to be knowledgeable about climate change (*M*=.65) and were fairly confident in their own knowledge (*M*=3.66).Females and males were similar with respect to in their knowledge and confident levels. They while expressing a high level of knowledge, they had a rather low sense of confidence in these knowledge.

With respect to gender, it can be said that females had higher in knowledge of consequences confidence in their knowledge about climate change than males (*M*= 3.68 for females and *M*= 3.63 for males).

Table 4.6 Mean and Standard Deviation of Domains for Knowledge about Climate Change Scale With Respect To Gender and Total Sample

		Causes		Sea and Glacier Consequences		Health Consequences		Weather Consequences	
	Gender	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
	Female	.66	.18	.61	.14	.61	.21	.53	.25
	Male	.69	.21	.60	.15	.61	.21	.58	.28
Total		.67	.19	.61	.14	.61	.21	.54	.26

Table 4.7 Mean and Standard Deviation of Domains for Knowledge about Climate Change Scale With Respect To Gender and Total Sample

		Causes		Sea and Glacier Consequences		Health Consequences		Weather Consequences	
	Gender	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
	Female	3.96	.91	3.40	.82	3.61	.83	3.65	.89
	Male	4.00	.88	3.66	.80	3.69	.83	3.78	.92
Total		3.97	.90	3.48	.83	3.64	.83	3.69	.90

Table 4.8 Frequency Distributions of Participant Agreement with Knowledge and Confidence about Climate Change Scale Statements and Corresponding Item Means and Standard Deviations

T	F	Items	VC	FC	U	FU	VU	M	StD
7.6*	92.4	The blanket of snow in the Northern hemisphere has decreased approximately 10% since the 1960s.	21.1	34.5	29.3	7.3	7.8	3.54	1.13
86.1	13.9*	The blanket of snow in the Northern hemisphere is currently approximately the same as in the 1960s.	20.6	26.5	23.3	13.9	15.7	3.23	1.34
21.9	78.1*	The number of storms and floods has increased prominently in the past 100 years.	29.1	35.2	23.2	7.9	4.5	3.77	1.09
85.4*	14.6	A cause of the rising sea level is the melting of glaciers and snow.	41.4	30.3	16.7	7.9	3.7	3.98	1.11
75.2	24.8*	The ice mass of the Arctic is expected to increase in the next 100 years.	23.8	26.2	23.0	14.5	12.5	3.34	1.32
84.5*	15.5	It is probable that an increasing number of mosquitoes and ticks within 50 years will cause more cases of human diseases in Turkey, due to the climate change.	24.9	37.6	24.1	7.8	5.6	3.68	1.10
81.5*	18.5	The climate change will increase the risk in Turkey for diseases transferred by water (i.e., diarrhea) during the next 100 years.	22.5	36.1	26.5	8.7	6.2	3.60	1.11
86.9*	13.1	It is probable that the mortality by lung edema and heart problems during heat waves in Turkey will increase during the next 50 years.	23.6	35.2	26.5	8.3	6.3	3.61	1.12
92.2*	7.8	The climate change is mainly caused by increased concentration of greenhouse gases.	40.7	31.9	15.8	7.0	4.6	3.97	1.12
82.8	17.2*	The increase of skin cancer is mainly caused by climate change.	27.5	30.2	26.0	11.0	5.3	3.64	1.15
78.0	22.0*	The climate change is mainly caused by the ozone hole.	40.3	33.7	16.0	5.8	4.2	4.00	1.08
88.0*	12.0	The increase of air pollution is one of important reasons of climate change.	39.2	31.9	17.5	7.9	3.5	3.95	1.10
85.9	14.1*	The global sea level has been constant the past 100 years.	25.6	23.4	21.9	13.9	15.1	3.30	1.38
		Total Scale						3.66	.664

(Note: T true, F false, VC very certain, FC fairly certain, U undecided, FU fairly uncertain, VU very uncertain, M mean, StD standard deviation, * indicates correct answers)

Regarding knowledge for causes, it was found that participants were informed about causes of climate change. Although great majority of participants answered the question about concentration of greenhouse gases causes the climate change (92.2%), only less than half (40.7%), felt very confident in their answers. In addition, the great majority selected the correct answer that air pollution is one of the important reasons of climate change (88%) but less than half (39.2%) felt very confident in their answer. On the other hand, participants had a misconception that climate change is mainly caused by ozone hole (78%) and more than half (74%), felt confident in their wrong answer when "very certain" and "fairly certain" choices were evaluated together.

Knowledge for consequences was composed of three domains such as sea and glaciers, health and weather consequences. Regarding knowledge for sea and glacier consequences, although great majority answers the question of the rising of sea level caused by melting of glaciers and snow correctly (85.4%), only less than half (41.4%), felt very confident in their answers. On the other hand, participants answer the questions about the blanket of snow in the Northern hemisphere and ice mass of the Arctic wrongly. Although majority of participants (92.4%) answers the question of approximately 10% decreases in the blanket of snow in the Northern hemisphere since the 1960swrongly, more than half (55.6%), felt confident in their answers when "very certain" and "fairly certain" choices were evaluated together. These findings clearly indicated that they were unaware of their misconceptions though 29.3% of participants were uncertain about their confidence level regarding whether the blanket of snow in the Northern hemisphere has decreased approximately 10% since the 1960s or not. Secondly, most of participants (86.1 %) had a misconception that "The blanket of snow in the Northern hemisphere is currently approximately the same as in the 1960s" and interestingly nearly half of them (47.1%) felt high confident in their responses when "very certain" and "fairly certain" choices were evaluated together. In addition, most of participants (75.2%) answers the question of ice mass of the Arctic wrongly and interestingly half of the participants (50%) self-confident in these responses when "very certain" and "fairly certain" choices were evaluated together. These findings clearly indicated that they were unaware of their misconceptions though 23% of participants were uncertain about their confidence level regarding whether the ice mass of the Arctic

is expected to increase in the next 100 years or not. Most of participants (85.9%) also answered the question of changes in global sea level the past 100 years wrongly but nearly half of the participants (49%) felt confident in their answers when "very certain" and "fairly certain" choices were evaluated together. These findings expressly revealed that they were unaware of their misconception about whether the global sea level has been constant the past 100 years or not.

Concerning knowledge for health consequences, participants (84.5%) knew that the increasing number of mosquitoes and ticks within 50 years due to climate change will cause more cases of human diseases in Turkey, found to (37.6%) minority of participants fairly-confident in their responses. Although great majority (81.5%) responded the question of risk for diseases transferred by water in Turkey correctly, only less than half (36.1%) felt fairly confident in their responses. On the other hand, most of participants (82.8%) had misconceptions that "The increase of skin cancer is mainly caused by climate change" and interestingly they were slightly high self-confident in their knowledge (57.7%) when "very certain" and "fairly certain" choices were evaluated together. These findings clearly indicated that they were unaware of their misconceptions though 26% of participants were uncertain about their confidence level regarding whether climate change increases skin cancer or not.

Regarding knowledge for weather consequences, most of the participants (86.9%) knew that mortality by lung edema and heart problems during heat waves in Turkey will increase during next 50 years but less than half of participants (35.2%) found to be fairly confident in their responses. Although great majority of participants (78.1%) answered the question of increases in number of storms and floods in the past 100 years, less than half of them (35.2%) felt fairly confident in their answers.

In conclusion, it can be inferred from descriptive results of knowledge about climate change and one's own confidence in knowledge about climate change scale that participants were knowledgeable and confident about air pollution and greenhouse gases regard as causes of climate change and increases of sea level and melting of glaciers and snow regard as consequences of climate change. However, they did not know melting of glaciers in the North hemisphere as a result of climate change and that ozone hole did not cause climate change but they were confident these misconceptions.

Knowledge is one significant factor that eases the adjustment to new conditions. Low confidence in individuals' own knowledge might stimulate the search and validation of the current condition by further information acquisition (Chaiken, Liberman, & Eagly, 1989). However, when actual knowledge and confidence of one's own knowledge are not matched to each other, individuals may not own a realistic view of their knowledge.

Table 4.9 Correlations for True Statements between Average Knowledge Scores and Mean Confidence Ratings

	Causes	**Consequences Sea and Glacier**	**Consequences Health**	**Consequences Weather**
PST	.096**	.094**	.160**	.080**

Note: ** $p < 0.01$

For each domain, the correspondence between actual knowledge and self-reported confidence was assessed by calculating product moment correlations between mean of knowledge scores and mean of confidence ratings. As presented in Table 4.9., the match between knowledge and confidence was better in domain of health consequences of climate change than other domains. The results of analysis showed that pre-service science teachers' knowledge about climate change in each dimension matched the confidence in knowledge of these dimension. It was implied that pre-service science teachers have realistic view about their knowledge. On the other hand, that the correlation values were smaller than .29 demonstrated small relationship between knowledge and confidence in knowledge among pre-service science teachers (Cohen, 1988, pp. 79-91). The positive correlation values indicated that when their knowledge about climate change was improved, their confidence in their knowledge would increase.

4.1.6. Environmental Attitude Scale

Pre-service science teachers' environmental attitudes evaluated in two dimensions; to ecocentric attitudes and anthropocentric attitudes. Table 4.10 indicates mean scores and standard deviations of environmental attitude dimensions with respect to gender, female pre-service science teachers had high ecocentric and anthropocentric attitudes towards environment.

Table 4.10 Mean and Standard Deviation of Environmental Attitude Scale With Respect To Gender and Total Sample

		Eco-centrism		**Anthropocentrism**	
	Gender	**M**	**SD**	**M**	**SD**
	Female	4.34	.553	3.24	.717
	Male	4.23	.596	3.22	.834
Total		4.31	.569	3.24	.753

As indicated in the Table 4.10, pre-service science teachers had higher scores on eco-centric dimension items (*M*= 4.31) when compared with the mean scores of anthropocentric dimension items (*M*= 3.24). Based on mean values, they were concerning for environmental issues for all living things than for only human beings. It can be said that pre-service science teachers tended to have an "eco-centric worldview" in other words, they thought that environment deserves protection because nature has intrinsic value. With respect to gender, females had higher scores on the eco-centric dimension and lower scores on the anthropocentric dimension, indicating that females were more valuing nature for its own sake. Males, however, reported having more anthropocentric attitudes, toward the environment. Males tended to believe that the environment should be conserved due to its value in sustaining or improving the quality of human life, human comfort and health (see Gagnon, Thompson & Barton, 1994).

Table 4.11 Frequency Distributions of Participant Agreement with Ecocentric Attitudinal Statements and Corresponding Item Means and Standard Deviations

Items	**SA**	**A**	**U**	**D**	**SD**	**M**	**StD**
One of the worst things about overpopulation is that natural areas are getting destroyed for development.	60.5	27.2	8.7	2.2	1.4	4.43	.849
I can enjoy spending time in natural settings just for the sake of being out in nature.	44.2	35.8	13.2	4.5	2.3	4.15	.967
Sometimes it makes me sad to see forests cleared for agriculture.	52.9	31.3	10.2	4.2	1.5	4.30	.917
I need time in nature to be happy.	50.0	33.5	11.4	3.8	1.4	4.27	.905
Sometimes when I am unhappy I find comfort in nature.	49.5	34.5	10.1	4.5	1.3	4.26	.910
It makes me sad to see natural environments destroyed.	56.7	30.9	7.4	3.4	1.6	4.38	.885
Nature is valuable for its own sake.	56.5	26.1	10.1	5.2	2.2	4.30	.991
Being out in nature is a great stress reducer for me.	54.4	29.6	10.6	3.4	2.0	4.31	.932
One of the most important reasons to conserve is to preserve wild areas.	53.4	28.9	10.3	3.6	3.8	4.25	1.030
Plants, animals have as much right as humans to exist.	59.7	28.9	7.2	2.5	1.7	4.42	.864
Total Scale						4.31	.569

(Note: SA strongly agree, A agree, U undecided, D disagree, SD strongly disagree, M mean, StD standard deviation)

Participants were likely to endorse sophisticated ecocentric attitudes towards environment. Stated differently, they conserved environment because they perceived nature as worth preserving without thing about the economic or lifestyle implications of conservation (Gagnon, Thompson & Barton, 1994).

In particular, they tended to believe that destruction of natural environment caused for human and human activities is so bad and create sadness among them. In addition, participants were likely to preserve nature not only for own sake but also for animals and plants. When "strongly agree" and "agree" choices were evaluated together; majority of the participants agreed that worst thing of the overpopulation is environmental destruction for development (87.7%) that destroying of environment saddens them (87.6%), that plants and animals have right for living in nature (88.6%). Participants also thought that being out in nature is a great stress reducer for them (84%). Participants felt sad to see natural environments destroyed (84.2%). Lastly, they had tendency to see nature as valuable for only its sake (82.6%).Moreover, mean and standard deviation scores supported that participants were likely to be happy in nature, conserve the nature for its own sake and be unhappy when destruction of environment for development occurred and they stay away from nature. In addition to this, participants give importance to wild areas for their own sake (82.3%).Participants showed the lowest agreement to enjoy spending time in natural settings just for the sake of being out in nature (80%).

Table 4.12 Frequency Distributions of Participant Agreement with Anthropocentric Attitudinal Statements and Corresponding Item Means and Standard Deviations

Items	SA	A	U	D	SD	M	StD
The worst thing about the loss of the rain forest is that it will restrict the development of new medicines.	15.7	27.5	33.1	10.9	12.8	3.23	1.214
The thing that concerns me about deforestation is that there will not be enough lumber for future generations.	10.8	17.6	21.5	20.6	29.5	2.60	1.354
One of the most important reasons to keep rivers and lakes clean is so that people can have a place to enjoy water sports.	13.2	20.1	22.2	22.3	22.2	2.80	1.342
One of the best things about recycling is that it saves money.	18.6	28.4	20.5	18.6	13.8	3.20	1.316
The most important reason for conservation is human survival.	40.5	34.5	12.1	6.3	6.6	3.96	1.171
Nature is important because of what it can contribute to the pleasure and welfare of humans.	32.2	32.2	13.9	11.2	10.6	3.64	1.316
We need to preserve resources to maintain a high quality of life.	40.3	31.1	12.4	8.0	8.3	3.87	1.256
One of the most important reasons to conserve is to ensure a continued high standard of living.	24.1	35.0	17.9	11.3	11.7	3.49	1.288
Continued land development is a good idea as long as a high quality of human life can be preserved.	14.4	25.2	24.5	15.0	20.8	2.97	1.346
As long as I do not have to change the quality of my life, I do my best to protect the environment.	27.2	38.7	15.4	10.6	8.1	3.66	1.210
Wild animals that provide meat for people are the most important species to protect.	16.0	27.7	29.7	14.5	12.1	3.21	1.226
Animals could be used in scientific experiments to save human life.	17.9	30.5	25.8	13.9	12.0	3.29	1.249
Humans have the right to modify the natural environment to suit their needs.	8.0	10.7	14.5	23.6	43.1	2.17	1.303
Total Scale						3.24	.753

(Note: SA strongly agree, A agree, U undecided, D disagree, SD strongly disagree, M mean, StD standard deviation)

Participants' strong anthropocentric attitudes reflected in some items organized around self and other people.When "strongly agree" and "agree" choices were evaluated together; great majority of participants (75%) seemed to contribute the conservation of nature because nature is needed for human survival which reflects anthropocentric attitudes towards environment. More than half of participants (71.4%) had tendency to preserve resources to maintain a high quality of life. Nearly two thirds of participants (65.9%) had tendency to make their effort to protect the environment as long they do not have to change quality of their life. More than half of participants (64.4%) were likely to give importance nature because of what it can improve the pleasure and welfare of human life. Participants agreed to preserve nature to maintain their high standards of living (59.1%) which reflect the anthropocentric attitude towards environment. On the other hand, when "strongly disagree" and "disagree" choices were evaluated together; two thirds of participants (66.7%) disagreed that humans have right to change nature for their needs which reflects ecocentric attitude towards environment. One third of participants (33.1%) were undecided about rain forest item "the worst thing about the loss of the rain forest is that it will restrict the development of new medicines". About 29.7% of participants hesitated to the item that protection of wild animals which provides meat demand of people is important. Participants were undecided to the item "animals could be used to save human life" (25.8%). Participants were also undecided about continue to land development as long as human life quality were sustained (24.5%). Participants were undecided to see one of the most important reasons to keep rivers and lakes clean for human to do water sports (22.2%). Participants were undecided to concern about deforestation because of not enough lumber for future generation (21.5%). Participants were undecided to recycling item "the best thing about recycling is that it saves money" (20.5%).

According to descriptive results of the ecocentric and anthropocentric attitudes towards environment, it can be inferred that participants attach importance to protection of environment and support conservation of nature as long as their welfare and quality of their life were not influenced by pro-environmental activities.

4.1.7. Topic Specific Epistemic Beliefs Questionnaire

Participants' responses to epistemic beliefs about climate change examined under 4 categories which are certainty of knowledge about climate change, simplicity of knowledge about climate change, source of knowledge about climate change and justification of knowledge about climate change (Table 4.13).

Table 4.13 Mean and Standard Deviation of Epistemic Beliefs about Climate Change Scale With Respect To Gender and Total Sample

		Certainty		**Simplicity**		**Source**		**Justification**	
	Gender	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
	Female	6.93	1.443	7.51	1.205	7.50	1.641	7.98	1.389
	Male	7.36	1.636	5.93	2.634	7.67	1.660	7.82	1.493
Total		7.06	1.514	7.03	1.905	7.55	1.646	7.93	1.421

As indicated in the Table 4.13 in a 10-point Likert type scale, pre-service science teachers had higher scores on justification dimension (*M*= 7.93) compared to those obtained by source (*M*= 7.55), certainty (*M*= 7.06), simplicity dimension (*M*= 7.03). Based on mean values, they considered knowledge about climate change (a) to be tentative and evolving rather than absolute and certain, (b) consist of interrelated concepts and complex theories rather than an accumulation of specific facts and details, (c) considered the themselves to be a source and constructor of knowledge rather than viewing knowledge about climate change to be transmitted from experts and (d) finally participants used rules of inquiry or reason and critically evaluated and compared sources rather than being content with what feels right or firsthand experience to justify knowledge about climate change. Higher scores in certainty of knowledge about climate change represented that knowledge about climate change is tentative and evolving rather than true and certain. Higher scores in simplicity of knowledge about climate change represented that knowledge about climate change is composed of interrelated concepts and complex theories rather than an accumulation of specific facts and details. Higher scores in source of knowledge about climate change represented that knowledge about climate change is constructed by individuals who consider self to be a source of knowledge about climate change rather than transmitted by experts. Higher scores in justification of knowledge about climate change represented that knowledge about

climate change are justified by using rules of inquiry and comparing multiple sources rather than being content with what feels right or firsthand experience.

When we compared the dimensions of epistemic beliefs scale about climate change, we used item mean scores presented in Figure 4.2. Pre-service science teachers had fairly sophisticated epistemological beliefs regarding climate change as indicated by the item mean scores ranging from 7.03 to 7.93 in a 10-point scale. For the justification of knowledge about climate change dimension, the mean score of 7.93 implies that when justifying and evaluating knowledge about climate change, participants most of the time believed that it is necessary to use rules of inquiry or reason and to critically evaluate and compare sources rather than being content with what feels right or firsthand experience. The mean value of 7.55 for the source of knowledge about climate change imply that pre-service science teachers tended to the view that knowledge is constructed by the knower rather than viewing knowledge about climate change to be transmitted from experts. The mean value (7.06) for the certainty of knowledge about climate change suggesting that pre-service science teachers tended to believe that knowledge about climate change is tentative and evolving rather than true and certain. For the Simplicity of knowledge about climate change the mean score of 7.03, suggests that pre-service science teachers tended to be slightly closer to believe that knowledge about climate change consist of interrelated concepts and complex theories rather than an accumulation of specific facts and details.

Regarding certainty of knowledge about climate change, participants tended to think that the results of climate change research are preliminary (*M*=7.15). Participants were likely to think that theories about climate can be disproved at any time (*M*=7.18). Participants slightly tended believed that knowledge about climate change tentative (*M*=7.06) and considered as certain knowledge today may be false in future (*M*=6.84). It can be inferred that participants thought that knowledge about climate change is tentative and evolving rather than true and certain.

Concerning simplicity of knowledge about climate change, participants were likely to think that accurate knowledge about details of climate change is most significant (*M*=7.96) and facts are more important than theories (*M*=7.78). Participants slightly tended to think that many things about climate change are evaluated together

(*M*=6.95) and knowledge about climate change primarily consists of a large amount of detailed information (*M*=6.83). Participants hesitated to think that knowledge about climate change consists of highly interrelated concepts rather than an accumulation of facts (*M*=5.66). It can be inferred that participants thought that knowledge about climate change consists of interrelated concepts and complex theories rather than an accumulation of specific facts and details.

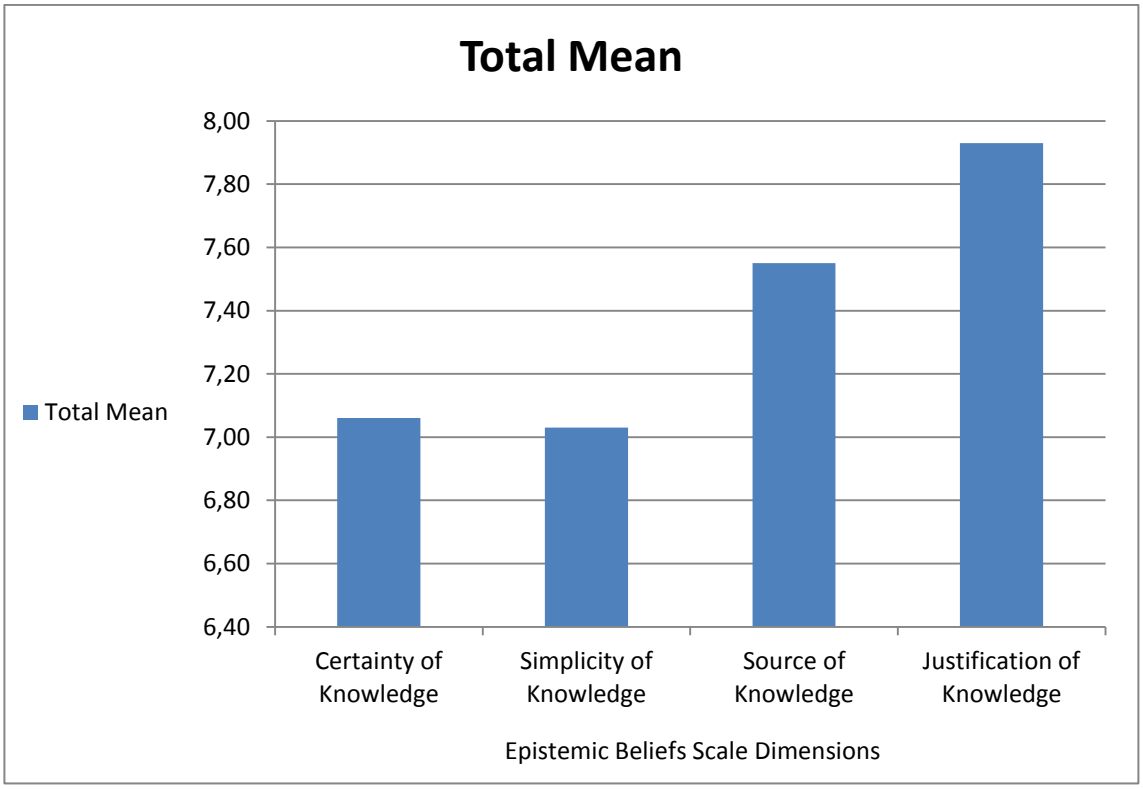

Figure 4.2 Total Mean Scores of Epistemic Beliefs Scale Dimensions

Concerning simplicity of knowledge about climate change, participants were likely to think that accurate knowledge about details of climate change is most significant (*M*=7.96) and facts are more important than theories (*M*=7.78). Participants slightly tended to think that many things about climate change are evaluated together (*M*=6.95) and knowledge about climate change primarily consists of a large amount of detailed information (*M*=6.83). Participants hesitated to think that knowledge about climate change consists of highly interrelated concepts rather than an accumulation of facts (*M*=5.66). It can be inferred that participants thought that knowledge about climate

change consists of interrelated concepts and complex theories rather than an accumulation of specific facts and details.

Regarding source of knowledge about climate change, participants were likely to think that they try to form their own understanding of the content when they read about climate change (*M*=7.75). Participants tended to think that they have to form their own personal opinion of readings about climate change to gain real insight into climate change issue (*M*=7.66). Participants tended to think that their own knowledge about climate change as important as knowledge about climate change in various texts (*M*=7.25). It can be inferred that participants thought that knowledge about climate change is constructed by individuals who consider self to be a source of knowledge about climate change rather than transmitted by experts.

Concerning justification of knowledge about climate change, participants were likely to think that individuals have to check various knowledge sources to trust knowledge claims in texts about issues concerning climate change (*M*=8.21). Participants tended to think that they have most confidence in knowledge that confirms what they have seen with their own eyes when they read about climate change problems (*M*=8.10). Participants had a tendency to think that they understand issues related to climate change better when they think through climate change issues themselves, and not only read about climate change issues (*M*=7.98). Participants had lowest mean score in justification of knowledge about climate change from item that "To find out whether what I read about climate problems is trustworthy, I try to compare knowledge from multiple sources" (*M*=7.65). It can be inferred that participants thought that knowledge about climate change are justified by using rules of inquiry and comparing multiple sources rather than being content with what feels right or firsthand experience.

Table 4.14 Frequency Distributions of Participant Agreement with Subscales of Epistemic Beliefs Statements and Corresponding Item Means and Standard Deviations

Certainty of knowledge about climate change	**SA**	→							**SD**	**M**	**StD**
The knowledge about issues concerning climate is constantly changing.	16.0	16.5	16.0	17.3	9.5	10.6	4.4	4.3	2.7	2.8	7.06	2.35
Theories about climate can be disproved at any time.	15.9	15.3	17.8	16.6	13.2	10.5	4.5	3.0	1.2	2.0	7.18	2.16
What is considered to be certain knowledge about climate today, may be considered to be false tomorrow.	16.9	15.0	15.3	14.2	10.9	9.7	5.0	4.0	3.0	6.0	6.84	7.15
The results of climate research are preliminary.	16.4	14.3	17.5	16.4	12.8	12.5	3.8	2.7	1.3	2.3	7.15	2.18
Total scale											7.06	1.51
Simplicity of knowledge about climate change												
Within climate research, facts are more important than theories.	36.6	11.7	16.5	11.5	8.1	5.6	1.1	0.8	2.6	5.6	7.78	2.55
Within climate research, accurate knowledge about details is the most important.	39.8	15.6	14.1	9.8	6.2	3.4	2.1	1.5	2.0	5.6	7.96	2.56
Knowledge about climate consists of highly interrelated concepts rather than an accumulation of facts	10.8	8.5	9.8	13.3	11.2	14	6.1	7.2	7.7	11.4	5.66	2.83
Within climate research, many things hang together.	19.6	14.6	15.1	14.4	9.6	9.4	4.7	2.7	3.9	5.9	6.95	2.63
Knowledge about climate is primarily characterized by a large amount of detailed information.	14.9	14.5	16.9	15.5	12.5	9.6	3.8	2.5	3.8	6.0	6.83	2.53
Total scale											7.03	1.91
Source of knowledge about climate change												
To gain real insight into issues related to climate, one has to form one's own personal opinion of what one reads.	24.5	17.1	18.6	13.5	10.3	8.0	3.0	2.4	.8	1.9	7.66	2.14

My own understanding of issues concerning climate is at least as important as the knowledge that exists about them in various texts.	16.0	17.5	17.0	17.1	11.7	9.6	4.5	3.4	1.5	1.6	7.25	2.16
When I read about issues related to climate, I try to form my own understanding of the content.	24.1	19.8	16.4	14.6	10.1	8.4	2.9	1.6	.7	1.3	7.75	2.04
Total scale											7.55	1.65
Justification of knowledge about climate change												
When I read about climate problems, I trust the results of scientific investigations more than the viewpoints of ordinary people.	29.1	18.6	18.3	12.8	7.9	6.6	2.7	1.4	1.3	1.3	7.95	2.06
I understand issues related to climate better when I think through them myself, and not only read about them.	25.5	22.1	18.5	14.7	8.0	6.0	2.2	1.5	0.6	.9	7.98	1.90
To find out whether what I read about climate problems is trustworthy, I try to compare knowledge from multiple sources.	22.7	17.9	19.0	14.7	9.2	8.6	3.8	2.2	0.6	1.3	7.65	2.07
When I read about climate problems, I have most confidence in knowledge that confirms what I have seen with my own eyes.	29.0	21.4	18.2	13.2	7.9	5.7	2.0	1.3	0.6	.7	8.10	1.88
To be able to trust knowledge claims in texts about issues concerning climate, one has to check various knowledge sources.	35.7	19.3	16.0	11.4	6.9	5.2	2.3	1.5	0.5	1.3	8.21	1.99
To check whether what I read about climate problems is reliable, I try to evaluate it in relation to other things I have learned about the topic.	22.2	18.7	20.2	14.7	8.8	7.8	3.4	2.1	0.9	1.2	7.70	2.04
Total scale											7.93	1.42

(Note: SA strongly agree, SD strongly disagree, M mean, StD standard deviation)

4.1.8. Uncertainty Scale: Scepticism about the reality of anthropocentric climate change and disinterest in climate change

In the questionnaire, there were 17 five point Likert type items evaluating the participants' scepticism about the reality of anthropocentric climate change and disinterest in climate change. (See Table 4.15)

Table 4.15 Mean and Standard Deviation of Uncertainty Scale With Respect To Gender and Total Sample

		Scepticism		**Disinterest in CC**	
	Gender	**M**	**SD**	**M**	**SD**
	Female	2.46	.70	2.27	.85
	Male	2.67	.79	2.53	.91
Total		2.52	.73	2.35	.87

As indicated in the Table 4.15 teachers had lower scores on scepticism dimension items (*M*= 2.52) and disinterest in climate change dimension items (*M*= 2.35) than the midpoint of 3. These findings clearly indicated that participants were non-sceptical about climate change. In addition, they considered knowledge about climate change to be irrelevant to them and thought that their activities on daily basis do not have effect on climate change. Higher scores in scepticism dimension represented higher level of scepticism in individuals' attitudes towards anthropogenic climate change. Higher scores in disinterest in climate change dimension represented that individuals were not interested with anthropogenic climate change. These findings represented that males had more uncertainty beliefs about anthropocentric climate change. It can be inferred that females believed and interested more the reality of anthropogenic climate change and knowledge about climate change than males.

Table 4.16 Frequency Distributions of Participant Agreement with Scepticism Statements and Corresponding Item Means and Standard Deviations

Items	**SA**	**A**	**U**	**D**	**SD**	**M**	**StD**
Climate change is something that frightens me	7.3	16.3	26.8	35.2	14.5	2.67	1.13
I am uncertain about whether climate change is really happening	6.7	10.3	15.7	39.4	27.8	2.29	1.17
The evidence for climate change is unreliable	6.6	14.3	38.9	29.1	11.1	2.76	1.04
Claims that human activities are changing the climate are exaggerated	6.2	12.7	20.3	38.8	22.0	2.42	1.15
There is too much conflicting evidence about climate change to know whether it is actually happening	9.9	26.6	34.9	22.7	5.9	3.12	1.05
The effects of climate change are likely to be catastrophic	5.9	5.6	11.7	38.4	38.4	2.02	1.12
Recent floods in this country are due to climate change	6.3	9.6	26.1	40.3	17.9	2.46	1.08
It is too early to say whether climate change is really a problem	7.5	13.5	18.6	36.8	23.5	2.45	1.20
The media is often too alarmist about issues like climate change	8.4	20.2	25.4	32.1	13.9	2.77	1.17
Flooding is not increasing, there is just more reporting of it in the media these days	8.2	16.8	28.1	30.4	16.4	2.70	1.17
I do not believe climate change is a real problem	5.6	10.7	11.0	30.8	41.8	2.08	1.21
Total Scale						2.52	.73

(Note: SA strongly agree, A agree, U undecided, D disagree, SD strongly disagree, M mean, StD standard deviation)

According to participants' mean scores, it can be said that pre-service science teachers were slightly certain about the reality of anthropogenic climate change. When "strongly disagree" and "disagree" choices were evaluated together; great majority of participants (76.8%) was unlikely to believe that the effects of climate change are likely to be catastrophic. Most of participants (72.6%) believed that climate change is a real problem. Two thirds of participants (67.2%) were certain about whether climate change is really happening. More than half of participants (60.8%) were unlikely to think claims that human activities are changing the climate are exaggerated. More than half of participants (60.3%) did not believe that it is too early to say whether climate change is really a problem. More than one third of participants (40.3%) disagreed that recent floods in Turkey are due to climate change. More than one thirds of participants (38.9%) hesitated that the evidence for climate change is unreliable. Nearly of one third of participants (34.9%) were undecided that there is too much conflicting evidence about climate change to know whether it is actually happening. To conclude, descriptive statistics revealed that majority of the participants were more likely to hold more certain about the reality of anthropocentric climate change.

In conclusion, participants mostly felt that climate change is significant problem which should be elucidated by human beings because of effects of human activities on climate change. However, they hesitated to media was too alarmist and it overstate the effect of climate change and evidence related with whether human induced climate change really happening. Also, according to mean scores and standard deviations, participants were undecided to see evidences about human induced climate change are overestimated by media and guided.

Table 4.17 Frequency Distributions of Participant Agreement with Disinterest in Climate Change Statements and Corresponding Item Means and Standard Deviations

Items	**SA**	**A**	**U**	**D**	**SD**	**M**	**StD**
It is already too late to do anything about climate change.	5.5	9.2	15.7	30.9	38.8	2.12	1.18
Human activities have no significant impact on global temperatures.	6.5	7.7	6.6	23.6	55.6	1.86	1.22
Nothing I do makes any difference to climate change one way or another.	7.0	13.2	9.9	33.8	26.2	2.41	1.20
I tend to consider information about climate change to be irrelevant to me.	7.5	12.1	12.8	35.7	31.9	2.28	1.24
There is no point in me doing anything about climate change because no-one else is.	8.2	17.3	13.1	28.6	32.8	2.40	1.32
Nothing I do on a daily basis contributes to the problem of climate change.	10.1	24.9	31.2	26.8	7.0	3.04	1.10
Total Scale						2.35	.87

(Note: SA strongly agree, A agree, U undecided, D disagree, SD strongly disagree, M mean, StD standard deviation)

Table 4.17 demonstrated the participants' level of agreements, in percentages, to the statements in disinterest in climate change dimension. When "strongly disagree" and "disagree" choices were evaluated together; most of participants (79.2%) were unlikely to think that human activities have no significant effect on global temperatures. Great majority of participants (69.7%) did not seem that it is already too late to do anything about climate change. Two thirds of participants (67.1%) tended to consider information about climate change to be relevant to them. More than half of participants (61.4%) disagreed that "there is no point in them doing anything about climate change because no-one else is". More than half of participants (60.0%) disagreed the item, "Nothing I do makes any difference to climate change one way or another". Nearly one third of participants (31.2%) hesitated to think that nothing I do on a daily basis contributes to the problem of climate change. In conclusion, participants saw climate change as real problem, human induced environmental problem. However, they were undecided efficacy of their daily life styles influences on human induced climate change problem. Also, they were unaware of effect of their behavior on climate change problem because they had no tendency to engage information about climate change.

4.2 Inferential Statistics

Under this heading, results regarding path analysis were presented after the assumptions of path analysis was checked for variables of the proposed model. Recalled that this analysis was conducted to measure a model explaining how knowledge about climate change, environmental attitudes, epistemic beliefs regarding climate change and unceratinty beliefs regarding climate change related to pro-environmental behaviour.

4.2.1 Assumptions of Path Analysis

The assumptions of underlying path analysis contains independence of observations, appropriate level of measurement, random sampling of participants, univariate normality, multivariate normality, linearity of the relationships among variables, and a reasonable sample size (Tabachnick & Fidell, 2013). To begin with, independence of observation is a fundamental necessity for generally all type of hypothesis testing. Shortly, each observation and measurement should be independent of any other observation and measurement. In the present study, data

were collected from participants of this study in their classroom periods. Each participant responded to the scales independent of one another.

The assumption of random sampling proposes that the participants were selected randomly from population by not using any special characteristics of participants. This assumption assists to ensure whether sample is representative of the population and results can be generalized to the population (Tabachnick & Fidell, 2013). In the current study, data were collected from students, enrolled in elementary science teacher education program in thirteen public universities in seven geographical regions, which were selected randomly in Turkey.

In path analysis, the assumption of linearity suggests to the existence of a straight line relationship between each pair of variable. Violation of the linearity of assumption implies that estimations of model fit and standard error were affected (Pallant, 2007). In the current study, linearity was checked by generating a matrix of scatterplots among each pair of variables. Figure 4.3 shows the matrix of scatterplots. According to the figure, most of the plots did not indicate any explicit evidence of non-linearity and so it can be said that linearity assumption was satisfied.

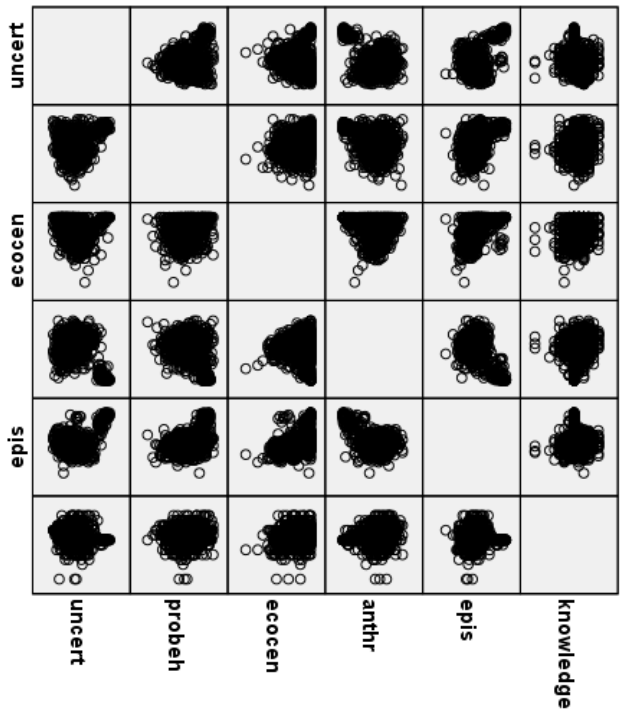

Figure 4.3 Matrix of Scatterplots among Variables

In path analysis, controlling the assumptions of univariate normality and multivariate normality are very important to decide which estimation method will be used during path analysis. Maximum Likelihood (ML) estimation method was used

in LISREL as default (Jöreskog & Sörbom, 1993). On the other hand, if the variables are not normally distributed, it is not suggested to use ML (Byrne, 1998; Kline, 2011; Schumacker & Lomax, 2004). When there is lack of multivariate normality, it is suggested to continue analysis with alternative methods such as Weighted Least Squares (WLS) or Robust Maximum Likelihood (RML).

Table 4.18 The Test of Univariate Normality

	Skewness			Kurtosis			Skewness and Kurtosis	
	Statistics	z-Score	p-value	Statistics	z-Score	p-value	Chi-square	p-value
Uncertainty beliefs about climate change	1.03	**12.69**	**0.00**	1.13	**8.24**	**0.00**	**228.79**	**0.00**
Behavior	-0.08	-1.22	0.22	-0.17	-1.27	0.20	3.11	0.22
Ecocentric attitudes	-0.96	**-12.03**	**0.00**	0.92	**6.70**	**0.00**	**189.56**	**0.00**
Anthropocentric attitudes	-0.94	**-11.84**	**0.00**	1.17	**8.54**	**0.00**	**213.10**	**0.00**
Epistemic beliefs about climate change	1.16	**13.82**	**0.00**	2.39	**17.49**	**0.00**	**497.15**	**0.00**
Knowledge about climate change	-0.81	**-10.46**	**0.00**	2.21	**16.16**	**0.00**	**370.34**	**0.00**

Table 4.19 The Test of Univariate Normality after Normalization

	Skewness			Kurtosis			Skewness and Kurtosis	
	Statistics	z-Score	p-value	Statistics	z-Score	p-value	Chi-square	p-value
Uncertainty beliefs about climate change	0.00	0.02	0.99	-0.02	-0.14	0.89	0.02	0.99
Behavior	-0.00	-0.04	0.97	-0.02	-0.11	0.91	0.01	0.99
Ecocentric attitudes	-0.13	-1.88	0.06	-0.35	-2.59	0.01	10.21	0.01
Anthropocentric attitudes	0.01	0.17	0.86	-0.07	-0.53	0.59	0.32	0.85
Epistemic belief about climate change	-0.00	-0.04	0.97	-0.02	-0.14	0.89	0.02	0.99
Knowledge about climate change	-0.05	-0.75	0.45	0.04	0.14	0.75	0.67	0.72

In detailed, univariate normality was checked with the skewness and kurtosis values of the variables in the model. If the skewness and kurtosis values exceed the range of -2 and +2, assumption of univariate normality is violated (Mardia, Kent & Bibby, 1989). Table 4.18 shows the skewness and kurtosis values of the variables in model. According to the results of univariate normality check, most of the variables had statistically significant z-score values for skewness and kurtosis (p<0.05), chi-square values (p<0.05) and normality check assumptions did not supported.

To overcome the violation of normality, original scores were converted into normally distributed score by using normalization in LISREL (Kline, 2011).To obtain normal scores in LISREL, 'Normal Scores' dialog box was selected from 'Statistics' menu. Table 4.19 indicates the results of univariate normality for normalized scores. According to results for normalized scores, univariate normality was supported.

In addition, the assumption of multivariate normality indicates that (1) "all the individual univariate distributions are normal", (2) "each variable is normally distributed for each value of every other variable", and (3) "all bivariate scatter plots are linear, and the distribution of residuals is homoscedastic" (Kline, 2011). Therefore, the multivariate normality check was supported.

Concerning the level of measurement assumption, all level of measurement (categorical, ordinal, interval or ratio) can be used in path analysis but using the different levels of measurement in the same correlation or covariance matrix is not be recommended (Kunnan, 1998). In LISREL program, if the variables have less than 15 categories, program identifies them as ordinal automatically. So, firstly all variables were described as continuous and then the model analysis was conducted.

Finally, according the assumption of sample size, large samples are needed for path analysis (Kelloway, 1998). If small sample size is used in path analysis, normality of variables can be violated; accuracy and stability of parameter estimates can diminish (Schumacker & Lomax, 2004). Also, small sample size can affect the power of significance tests and present biased goodness of fit indices (Curran, West, & Finch, 1996). In the literature, generally 10 to 20 cases per estimated parameter were recommended (Schumacker & Lomax, 2004; Kelloway, 1998). In the current study, the sample size was 1277, which was a highly satisfactory number for ensuring the sample size issues stated.

4.2.2 Path Analysis

In this part, the pathway analysis was conducted to examine the relationships among underlying variables of pre-service science teachers' pro-environmental behavior by using the method Maximum Likelihood in modeling analysis. In addition, significance level of 0.05 is used in all the analysis. Firstly, the conceptual model presented in Chapter 1 was tested with pre-service science teachers participated in the present study. Then, non-significant paths were deleted from the model according their *t* values, modification indices and standard solution index presented by LISREL program. The conceptual model presenting the relationship among pre-service science teachers' knowledge about climate change, anthropocentric and ecocentric values, epistemic beliefs about climate change, uncertainty beliefs about climate change and pro-environmental behavior towards climate change was tested through path analysis. Path analysis was conducted by using LISREL 8.80. The standardized coefficients and *t* values given figure 4.4 and 4.5 show that first conceptual model did not fit the data very well. In the first conceptual model, t-values for some pathways were not significant, in terms of pathway between knowledge about climate change and pro-environmental behaviors towards climate change, pathway between knowledge about climate change and epistemic beliefs about climate change, and pathway between anthropocentric value and pro-environmental behavior towards climate change. Therefore, insignificant pathways were eliminated from conceptual model and a new model was specified. The fit index of new specified model was given in table 4.20.

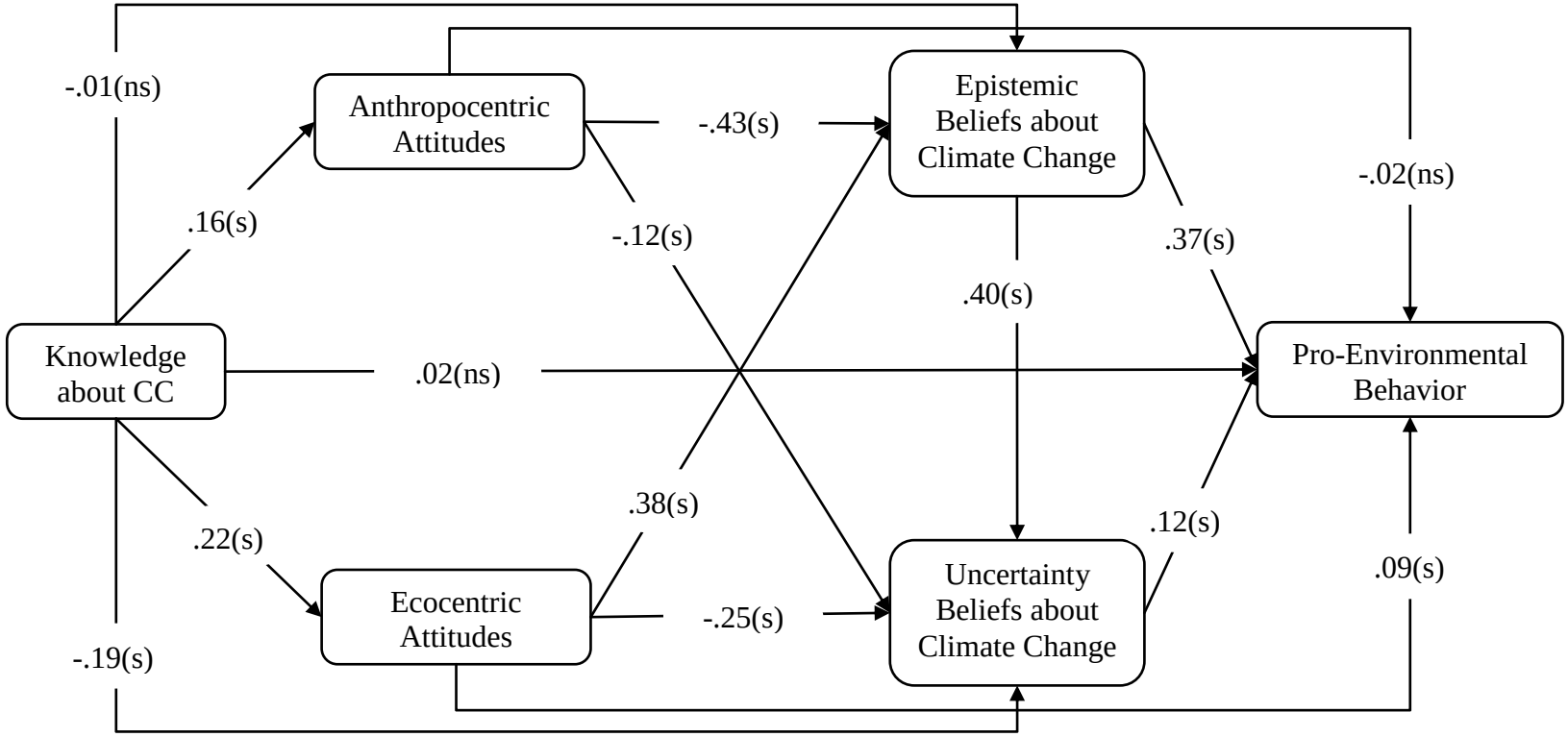

Figure 4.4 Conceptual Models with standardized path coefficients for direct effects

(Note: s significant path, ns non-significant path)

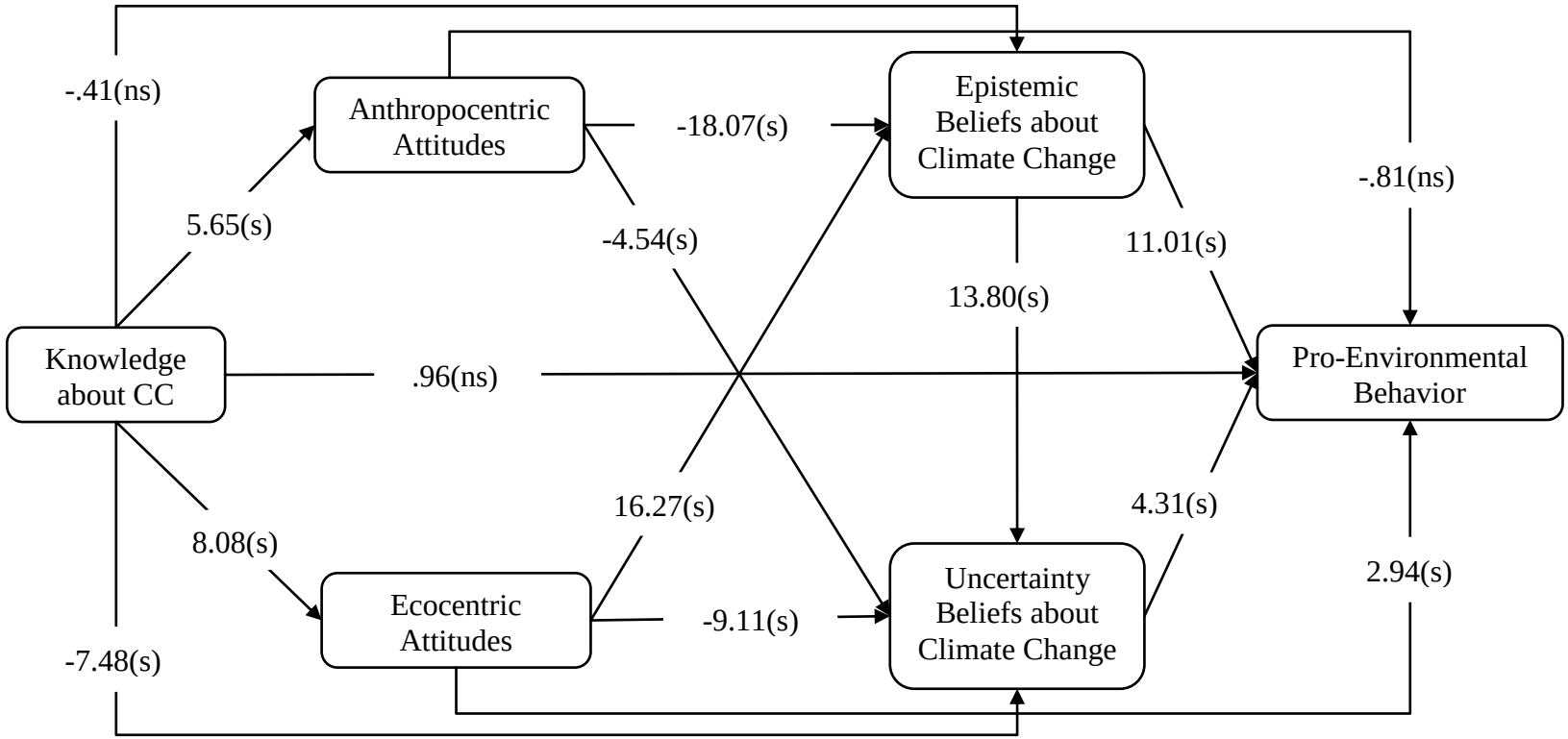

Figure 4.5 Conceptual Model with *t* values
(Note: s significant path, ns non-significant path)

Table 4.20 Models Fit Indices of Path Analysis

Fit Indices	Criterion	Sample
Chi-square (χ^2)	Non-significant	13.50
(χ^2/sd)	$0 < \chi^2/sd < 5$	3.375
p value	$p < 0.05$	0.0091
Goodness of Fit Index (GFI)	GFI > 0.90	1.00
Adjusted Goodness of Fit Index (AGFI)	AGFI > 0.90	0.98
Root Mean Square Error of Approximation (RMSEA)	RMSEA < 0.05	0.043
Standardized Root Mean Square Residual (R-RMR)	S-RMR < 0.05	0.027
Normed Fit Index (NFI)	NFI > 0.90	0.99
Non-Normed Fit Index (NNFI)	NNFI > 0.90	0.97
Comparative Fit Index (CFI)	CFI > 0.90	0.99
Incremental Fit Index (IFI)	IFI > 0.90	0.99
Relative Fit Index (RFI)	RFI > 0.90	0.96

As indicated in Table 4.19, the re-specified model index supported to an acceptable fit. The Chi-Square, $\chi^2 = 13.50$, was significant with degrees of freedom, df = 4, and the significance level, $p = 0.0091$. The sample size of the present study was 1277 and large sample size can be used to obtain a significant test statistic. Consequently, the Normed Chi-Square (NC), which was calculated by χ^2/df, of last acceptable model for this sample was 3.375 which was less than 5 showing a good fit to the data (Kelloway, 1998).The Goodness-of-Fit Index (GFI) and the Adjusted Goodness-of-Fit Index (AGFI) of the structural model for pre-service science teacher were 1.00 and 0.98,respectively. These values show that the model had a good fit to data. The Standardized Root-Mean-Square Residual (SRMR) of the model was 0.027. This value of SRMR showed a good fit to the data since the value was less than 0.05.Another criterion for goodness-of-fit, the Root-Mean-Squared Error of Approximation (RMSEA) of the model was 0.043. This value of RMSEA indicated a good fit to the data. The Comparative Fit Index (CFI) of the structural model for pre-service science teachers was 0.99. Since this value was approaching unity, it indicated a good fit of the model to the data. In conclusion, some goodness-of-fit indices of the structural model were examined through their criteria and it was found that the model for pre-service science teachers showed a good fit to the data. Thus, all the indicators suggested an overall fit for structural model explaining pro-environmental behavior towards climate change. The fit indices of the study

indicated that specified model explains the data well. So, the standardized path coefficients for direct, indirect and total effects were analyzed to evaluate specified model. The specified model is presented in Figure 4.6. The standardized path coefficients for direct, indirect and total effects are presented in Table 4.21

In the specified model, knowledge about climate change accounted for 2.4% of the variance in pre-service science teachers' anthropocentric values and accounted for 4.9% of the variance in pre-service science teachers' ecocentric values (see Table 4.22). More specifically, results demonstrated that knowledge about climate change (β= .16) significantly and positively associated with pre-service science teachers' anthropocentric value. Also, knowledge about climate change (β= .22) significantly and positively associated with pre-service science teachers' ecocentric value. These findings implied that pre-service science teachers were reflecting their intrinsic value of nature and seeing nature as valuable for human life when they were knowledgeable about climate change.

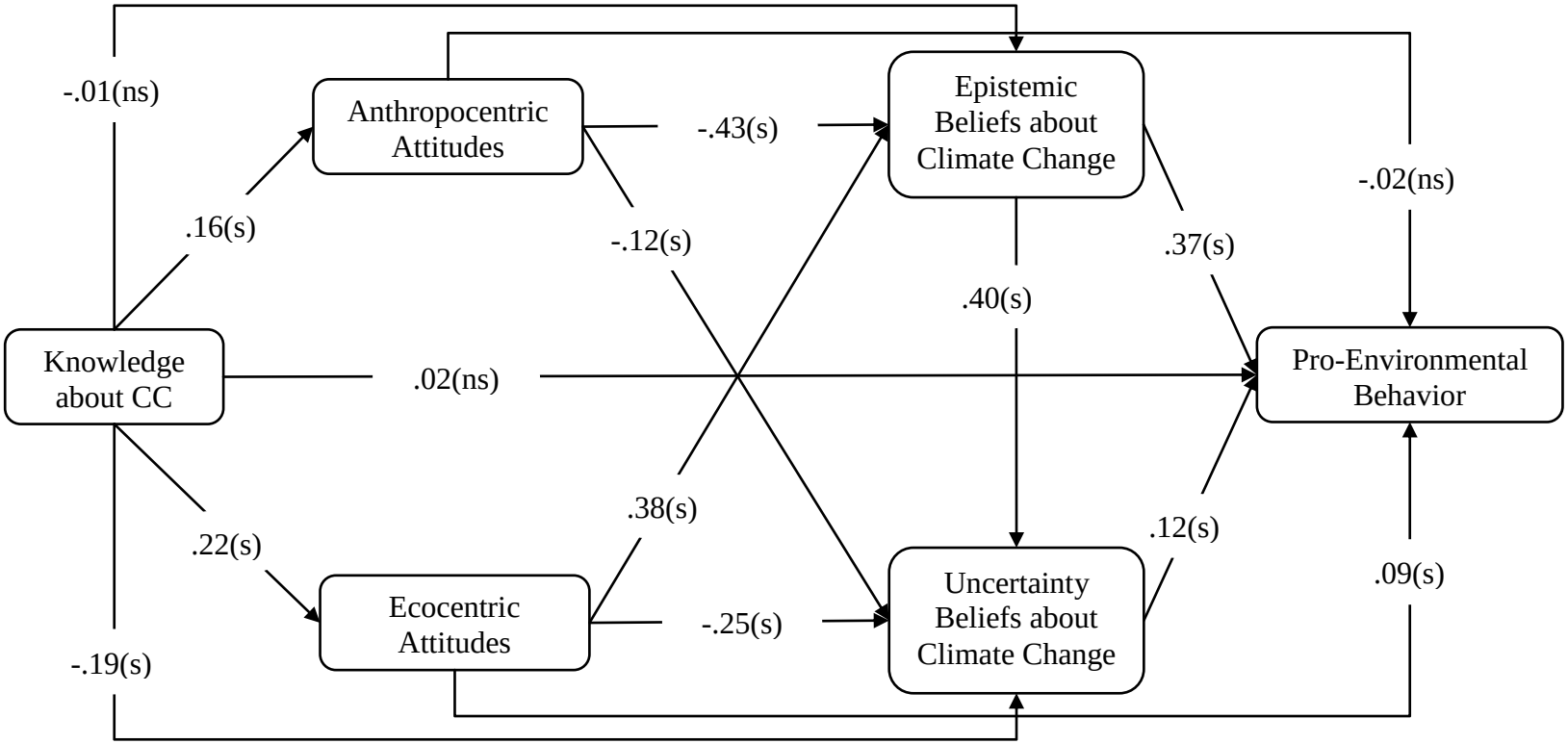

Figure 4.6 Specified model with the standardized path coefficients for direct effects.

(Note: s significant path, ns non-significant path)

Concerning the relationship among epistemic beliefs about climate change, anthropocentric and ecocentric value, results demonstrated that anthropocentric value (β= -.43) and ecocentric value (β= .38) explained 32% of the variance in epistemic beliefs about climate change. This result suggested that pre-service science teachers receiving positive ecocentric value regarding environment and not having the belief that nature is valuable because of increased the quality of human life tend to see knowledge about climate change as evolving, tentative and characterized by integrated concepts and multiple sources. Briefly, when pre-service science teachers' ecocentric values significantly and positively associated with their epistemic beliefs about climate change, their anthropocentric values significantly and negatively associated with their epistemic beliefs about climate change.

Although negative relationships was found between knowledge about climate change (β= -.19), anthropocentric value (β= -.12), ecocentric value (β= -.25) and uncertainty beliefs about climate change, positive high relationships was reached between epistemic beliefs about climate change (β= .40) and uncertainty beliefs about climate change. This revealed that higher levels of epistemic beliefs about climate change was associated with higher levels of uncertainty beliefs about climate change. Moreover, pre-service science teachers, had low level of knowledge about climate change and environmental values towards environment, tend to show high level of uncertainty beliefs towards climate change. Therefore, it can be implied that if pre-service science teachers are well informed about climate change, they cannot have uncertainty beliefs about climate change.

Table 4.21Path Coefficients

	Ecocentric			Anthropocentric			Epistemic Beliefs			Uncertainty Beliefs			Pro-Environmental Behavior		
Variables	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Knowledge	.16	-	.16	.22	-	.22	-.01	-.02	-.03	-.19	-.07	-.26	.03	-.01	.02
Ecocentric							.38	-	.38	-.25	.15	-.10	.09	.11	.20
Anthropocentric							-.43	-	-.43	-.12	-.17	-.29	-.02	-.17	-.19
Epistemic Beliefs										.40	-	.40	.37	.05	.42
Uncertainty Beliefs													.12	-	.12

Regarding the relationship of pro-environmental behavior with ecocentric values, epistemic beliefs about climate change, uncertainty beliefs about climate change, results showed that epistemic beliefs about climate change (β= .37), uncertainty beliefs about climate change (β= .12) and ecocentric value (β= .09) was associated with pro-environmental behavior (R^2= .21). Moreover, anthropocentric values (β= -.17) was indirectly and negatively associated with pro-environmental behavior. Therefore, pre-service science teachers have positive attitude towards nature for its own sake, high level of epistemic beliefs about climate change, uncertainty beliefs about the reality of human-induced climate change inclined to show pro-environmental behaviors related with climate change. Moreover, pre-service science teachers who seeing knowledge about climate changes as tentative and evolving knowledge and also believing it was based on integrated concepts and critically examined from multiple sources, they likely to show pro-environmental behavior. Also, even though pre-service science teacher had uncertainty beliefs about the reality of human-induced climate change, they felt responsibility to show pro-environmental behavior related with climate change. On the other hand, the findings implied that individuals, who value nature because of improving the quality of human life and meeting their needs, have less tendency to act in pro-environmental behavior.

Table 4.22 Effect size of the Model

Latent variables	Squared Multiple Correlations (R^2)
Ecocentric	0.049
Anthropocentric	0.024
Epistemic Beliefs	0.32
Uncertainty Beliefs	0.27
Pro-Environmental Behavior	0.21

4.3 Summary of Results

The results of the current study can be summarized as follows:

i. Descriptive results of Pro-Environmental Behavior Scale revealed that pre-service science teachers tend to show pro-environmental behaviour towards climate change. On the other hand, males have more mean score on pro-environmental scale.

ii. Based on descriptive results of Environmental Attitude Scale, pre-service science teachers were more ecocentric value than anthropocentric value. In addition, females had higher mean score on ecocentric attitudes and so they inclined to hold that the environment should be protected for its own sake.

iii. According to descriptive results of Uncertainty Scale, pre-service science teachers had moderately scepticism beliefs about climate change and disinterest beliefs in climate change. Shortly, it can be inferred that pre-service science teachers had moderate uncertainty about anthropogenic climate change.

iv. Based on the descriptive results of knowledge and confidence in knowledge about climate change, pre-service science teachers had high level of knowledge and confidence in their own knowledge. Also, females had less knowledge about climate change but high level of confidence in their knowledge about climate change than males. Also, they thought that they were sufficiently and moderately informed about climate change.

v. Descriptive results of epistemic beliefs about climate change, pre-service science teachers had high level of epistemic beliefs about climate change. This shows that they thought knowledge about climate change is tentative, characterized by highly integrated concepts and constructed knowledge in interaction with other sources (expert opinions) by using rules of inquiry.

vi. Knowledge about climate change had a significant and positive relationship with ecocentric and anthropocentric attitudes. When pre-service science teachers were knowledgeable about climate change, they were reflecting their intrinsic value of nature and seeing nature as valuable for human life.

vii. Although ecocentric attitudes had a significant and positive relationship with epistemic beliefs about climate change, anthropocentric attitudes had a significant and negative relationship with epistemic beliefs about climate change. This showed that when pre-service science teachers had more favorable attitudes toward environment, they had more epistemic beliefs about climate change. When they hold anthropocentric attitudes toward environment, they hold less epistemic beliefs about climate change.

viii. Despite the fact that environmental attitudes and knowledge about climate change had a significant and negative relationship with uncertainty beliefs about climate change, epistemic beliefs about climate change had a

significant and positive relationship with uncertainty beliefs about climate change. This showed that if pre-service science teachers were well informed about climate change and owned positive attitudes toward environment, they did not have uncertainty beliefs about climate change.

ix. Ecocentric attitudes, epistemic beliefs and uncertainty beliefs about climate change had a significant and positive relationship with pro-environmental behavior towards climate change. This indicated that pre-service science teachers have positive attitude towards nature for its own sake, high level of epistemic beliefs about climate change, uncertainty beliefs about the reality of human-induced climate change inclined to show positive pro-environmental behaviors related with climate change.

CHAPTER 5

CONCLUSIONS, DISCUSSION AND IMPLICATIONS

This chapter includes discussion of the results, implications of the study and recommendations for further research.

5.1. Discussion of the Results

The main purpose of this study was to illuminate the complex nature of pro-environmental behavior toward climate change by extending prior collaborates. The currents study utilized knowledge about climate change, environmental values, epistemic beliefs regarding climate change and uncertainty beliefs about anthropocentric climate change as the predictor variables of pro-environmental behavior toward climate change which were reported as significant predictors of pro-environmental behavior.

Specifically, path analysis was conducted to investigate to what extent uncertainty beliefs about the reality of anthropocentric climate change, epistemic belief about climate change, environmental values and knowledge about climate change related with pro-environmental behavior. Analysis revealed that pro-environmental behavior while directly and positively predicted by epistemic beliefs about climate change (β = .37), uncertainty beliefs about the reality of anthropogenic climate change (β = .12) and ecocentric values (β = .09), indirectly and significantly by anthropocentric value (β = -.17). Besides ecocentric value (β = .11) and epistemic beliefs (β = .05) had indirect effects on pre-service science teachers' pro-environmental behavior. The largest contribution to the prediction of pro-environmental behavior was made by epistemic beliefs. Ecocentric value made least statistically significant contribution to prediction of behavior. Knowledge about climate change was the only variable which neither direct nor indirect effect on pro-environmental behavior.

As expected, current findings suggested that more certainty (non-marginally sceptical) beliefs about the reality of anthropogenic climate change resulted with more pro-environmental behavior. This means that uncertainty belief was seen as

scepticism about the reality of anthropogenic climate change and included ambiguity beliefs whether human action influence on climate change. In fact, descriptive statistics supported these findings. Descriptive results contributed the relation between behavior and uncertainty beliefs. In general, pre-service science teachers who participated in the current study had low to moderate levels of uncertainty beliefs about the reality of anthropogenic climate change. Particularly, they were non-sceptical (M = 2.46). It can be inferred from these results that pre-service science teachers in our sample tended to act in pro-environmental to mitigate effect of climate change including recycling and conservation behaviors. To shed light on these findings, it can be necessary to examine dimensions of uncertainty beliefs. As far as these findings interpreted in dimensions of uncertainty beliefs in terms of scepticism about human-induced climate change and disinterest in climate change. Recalled that first dimension as "scepticim with disbelief in climate change, but its origins lie in the scientific method as an approach to questioning truth claims and interrogating evidence" (Whitmarsh, 2011, p. 698). The mean value of 2.52 for scepticism about anthropogenic climate change indicated that participants were non-sceptical about the reality of anthropogenic climate change and they considered climate change as real human induced environmental problem. They however, were unaware of influence of their behavior on climate change because they hesitated to engage knowledge about climate change. As far as the results of frequency distribution were considered, it was concluded that, while participants disagreed many items regarding scepticism about the reality of anthropogenic climate change (such as 'I am uncertain about whether climate change is really happening' and 'Claims that human activities are changing the climate are exaggerated' and 'It is too early to say whether climate change is really a problem'), they generally remain uncommitted to the statements favoring non-sceptical beliefs such as 'Climate change is something that frightens me'. Participants were in doubt about evidences of climate change and media reports including 'The evidence for climate change is unreliable', 'There is too much conflicting evidence about climate change to know whether it is actually happening', 'The media is often too alarmist about issues like climate change' and 'Flooding is not increasing, there is just more reporting of it in the media these days'. In fact, participants' hesitation can be attributed to either their lack of scientific knowledge or distrust into media sources such items further indicated that pre-service science teachers did not possess sufficient information to

understand and interpret scientific evidence about climate change because scientific evidences and reports is complex to be understood by non-experts of climate change (Poortinga et al., 2011). Media reports and news about climate change on the other hand includes more misconceptions and inconsistencies about climate change (Antilla, 2005). Pre-service science teachers in our study viewed media too alarmist and media report were not trustworthy and also did not believe that climate change result in direct risk to daily life of them. This abstract nature of may make it complicated for people to engage with the topic and cause the feeling of some degree of uncertainty about it (Kollmuss & Agyeman, 2002; Weber 2010).

These results also indicated their interest in climate change (M = 2.35). Similar to scepticism dimension they thought their activities on daily basis influence on climate change to be relevant to their behavior. Participants were appeared to be interested in the reality of anthropogenic climate change and accepted human-induced climate change. Specifically, they tend to consider information about climate change relevant to themselves because participants were interested in the reality of anthropogenic climate change. Participants had a tendency to consider information about climate change relevant to them, make some actions towards climate change if not be doing something by others and believe human activities having impact on climate change. Participants were appeared to be interested in the reality of anthropogenic climate change and accepted human-induced climate change.

Related literature reported somewhat similar results. For example, in her two studies, Whitmarsh (2011) found that their participants were non-marginally sceptical about the reality of anthropocentric climate change. They also reported that while rejection of notion of anthropocentric climate change is not widespread, the proportion of the public stating some degree of uncertainty and doubt about climate change is far higher. The most widely shared view among public was that media was too alarmist about climate change because public thought that media used dramatic imagery about climate change. Another consistent finding with the study was whether public behavior and activity cause climate change. The current thesis findings showed that pre-service science teachers use mass media such as TV, Internet and newspaper as source of information about climate change. In another study, Whitmarsh (2005) found that public was certain about occurrence of climate change but they did not believed media reports and media analysis because of exaggeration of climate change scenario in media communication. While people are

stimulated to change their behaviors in daily life to mitigate climate change, they saw important barriers to doing so, such as lack of knowledge, uncertainty and scepticism, distrust in information sources and seeing climate change as a distant threat. The author attributed the results in relation to climate change, scepticism stated about climate change might be explained a mechanism of denial to take over an internal discrepancy at a personal level between the wants to engage with climate change and pro-environmental behavior. Previous work by O'Neill and Nicholson-Cole (2009) also emphasized that alarmist and fear-based communication was likely to diminish endeavors to engage the public with climate change and stimulate people to shape their behavior. Information about climate change should be shaped to specific audience values and beliefs, and trusted sources of information should be used; while political actors might be one such source, more trusted sources maybe community members and scientists considered to be independent. Consequently, behavior change will, of course, not only related on communication but also on wider social and institutional change to help and stimulate pro-environmental lifestyles as mentioned by Whitmarsh (2005). Similar findings were reported by Lorenzoni et al. (2007). Lorenzoni and his colleagues found some barriers to engagement with climate change in behavioral, affective and cognition domains, such as lack of knowledge, uncertainty beliefs, distrust in information sources, and lack of political action, social norms and expectations. Recent research by Islam, Barnes and Toma (2013) found that only a small proportion of Scottish dairy farmers was sceptical, nearly half of the farmers were non-sceptical and a quarter of farmers were ambivalent (unsure) about climate change risks including productivity loses, decreasing of investment, increase in disease and pest infestations due to uncertainty of climate change. Similarly, like pre-service science teachers in our study, farmers viewed as media too alarmist and media report were not trustworthy and also did not believe that climate change result in direct risk to daily life of them, such as flooding and diseases.

Actually, the uncertainty beliefs about the reality of anthropogenic climate change were seen as barriers to engagement in climate change and take pro-environmental behavior by some researchers (Lorenzoni et al., 2007; Poortinga, Spence, Whitmarsh, Capstick & Pidgeon, 2011; Whitmarsh, 2011). Whitmarsh (2008) research results revealed that while scepticism was positively related with using public transport behavior to mitigate the effect of climate change, scepticism

had negatively significant influence on domestic energy conservation behaviors towards climate change. Lorenzoni et al. (2007) found barriers that limit to engagement climate change, including uncertainty beliefs, distrust in source of information. The author attributed the results to the lack of constant attention paid to climate change by the media was also cited by participants as a reason for uncertainty about the presence and seriousness of the issue, and in some cases as an explicit reason for unwillingness to engage (see also Hargreaves et al., 2003). The authors concluded that simply providing climate change information is unlikely to be successful to cope with uncertainty beliefs among public as new information is often interpreted by people in line with their prior attitudes and worldviews (see also Poortinga & Pidgeon, 2004) and also addressed that uncertainty beliefs and tendency to act in pro-environmental behavior were based on political ideology and personal values rather than on a critical evaluation of the available evidence (Corner, 2010).

The current study indicated epistemic beliefs regarding climate change as another significant predictor of pre-service science teachers' pro-environmental behavior in addition to uncertainty beliefs. In fact, epistemic beliefs regarding climate change influence on pro-environmental behavior directly as well indirectly through uncertainty beliefs. These findings suggested that pre-service science teachers who had sophisticated beliefs about climate change were more likely to behave in environmental friendly behavior as well as possess less uncertainty beliefs which lead to higher act in pro-environmental behavior.

In other words, participants believed necessity of use rules of inquiry and critically assess and compare sources rather than depending on what seem as right or own experiences, tend to think that knowledge about climate change is constructed by knower rather than knowledge to be delivered by experts, thought that knowledge about climate change is tentative and evolving rather than certain and true, thought that knowledge about climate change is composed of interrelated and complex theories rather than an accumulation of specific facts and details. To summarize, pre-service science teachers viewed knowledge about climate change as complex, tentative, personal construction and confirmed by multiple source. Accordingly, it is not surprising for pre-service science teachers having sophisticated epistemic beliefs regarding climate change had high tendency to act in pro-environmental behavior.

These findings were consistent with related literature although limited amount tended to report somewhat similar results (Braten et al., 2009; Stromso et al., 2010).

As expected, the results of Braten and his colleagues' workings about epistemic beliefs about climate change among university students were consistent with our results. For example, studying with undergraduate students by Stromso et al. (2010) concluded that they viewed personal judgments and interpretations to be main source of knowledge about climate change and less trusted external authorities, tended to adopt the notion that knowledge claims about climate change needed to be checked against reason and confirmed by multiple sources. In addition, it was reported that students believing knowledge about climate change to be theoretical, complex and tentative because of knowledge about climate change in media including uncertainties about causes and consequences of climate change. The authors attributed these results implied that awareness of source knowledge and this may play unique role in the university students' epistemic beliefs about climate change. In this study, authors emphasized why students should pay attention to source information are that this may facilitate their climate change comprehension. Therefore, there was good reason why teachers should focus more explicitly on developing students' sourcing skills about climate change. Another study exploring and comparing the dimensionality of personal epistemology with respect to climate change across the contexts of Norwegian and Spanish undergraduates as well as relationship with pro-environmental behavior, Braten at al. (2009) reported that undergraduates slightly believing knowledge about climate change to be tentative, theoretical, complex and evaluated through the comparison of multiple related sources, moderately believing that knowledge about climate change relied on personal judgments and interpretations as found in our study. There were also differences in the specific contents and instructional practices that the two samples experienced, with this, possibly, influencing participants' epistemic beliefs. Epistemic beliefs regarding knowledge about climate change had relationship with pro-environmental behavior. Their results also indicated that the more they believed that knowledge claims about climate change should be evaluated through critical reasoning and comparison of multiple knowledge sources, the more tendency they had to act in pro-environmental behavior. In addition, Spanish university students who more believed knowledge about climate change was tentative, theoretical and mainly sourced from personal judgments and interpretations, more tended to engagement to climate change. However, Norwegian university students who more believed knowledge about climate change was permanent, mainly sourced from

experts and loose collection of proven facts, more tended to engagement to climate change. Spanish undergraduate epistemic beliefs regarding climate change were consistent with Turkish pre-service science teachers' epistemic beliefs regarding climate change. Braten and his colleagues (2009) attributed these results to the cross-cultural comparison of the structure of the TSEBQ-data draws attention to the cultural embeddedness of topic-specific epistemic beliefs.

Apart from uncertainty beliefs and epistemic beliefs, environmental attitudes also found to be related pre-service science teachers' pro-environmental behaviors. In specifically, pre-service science teachers in the Turkey while seeing nature as worth conserving regardless of the human basic needs like food consumption and students hesitated to protect the environment because of its value in maintaining or because of enhancing the quality of human life, besides, the participants were seem to interested in environmental issues. They also support conservation human comfort. While ecocentric attitudes had a direct and indirect positive effect on pro-environmental behavior, anthropocentric attitudes had an indirect negative effect on pro-environmental behavior through epistemic beliefs regarding climate change and uncertainty beliefs about the reality of anthropogenic climate change. These results indicated that pre-service science teachers who generally valuing nature for its own sake and express concern for nonhuman objects and ecosystems even if protection of nature requires human sacrifice and decreased their living standard were more likely to behave in environmental friendly behavior as well as possess sophisticated epistemic beliefs and less uncertainty beliefs lead to act in pro-environmental behavior. On the other hand, pre-service science teachers who perceived human needs all above other values, and they conserve the environment if it fulfills human needs were less likely to behave in pro-environmental manner as well as less epistemic beliefs regarding climate change and uncertainty beliefs about human induced climate change were less likely to result in friendly-environmental behaviors.

It was concluded that, students were likely tended to think that overpopulation destroyed the natural areas and animals and plants should have right to live as humans. They generally had a tendency to support recycling, conservation activities and preserving resources for the benefit of humankind. Pre-service science teachers also were not likely to support modifying environment to suit human needs, deforestation to provide lumber and pollution of river and lakes. More than half of

the participants support the preservation of nature but their motives for this interest are different from those reported by ecocentric students due to meeting needs of next generation. Such students though perceived nature as important because it can contribute to the pleasure and welfare of humans, they believe that resources should be preserve in order to maintain a high quality of life and only the plants and animals having economical value should be conserved.

The results of current study indicated that pre-service science teachers who were not willing to touch upon the nature or control nature to satisfy wants and desires were more likely to engage in pro-environmental behavior. There were diversity research results about relationships between environmental values and pro-environmental action in literature. Consistently, Thompson and Barton (1994) research results supported completely our results about the relation between pro-environmental behavior and environmental attitudes. They reported their participants (mean age of 43 years old) to be more eco-centric, less anthropocentric and stating less apathy about environmental problems and issues. They stated that both ecocentric and anthropocentric individuals support favorable environmental actions, however their underlying motives are different. While ecocentric individuals protect environment for its own sake, anthropocentric individuals support and protect environment for their requirements, welfare of their life and increase quality of their life. The authors suggested the results that ecocentric individuals may have different reasons from anthropocentric individuals to protect environment. For instance, they conserved the environment to save money. The authors recommended that programs designed to stimulate environmental awareness in children or adults should emphasize on increasing ecocentric concern in the environment rather than anthropocentric concern because of higher tendency of ecocentric individual to act in pro-environmental behavior and participate with conserving actions. The authors proposed that emphasizing the intrinsic reward of being nature, experiences in nature and taking pleasure of nature could be better approach. The authors attributed the difference between ecocentric and anthropocentric that understanding of associated motives and values underlying attitudes toward environment to constitute the basis for these attitudes. Consequently, investigating both attitudes and associated motives could be resulted in a better comprehension of environmental behavior and new opinions to stimulate conservation actions.

Knowledge about climate change was not found as a predictor of pro-environmental behavior. This finding was inconsistent with the study of Lorenzoni, et al. (2007) who stated that knowledge about climate change is significant aspect of engagement of climate change in terms of cognitive, behavioral, and affective. Lorenzoni et al. (2007) reported that lack of knowledge was one of important barriers to engage in climate change and this information about climate change and mitigative activities for climate change were needed to be communicated through credible channels and provided in context consistently with scientific opinions and previous reports about climate change. Science education had a crucial role in shaping of public knowledge about climate change and improving of engagement to climate change (see also Lorenzoni et al. 2007, p. 455).

Although knowledge about climate change did not statistically significantly related to pro-environmental behavior, how interpreting and perceiving this knowledge or nature of knowledge, (i.e., epistemic beliefs towards knowledge about climate change) was significantly. The addressing of the way of knowing and reasoning skills about climate change in curriculum might be useful and may a good starting point for improving of pro-environmental behavior. As stated in UNEP (1994), epistemology and nature of knowledge courses was required for teacher training programs on environmental education.

Nevertheless, knowledge about climate change found to be related to environmental value orientations, uncertainty beliefs about the reality of anthropogenic climate change. In other words, pre-service science teaches with more favorable knowledge about climate change readily values environment for its own sake and physical demands for human. However, pre-service science teachers with high level of knowledge about climate change had less uncertainty beliefs about the reality of human induced climate change. For this reason, it can be inferred that they know the reality of human induced climate change and informed about causes and consequences of climate change.

Also, Kollmus and Agyeman (2002) reported that knowledge about environmental issues cannot directly influence on environmental behavior due to different types of knowledge. If individuals did not have necessary knowledge how they behave in responsible manner towards environment, they could not act in responsible behavior and also basic knowledge about environmental issue could not lead to act in pro-environmental behavior. Chen (2012) compared individuals who

were the lower and higher informed about climate change to show the effect knowledge about climate change on pro-environmental behavior, environmental values, environmental attitudes and environmental beliefs. The results of his study indicated that there were no significant difference between better and less informed about climate change respondents on pro-environmental behavior and environmental values. On the other hand, Fietkau and Kessel (1981) reported in their pro-environmental model that environmental knowledge acts as a modifier of environmental attitudes and values to influence on pro-environmental behavior. In current study reported that informed individuals about climate change had a tendency to save and support environment for its own sake or meet human needs and welfare.

Knowledge about climate change found as one the predictors of understanding and responding to climate change (Whitmarsh, 2011). NEEFT and Roper (2005) presented that knowledge about climate change in environmental literacy was not deep scientific knowledge about climate change. Actually, it was composed of general knowledge about climate change that public could define and perceive causes, states and effects of climate change on environment and living beings (Sundblad et al., 2009). Knowledge about climate change concept included in our study covers the same knowledge comprehension. In brief, environmental knowledge was defined as important predictor of environmental beliefs and actions. Also, studies researching on knowledge about climate change emphasize that people are aware of causes of climate change and concern about impacts of climate change but they suffer from lack of knowing how they combat and mitigate climate change (Bord et al., 2000; Masud et al, 2013).

Unexpectedly, the current study results indicated that there was no statistically significant relationship between knowledge about climate change and epistemic beliefs towards climate change. Some researchers (Bråten et al., 2009; Stromso et al., 2010) stated that individuals who had knowledge about climate change, believed that knowledge claims about climate change should be evaluated through critical and logical thinking, as well as compared with multiple related sources.

Findings indicated that environmental attitudes also play a significant role in the shaping of the associated variables. The results showed that ecocentric and anthropocentric values had a significant direct relationship with pre-service science teachers' uncertainty beliefs about the reality of anthropogenic climate change and

epistemic beliefs towards climate change. Consistently, Whitmarsh (2008) research results revealed that respondents who believed the environment is deterioration, resources was limited, and non-human things had intrinsic value were more likely to believe anthropocentric climate change was real, to consider it personally very significant and posing a threat, and to taking pro-environmental action in responding to climate change. Ozkan et al., (2011) pre-service early childhood teachers reported that there were not statistically significant relation between epistemological beliefs and environmental motives. However, in our study, while anthropocentric value negatively related with epistemic beliefs about climate change, ecocentric values were positively related with epistemic beliefs about climate change. It was inferred that people who save nature for its own sake and support for environment and living things believed that knowledge about climate change as complex, tentative, composed of integrated concepts and critically examined from multiple sources. On the other hand, individuals who support nature for human beings and meet human needs for their welfare and comforts saw the knowledge about climate change as permanent, unambiguous, consisting of a loose collection of proven facts, rely on expert authors.

Another finding of the current study was the source of information about climate change. The mass media, however, was reported to be the leading source of knowledge about climate change for pre-service science teachers. Specifically, majority of the pre-service science teachers depended on mainly television and Internet (86.1% and 75.2% respectively) to obtain their knowledge about climate change. Two thirds of the pre-service science teachers reported to get their environmental information from their school/university education. Less prominent were the friends, involvement in NGOs events, government institutions and libraries. These results supported the growing effect of media on environmental education. This study was consistent with many other studies (Islam et al., 2013; Whitmarh, 2005). In the related literature, Islam et al., (2013) stated use of media positively related with scepticism and environmental values among farmers. Richetin and friends (2007) reported that watching TV programs about climate change positively related reducing energy consumption because TV programs emphasized on significance of sustainable life and importance of domestic energy conservation in mitigating climate change. However, Lorenzoni et al., (2007) expressed that UK public use mass media as source of information about climate change but they

distrusted media sources. This distrust in information source resulted in uncertainty and scepticism towards climate change. In conclusion, sources of information about climate change had an influence on climate change scepticism, knowledge about climate change, environmental values and environmental values. Therefore, media and other information sources can be used to develop beliefs and understanding of individuals about climate change, encourage them take more pro-environmental and sustainable behavior towards climate change. Mass media devices might be used educate young generation about environmental issues and sustainable development to take the responsibility of their future because students will be an adult in future. In the current study findings also demonstrated that most of pre-service science teachers have heard climate change before, thought that things can be done to mitigate climate change and it is a significant problem although they have not regularly taken any action out of concern for climate change so far. In addition, they thought that all people are influenced adversely from effects of climate change. They also stated that all people, environmental organizations and business and industry should take the responsibility to mitigate climate change. These findings were consistent with Whitmarsh (2005) findings among society in the UK. Whitmarsh (2005) reported that although they thought that climate change is important problem and all people should take the responsibility of mitigating climate change, the UK public did not take any regularly any action to mitigate effects of climate change. The author attributed these findings to alarmist news about climate change which were reported by mass media. These alarmist messages cause uncertainty beliefs about climate change and less tendency to attending to mitigating climate change among the UK public.

Overall, the present study indicated that pre-service science teachers with more favorable epistemic beliefs towards climate change, more certainty beliefs about the reality of anthropogenic climate change and more intrinsic value toward the environment readily take more pro-environmental behavior. Also, the current study showed that knowledge about climate change had significant positive effect on environmental values but negative effect on uncertainty beliefs about the reality of human-induced climate change.

The results of the study can be used to develop a strategy to mitigate anthropogenic climate change and encourage to climate-friendly behaviors among Turkish public. Knowledge, gender, political view and source of information could

not found as significant predictors of pro-environmental behaviors. These indicators may be explored in future studies. Also, geographical differences on pro-environmental behavior models can be investigated in next studies. The pro-environmental behavior questionnaire in current study could not focused specifically on climate change issue so specifically focused on climate change pro-environmental behavior questionnaire can be developed for next nation-wide studies. Moreover, this study limited to perceived locus of control and so future studies will also use of these factors in nation-wide study.

5.2. Implication of the Study

Indoor and outdoor activities such as nature walk, field trip can be made. This makes help students to enhance their pro-environmental behavior and improve their attitudes.

Nature of science embedded activities can be used to improve epistemic beliefs of students towards climate change. History of science embedded activities can be added to curriculum to enhance students' epistemic beliefs regarding climate change. When administering climate change in classroom environment, extra effort was acted to integrate nature of science to explain how scientists work to form climate change model. This makes help students to advance their epistemic beliefs regarding climate change. In addition, epistemic beliefs seem as influential effect on pro-environmental behavior.

The present study gives educators, policymakers, and academic staff some significant clues which could be used to enhance pro-environmental behavior. Considering the role of ecocentric value orientations in shaping behaviors and the relevant attributes, pre-service teachers could be participate in some pro-environmental activities in outdoor and indoor settings.

To overcome uncertainty beliefs about the reality of human-induced climate change among teachers, trust in source of information about climate change may be improved and climate change textbooks for teacher, students and public can be designed.

The results of study provide educators, teachers, curriculum developers, textbook authors and social politicians with suggestions that contribute to the improvement of the quality of environmental education in Turkey. Pre-service science teachers in the current study found to have moderate knowledge about

climate change. Since, their knowledge about climate change was limited and they had some misconceptions and low level confidence in their knowledge especially about consequences of climate change related with health and sea level; curriculum developers and academic staff should pay more attention to the teaching of these concepts, as well as others.

In the process of creating curricula to address climate change and pro-environmental behavior towards climate change, the knowledge base, principles and guidelines are reformed through sustainability goals selected for the society. In the light of the results of the current study will guide the reorientation of the formal curriculum because of predictors of their pro-environmental behavior towards climate change. Values toward the environment were found to have a significant role for forming pro-environmental behaviors. In this aspect, ecocentric worldviews about the environmental degradation and feelings of concern on human health and social well-being should be placed as strong motivators for movement in creating environmental sustainable curricula to mitigate climate change.

Considering lifestyle change to mitigate the challenges of climate change, reduction in household energy use, recycling, surface transportation behavior were could be taken on an individual level. Pre-service science teachers acted frequently political influence by supporting climate-friendly policies.

There is a strong need to investigate the relationships and understandings of academic staff on pro-environmental behaviors towards climate change and the potential barriers that hinder the effective exposition of a climate-friendly curriculum. A further research study is significantly required to decide the barriers which hamper conversion of Faculty of Education students' knowledge, value and beliefs into more pro-environmental behaviors toward climate change. Therefore, the results of current about teachers can be seen as initiator for this aim.

5.3. Limitations and Recommendations

The current study presented a pro-environmental behavioral model of pre-service science teachers by measuring their knowledge about climate change, environmental attitudes, epistemic beliefs regarding climate change, uncertainty beliefs climate change by using questionnaire adapted from previously developed instruments. Accordingly, this study limited to these constructs and pre-service science teachers. Therefore, a future study should be conducted with different

participants, such as academic staff who could have effective role in shaping of teachers' pro-environmental behaviors towards climate change, with teachers who influence on students' pro-environmental behaviors towards climate change, with young children as well as public either by using same construct or other constructs thought to influence pro-environmental behavior such as locus of control, perceived efficacy, environmental identity and different personality characteristics etc.

Moreover, although collected in this study, some of the constructs, including confidence in knowledge about climate change and demographic variables, neither integrated into the model or examined separately (i.e., gender, political orientation, SES, geographical region, source of information etc.). Further research should examine the influence or effect of such variables.

Major limitation of the study was the use of different instruments, some of which did not specifically address the climate change. This study can be replicated utilizing instruments specifically developed for climate change.

Lastly, the study was limited by its reliance on self-reported data. Subsequent research is needed to verify the consistency and accuracy of the present findings through use of multiple methods and measures. Nevertheless, a nation-wide study can be needed to generalize the results to Turkish population.

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APPENDICES

APPENDIX A

Bu araştırmanın amacı fen bilgisi öğretmen adaylarının iklim değişikliğine yönelik davranışlarını belirlemektir. Anketi doldurmanız yaklaşık 30dakikanızı alacaktır. Araştırmaya katılmanız ve anketleri eksiksiz doldurmanız büyük önem taşımaktadır. Anketlerden elde edilen kişisel bilgileriniz gizli tutulacaktır. TEŞEKKÜR EDERİM.

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1. İklim değişikliği kelimesini daha önce duydunuz mu? ☐Evet ☐ Hayır

2. İklim değişikliği ile ilgili, genel olarak, ne kadar bilginiz olduğunu düşünüyorsunuz?

☐Çok fazla ☐Yeteri kadar ☐Biraz ☐Çok az ☐Bilgim yok

3. İklimlerin değiştiğini düşünüyor musunuz? ☐Evet ☐Hayır ☐Bilmiyorum

4. Aşağıda iklim değişikliği hakkında belirtilen genel ifadelere ne derece katıldığınızı belirtiniz.	**Kesinlikle Katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Kesinlikle Katılmıyorum**
İklim değişikliğinin etkilerini azaltmak için hepimiz üzerimize düşeni yapabiliriz.	5	4	3	2	1
Modern toplumun işleyişi nedeniyle iklim değişikliği kaçınılmazdır.	5	4	3	2	1
Eğer enerji tüketimini azaltmak iklim değişikliğini yavaşlatıyorsa, insanların enerji tüketimlerini azaltmaları gerekiyor.	5	4	3	2	1
İklim değişikliği Türkiye'nin hava şartlarını düzeltecektir.	5	4	3	2	1
İklim değişikliği tek kelimeyle dünyanın sıcaklığındaki doğal bir dalgalanmalardır.	5	4	3	2	1
Herkes iklim değişikliğini azaltmak için düşeni yaptığında ben de kendi payıma düşeni yapardım.	5	4	3	2	1
Hükümet, çevreyi korumaları için insanları özendirmelidir.	5	4	3	2	1
İklim değişikliği ile ilgili bir şeyler yapmak için artık **çok geçtir.**	5	4	3	2	1
İnsan faaliyetlerinin küresel ısınma üzerinde önemli bir etkisi yoktur.	5	4	3	2	1

İklim değişikliği beni dehşete düşürüyor.	5	4	3	2	1
Gelişmekte olan ülkeler, iklim değişikliğinin sonuçlarına yönelik sorumluluğu almalıdır.	5	4	3	2	1
İklim değişikliğinin gerçekten olup olmadığı konusunda kararsızım.	5	4	3	2	1
İklim değişikliğinin üstesinden gelmek için toplumda köklü değişikliklerin yapılması gerekmektedir.	5	4	3	2	1
İnsanlar iklim değişikliği ile ilgili bir şeyler yapmayacak kadar çok bencildir.	5	4	3	2	1
İklim değişikliği hakkındaki mevcut kanıtlar güvenilir **değildir**.	5	4	3	2	1
Amerika Birleşik Devletleri iklim değişikliğinin sonuçlarına yönelik sorumluluğu almalıdır.	5	4	3	2	1
İnsan faaliyetlerinin iklimleri değiştirdiği yönündeki iddialar **abartılıyor**.	5	4	3	2	1
İklim değişikliği ile ilgili bir bilgiye rastladığımda onu incelerim.	5	4	3	2	1
İklimlerin gerçekten değişip değişmediği hakkında gereğinden fazla çelişkili kanıt vardır.	5	4	3	2	1
Evimdeki ışıkların açık bırakılması, iklim değişikliğini **körükler**.	5	4	3	2	1
İklim değişikliği modern yaşamın bir sonucudur.	5	4	3	2	1
İklim değişikliğinin etkileri felaketle sonuçlanabilir.	5	4	3	2	1
Öyle ya da böyle, yaptığım hiçbir şey iklim değişikliği için fark **yaratmıyor**.	5	4	3	2	1
Sanayi kirliliği, iklim değişikliğinin temel nedenidir.	5	4	3	2	1
İklim değişikliği ile ilgili bilgilerin benim için alakasız olduğunu düşünme eğilimindeyim.	5	4	3	2	1
Son zamanlarda yaşanan su baskınlarının nedeni iklim değişikliğidir.	5	4	3	2	1
İklim değişikliğinin gerçekten bir problem olup olmadığını söylemek için henüz çok erkendir.	5	4	3	2	1
Medya, genellikle iklim değişikliği gibi konularda insanları gereğinden fazla telaşlandırıyor.	5	4	3	2	1
Su baskınları artmıyor; sadece son günlerde medyada su baskınları ile ilgili daha fazla haber yer alıyor.	5	4	3	2	1
İklim değişikliği hakkında kişisel bir şey yapmanın benim için hiçbir önemi yoktur, zira hiç kimse bir şey **yapmıyor**.	5	4	3	2	1
Uzmanlar, iklim değişikliğinin gerçek bir problem olduğunu kabul ediyorlar.	5	4	3	2	1
Günlük yaşamımda iklim değişikliği problemini körükleyecek herhangi bir şey **yapmıyorum**.	5	4	3	2	1

Sanayiciler ve iş dünyası iklim değişikliğinin üstesinden gelebilmek için daha fazla çaba harcamalıdır.	5	4	3	2	1
Hükümet, genelde iklim değişikliğini azaltmayı hedefliyor.	5	4	3	2	1
İklim değişikliğinin gerçek bir problem olduğuna **inanmıyorum**.	5	4	3	2	1
Hükümet, iklim değişikliğiyle mücadele için yeterince çaba **göstermiyor**.	5	4	3	2	1
İklim değişikliği ile ilgili bir şeyler yapmayı ahlaki bir görev olarak görüyorum.	5	4	3	2	1

5. Aşağıda belirtilen faaliyetleri ne sıklıkla gerçekleştirdiğinizi belirtiniz.	**Her zaman**	**Çoğu zaman**	**Bazen**	**Nadiren**	**Hiçbir zaman**
Kısa mesafelerde motorlu taşıtlara binmek yerine yürümeyi ya da bisiklete binmeyi tercih ediyorum.	5	4	3	2	1
İthal ürünler yerine yerel yiyecekleri satın alıyorum.	5	4	3	2	1
Çevre koruması ile ilgili protesto yürüyüşlerine ya da gösterilere katılıyorum.	5	4	3	2	1
Özellikle tekrar kullanılabilir ya da geri dönüştürülebilir paketlerde bulunan ürünleri satın alıyorum.	5	4	3	2	1
Çevreye zarar veren firmaların ürünlerini satın almaktan kaçınıyorum.	5	4	3	2	1
Yere atılmış çöpleri topluyorum.	5	4	3	2	1
Cam sise, alüminyum kutu ya da kâğıtları geri dönüşüm kutusuna atıyorum.	5	4	3	2	1
Daha az enerji (elektrik, su gibi) tüketmeye çalışıyorum.	5	4	3	2	1
Odadan çıkan en son kişiysem ışıkları kapatıyorum.	5	4	3	2	1
Dişlerimi fırçalarken ya da banyo yaparken az su tüketmeye özen gösteriyorum.	5	4	3	2	1
Bir siyasi partiyi desteklerken ya da oy verirken çevre sorunlarının çözümüne yönelik tutumlarını da göz önünde bulunduruyorum.	5	4	3	2	1
Çevreyle ilgili konuları içeren yayınları okuyorum.	5	4	3	2	1
Çevreye zarar veren insanları bu tür davranışlarına son vermeleri için uyarıyorum.	5	4	3	2	1
Çevre yanlısı harekete geçmeleri için insanları teşvik ediyorum.	5	4	3	2	1

6. Aşağıdaki ifadeye *kesinlikle KATILIYORSANIZ* 10; *kesinlikle KATILMIYORSANIZ* 1 sayısını işaretleyiniz. Eğer bir ifadeye daha fazla veya daha az katılıyorsanız, 10 ile 1arasında sizin düşüncenizi en iyi ifade eden sayıyı işaretleyiniz.	**Kesinlikle katılıyorum**	**Kesinlikle katılmıyorum**
İklim değişikliği araştırmalarında, gerçekler teorilerden daha önemlidir.	10	1
İklim değişikliği ile ilgili bilgiler sürekli değişmektedir.	10	1
İklim değişikliği araştırmalarında, ayrıntılar hakkında doğru bilgiye sahip olmak çok önemlidir.	10	1
İklim sorunları ile ilgili bilimsel araştırmaların sonuçlarına, sıradan insanların görüşlerinden daha çok güvenirim.	10	1
İklim değişikliği hakkındaki teoriler her an çürütülebilir.	10	1
İklim değişikliğiyle ilgili konuları daha iyi anlamak için sadece okumam yeterli değildir; ayrıca üzerinde düşünmem de gerekir.	10	1
İklim değişikliği ile ilgili bilgiler, gerçeklerin birikiminden çok, birbiriyle yüksek derecede ilişkili kavramlardan oluşur.	10	1
İklim değişikliği sorunları ile ilgili okuduklarımın güvenilir olup olmadığını, konu hakkında öğrendiğim diğer bilgilerle ilişkilendirerek kontrol etmeye çalışırım.	10	1
İklim değişikliği araştırmalarında birçok şey birbirine bağlıdır.	10	1
İklim değişikliği sorunları hakkında bir şeyler okuduğumda, en çok kendi gözlerimle de gördüğüm bilgiye güvenirim.	10	1
İklim değişikliğiyle ilgili yazılarda ileri sürülen iddialara güvenebilmek için, birden fazla bilgi kaynağı incelenmelidir.	10	1
Günümüzde iklim değişikliği ile ilgili kesin olarak kabul edilen bilgiler, gelecekte yanlış olarak kabul edilebilir.	10	1
İklim değişikliğiyle ilgili bilgiler, yüksek miktarda ayrıntılı bilgiden oluşur.	10	1
İklim değişikliği alanında yapılan araştırmalarda, birçok konu arasında ilişki vardır.	10	1
İklim değişikliği araştırmalarının sonuçları başlangıç niteliğindedir.	10	1
Bir birey İklim değişikliğiyle ilgili konularda gerçek bir bakış açısı kazanmak için, okuduklarından faydalanarak kendi kişisel görüşünü oluşturmalıdır.	10	1
İklim değişikliği konusundaki kendi düşüncelerim, en az çeşitli bilimsel metinlerdeki mevcut bilgiler kadar önemlidir.	10	1
İklim problemleri hakkında okuduklarımın güvenilir olup olmadığını kontrol etmek için konu hakkında öğrendiğim diğer şeylerle ilişkili olarak değerlendirmeye çalışırım.	10	1
İklim değişikliğiyle ilgili konular hakkında okuduğumda, konunun içeriği hakkında kendi anlayışımı oluşturmaya çalışırım.	10	1

Doğru Yanlış	**7.**Aşağıdaki cümlelerin **doğru olduğunu düşünüyorsanız DOĞRU, yanlış olduğunu düşünüyorsanız YANLIŞ** seçeneğini işaretleyiniz. **Verdiğiniz yanıta ÇOK GÜVENİYORSANIZ 5 sayısını; HİÇ GÜVENMİYORSANIZ 1 sayısını** işaretleyiniz. Eğer verdiğiniz yanıttan daha fazla veya daha az eminseniz, 5 ile 1 arasında sizin düşüncenizi en iyi ifade eden sayıyı işaretleyiniz.	Cevabımdan eminim ... Cevabımdan emin değilim
D Y	Kuzey yarımküredeki kar örtüsü 1960'lardan bu yana yaklaşık %10 azaldı.	5 4 3 2 1
D Y	Kuzey yarımküredeki kar örtüsü yaklaşık olarak şu anda 1960'lardaki seviyesiyle aynıdır.	5 4 3 2 1
D Y	Fırtına ve sellerin sayısı son 100 yıl içinde belirgin bir biçimde arttı.	5 4 3 2 1
D Y	Buzulların ve karların erimesi deniz seviyesinin artmasının bir sebebidir.	5 4 3 2 1
D Y	Deniz suyu sıcaklığındaki artış deniz seviyesinin artmasının bir sebebidir.	5 4 3 2 1
D Y	Kuzey kutup bölgesindeki buz kütlesinin önümüzdeki 100 yıl içerisinde artması bekleniyor.	5 4 3 2 1
D Y	İklim değişikliğinin neden olduğu sivrisinek ve kene sayısındaki artış önümüzdeki 50 yıl içerisinde Türkiye'de daha fazla insanın hastalanmasına sebep olması ihtimal dâhilindedir.	5 4 3 2 1
D Y	İklim değişikliği, önümüzdeki 100 yıl içerisinde Türkiye'de ishal gibi su yoluyla bulaşan hastalıklara yakalanma riskini artıracaktır.	5 4 3 2 1
D Y	Türkiye'deki sıcak hava dalgalarının artması önümüzdeki 50 yıl içerisinde akciğer ödemi ve kalp rahatsızlıklarının yol açacağı ölümlerin artmasına sebep olabilir.	5 4 3 2 1
D Y	İklim değişikliğinin sağlık üzerindeki olumsuz etkileri, kırsal bölgelerde yaşayan insanları şehirlerde yaşayanlardan daha çok etkileyecektir.	5 4 3 2 1
D Y	Sera gazlarındaki artış ozon tabakasının incelmesine sebep olacağı için cilt kanserine yakalanma riskini arttırır.	5 4 3 2 1
D Y	Sera gazlarındaki artış ozon tabakasının incelmesine sebep olacağı için cilt kanserine yakalanma riskini arttırır.	5 4 3 2 1
D Y	Sera gazı salınımı iklim değişikliğine neden olur.	5 4 3 2 1
D Y	Cilt kanserindeki artışın sebebi iklim değişikliğidir.	5 4 3 2 1
D Y	Ozon tabakasının incelmesi iklim değişikliğinin önemli nedenlerinden biridir.	5 4 3 2 1
D Y	Hava kirliliğinin artması iklim değişikliğinin önemli nedenlerinden biridir.	5 4 3 2 1

D Y	Önümüzdeki 50 yıl içerisinde iklim değişikliği nedeniyle oluşacak sağlık etkileri sadece tropik bölgelerde oturan insanları ilgilendirir.	5 4 3 2 1
D Y	Küresel deniz seviyesi son 100 yılda sabit kalmıştır.	5 4 3 2 1

8. Aşağıdaki maddelerden her birinin <u>sizi temsil etme derecesini</u> yandaki ölçekte yer alan numaralardan birini kullanarak gösteriniz	**Kesinlikle Katılıyorum**	**Kesinlikle Katılmıyorum**
Aşırı nüfus artışının en kötü yanı doğal alanların yok ediliyor olmasıdır.	5	1
Sırf doğada olmak uğruna, doğal ortamda vakit geçirmekten zevk alırım.	5	1
Tarım alanları yaratmak için ormanların tahrip edilmesi beni üzer.	5	1
Yağmur ormanlarının kaybının en kötü yanı, yeni ilaçların geliştirilmesinin sınırlanacak olmasıdır.	5	1
Mutlu olmak için doğada zaman geçirmeye ihtiyaç duyarım	5	1
Ormanların yok olması hakkında beni en çok endişelendiren şey, gelecek nesiller için yeterli kereste bulunmayacak olmasıdır.	5	1
Nehirleri ve gölleri temiz tutmanın en önemli nedenlerinden biri insanlara su sporları yapacakları yerler sağlamaktır.	5	1
Bazen mutsuz olduğum zamanlarda doğada rahatlarım.	5	1
Çevreye zarar verilmesini görmek beni üzer.	5	1
Geri dönüşüm yapmanın en iyi yanlarından biri para tasarrufu sağlamasıdır.	5	1
Doğanın korunmasının en önemli nedeni, insan yaşamının devamının sağlanmasıdır.	5	1
Doğa, insanların refah ve keyfine katkı sağladığı için önemlidir.	5	1
Doğa, kendi başına değerlidir.	5	1
Doğal kaynakları, yüksek bir yaşam kalitesi sürdürmek için korumalıyız.	5	1
Doğada zaman geçirmek stresimi büyük oranda azaltır.	5	1
Doğal kaynakları korumanın en önemli nedenlerinden birisi, insanların yüksek yaşam standardının devamını sağlamaktır.	5	1
Doğal kaynakları korumanın en önemli nedenlerinden biri, doğal yaşam alanlarının yok olmamasını sağlamaktır.	5	1
Arazilerin sürekli olarak ıslah edilmesi (arazi reformu) insanlara yüksek yaşam kalitesi sunduğu sürece iyi bir fikirdir.	5	1
Yaşam tarzımı değiştirmek zorunda olmadığım sürece çevreyi korumak için elimden gelenin en iyisini yaparım.	5	1
İnsanlarda, diğer hayvanlar kadar ekosistemin bir parçasıdır.	5	1
İnsanların et ihtiyaçlarının karşılandığı vahşi hayvanlar korunması gereken en önemli türlerdir.	5	1
Eğer insan hayatını kurtarabilecekse, hayvanlar bilimsel deneylerde kullanılmalıdır	5	1
İnsanların doğayı kendi menfaatleri doğrultusunda değiştirmeye hakkı vardır.	5	1

9.İklim değişikliği ile mücadele sizce **aşağıdakilerden hangisinin sorumluluğundadır?**	**Kesinlikle katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Kesinlikle katılmıyorum**
Uluslararası örgütlerin (Birleşmiş Milletler, UNESCO vb.)	5	4	3	2	1
Hükümetin	5	4	3	2	1
Yerel yönetimin	5	4	3	2	1
Sanayicilerin	5	4	3	2	1
Çevre örgütleri ve lobi gruplarının (Dünya Doğa Fonu)	5	4	3	2	1
Bireylerin	5	4	3	2	1
Bütün insanların	5	4	3	2	1

10.İklim değişikliğini nereden duydunuz? (Birden fazla seçenek seçebilirsiniz)	
☐ Televizyon	☐ Devlet kurumları
☐ Radyo	☐ Halk Kütüphaneleri
☐ Gazete	☐ Arkadaşlar
☐ Internet	☐ Aile
☐ Uzman yayınları/akademik dergiler	☐ Yerel belediyeler
☐ Çevreci gruplar (Dünya Doğa Fonu)	☐ Enerji sağlayan devlet kurumları
☐ Okul/üniversite	☐ Diğer (……..)

İklim değişikliğinin etkileri kimleri olumsuz şekilde etkileyecektir?

☐ Bütün herkesi ☐ Sahil kenarında yaşayanlar

☐ Üçüncü Dünya ülkeleri ☐ Fakir insanlar

Aşağıdakilerden hangisi sizin görüşünüze en yakındır?

☐ İklim değişikliği günümüzde insanların karşı karşıya olduğu en önemli 2 ya da 3 problemden biridir.

☐ İklim değişikliği önemli bir problemdir, ama daha önemli başka problemler de vardır.

☐ İklim değişikliği önemli bir problem **değildir**.

☐ İklim değişikliği bir problem **değildir**.

İklim değişikliğinin etkilerini azaltmak için sizce yapılabilecek bir şey olduğunu düşünüyor musunuz?

☐Evet ☐ Hayır ☐ Bilmiyorum

Yukarıdaki soruya cevabınız evetse, lütfen belirtiniz?

_____

İklim değişikliğiyle mücadele edebilmek için sizce yapılabilecek bir şey var mı?

☐Evet ☐ Hayır ☐ Bilmiyorum

Yukarıdaki soruya cevabınız evetse, lütfen belirtiniz?

_____

Kişisel Bilgiler

Cinsiyetiniz: ❑ Kadın ❑Erkek Yaşınız: ……..

Sınıfınız: ❑1 ❑2 ❑3 ❑4 Genel Not Ortalamanız: …..

Üniversitede çevre dersi aldınız mı? ❑ Evet ❑Hayır

Annenizin Eğitim Durumu

❑Okuryazar değil ❑İlkokul ❑Ortaokul ❑Lise ❑Üniversite

❑Yüksek lisans/Doktora

Babanızın Eğitim Durumu

❑Okuryazar değil ❑İlkokul❑Ortaokul ❑Lise ❑Üniversite

❑Yüksek lisans/Doktora

Annenizin mesleği (emekli ise emekli olmadan önceki mesleğini yazınız):

❑Ev hanımı ❑Memur ❑İşçi ❑ Serbest meslek

Babanızın mesleği (emekli ise emekli olmadan önceki mesleğini yazınız):

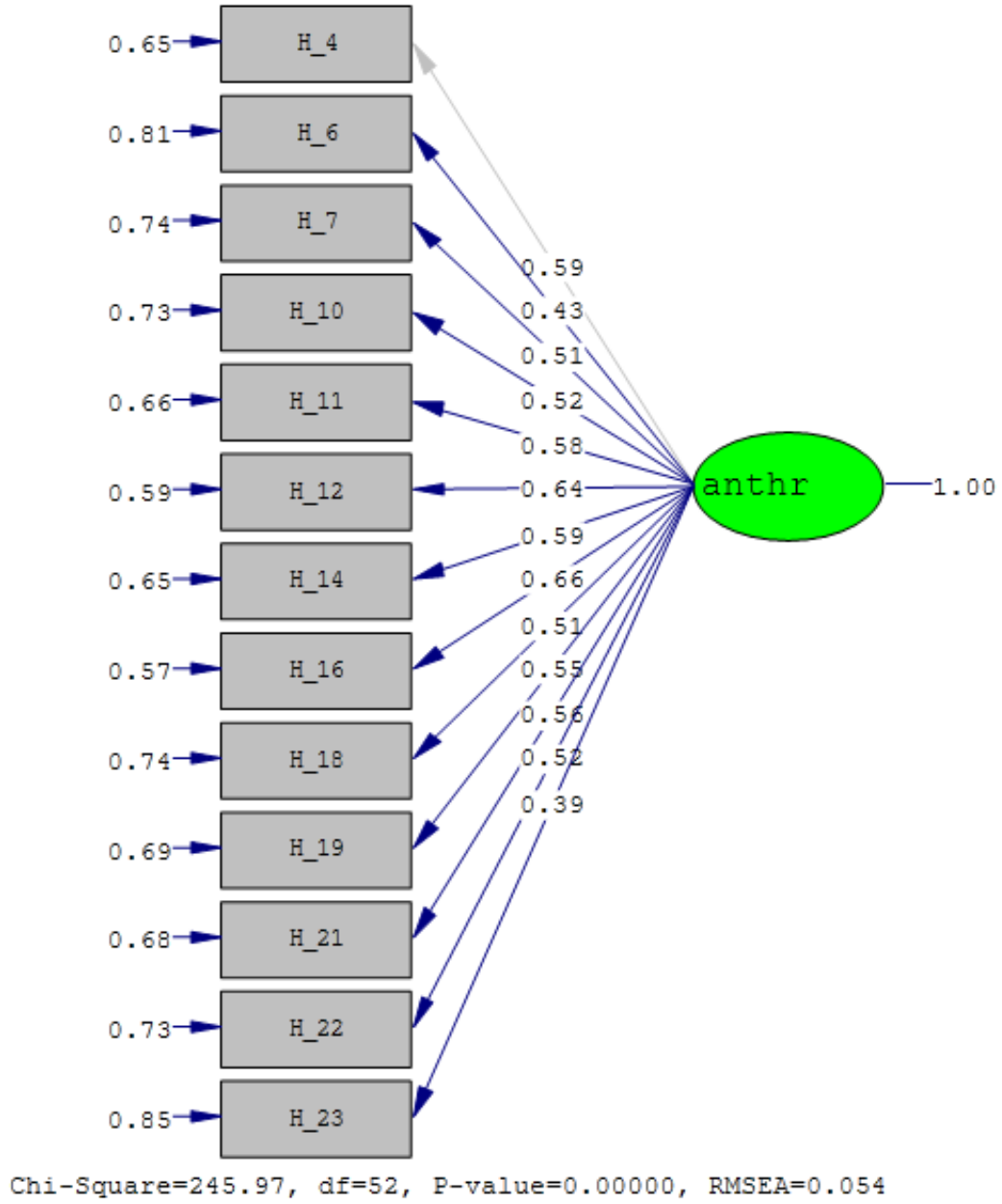
❑Çiftçi❑Memur ❑İşçi ❑ Serbest meslek ❑Çalışmıyor

Appendix B

CFA For Anthropocentric Value Dimension

LISREL Estimates of Parameters for Anthropocentric Value Dimension

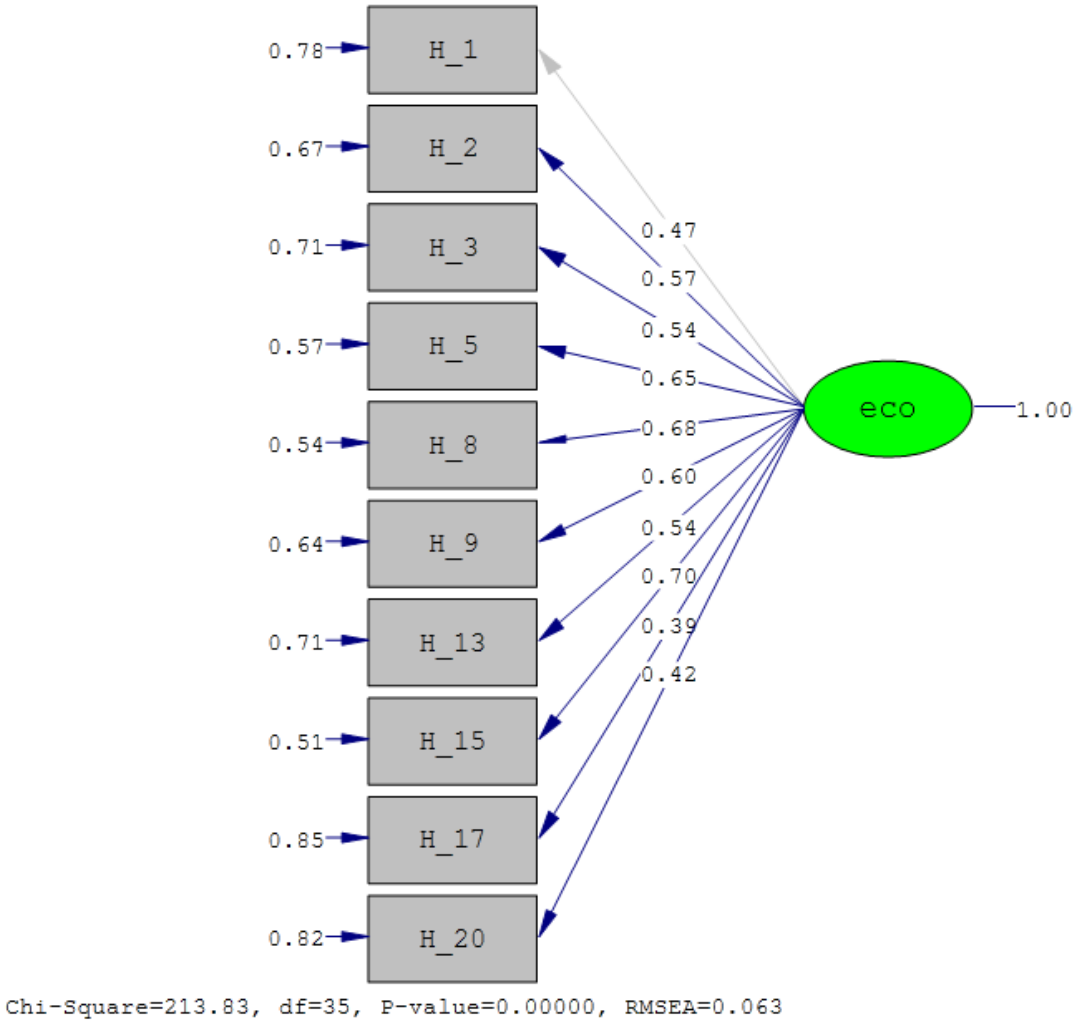
Coefficients in Standardized Value



CFA For Ecocentric Value Dimension

LISREL Estimates of Parameters for Ecocentric Value Dimension

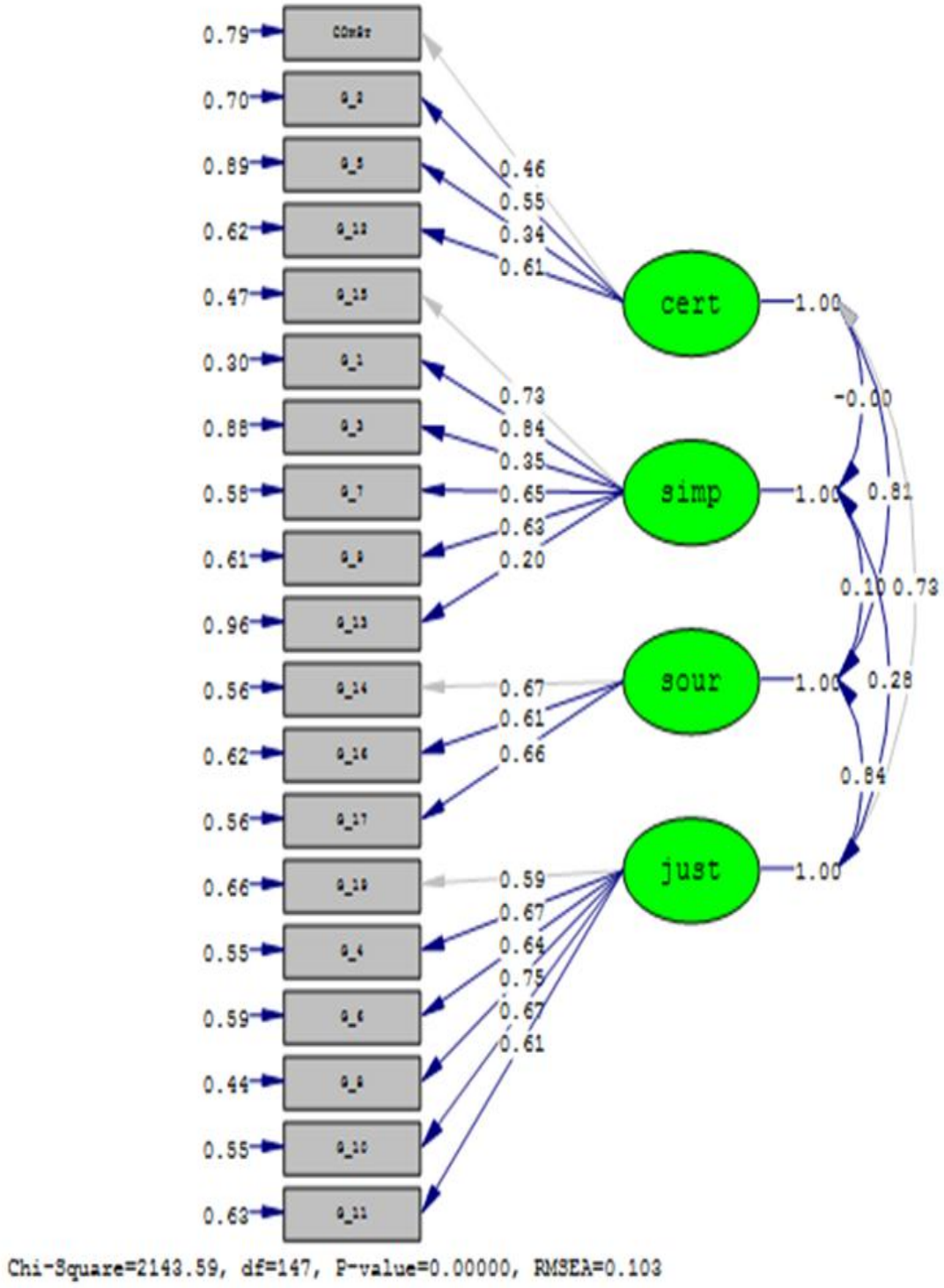
Coefficients in Standardized Value



CFA For Epistemic Beliefs Scale

LISREL Estimates of Parameters for Epistemic Beliefs Scale

Coefficients in Standardized Value

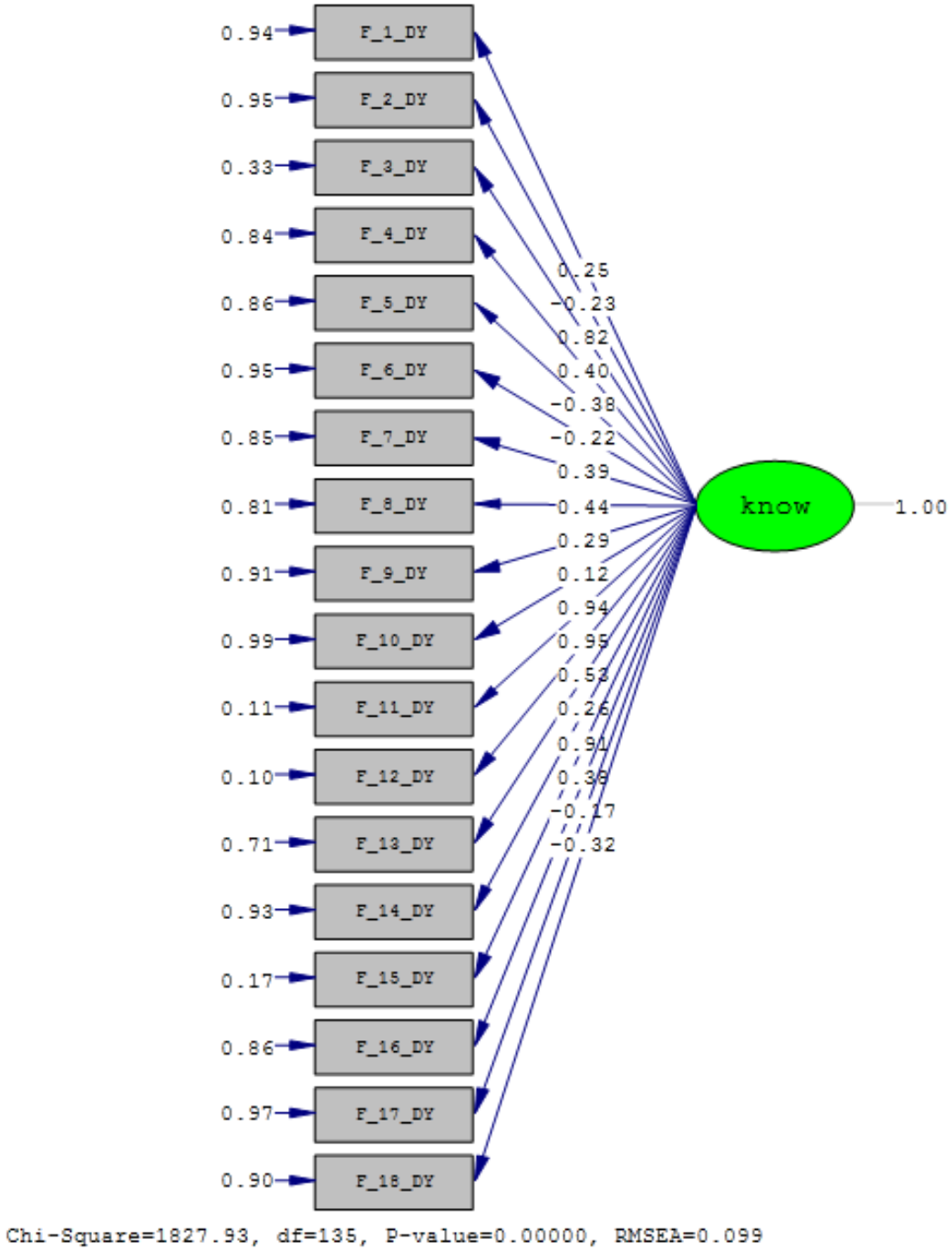


Chi-Square=2143.59, df=147, P-value=0.00000, RMSEA=0.103

CFA For Knolwedge About Climate Change Scale

LISREL Estimates of Parameters for Knolwedge About Climate Change Scale

Coefficients in Standardized Value

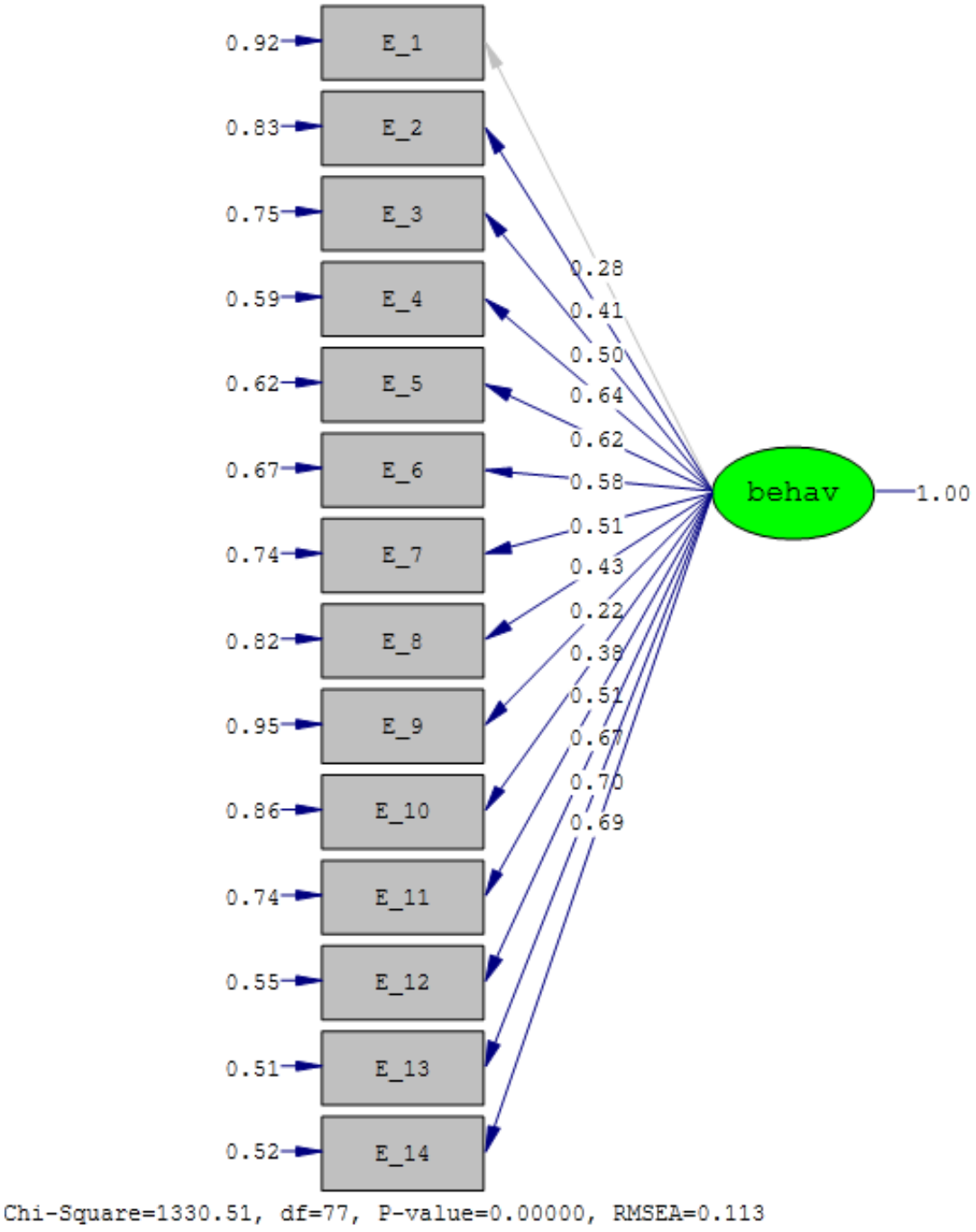


Chi-Square=1827.93, df=135, P-value=0.00000, RMSEA=0.099

CFA For Pro-Environmental Behaviour Scale

LISREL Estimates of Parameters for Pro-Environmental Behaviour Scale

Coefficients in Standardized Value



Appendix C: Turkish Summary

1. Giriş

Yıllardır insanlar iklim değişikliği, küresel ısınma, biyolojik çeşitliliğin yok olması, hava kirliliği, kuraklık, su kirliliği gibi karşılaştıkları çevresel problemlere gerekli çevreye sorumlu davranışları ve ilgiyi gösterememişlerdir (WCED, 1987). Birçok araştırmacı insanların eylemlerinin ve davranışlarının çevresel sorunların oluşmasında etkisi olduğunu düşünmektedir (Dunlap, Van Liere, Mertig & Jones, 2000; Nordlund & Garvill 2002; Oskamp 2000; Schultz, Gouveia, Cameron, Tankha, Schmuck & Franěk, 2005). IPCC raporları (2007) iklim değişikliğinin yalnızca fosil yakıt kullanımı, ormanların yok edilmesi gibi insan kaynaklı eylemler sonucunda değil ayrıca volkanik patlamalar gibi doğal süreçlerin sonunda da meydana geldiği açıklamaktadır. EPA (2008) sonuçlarına göre bilimsel kanıtların ortak görüşü iklim değişikliğinin insanlar ve onların çevreleri için önemli problemler oluşturduğunu ve bunların zorlu hava şartları, denizlerin yükselmesi, seller ve kuraklıklar gibi insanların yaşamlarını ve sağlıklarını tehdit eden problemler olduğunu göstermiştir. Bu tehditlerin yanı sıra iklim değişikliği insanlar, toplum ve iş dünyasını bölgesel ve küresel ölçekte etkilemektedir (IPCC, 2001). Ek olarak buzulların erimesi denizlerin yükselmesine bütün dünyayı olumsuz şekilde etkileyeceği, özellikle temiz su kaynaklarının, kıyı bölgelerin daha fazla etkileneceği rapor edilmiştir (IPCC, 2007).

İklim değişikliği son on yılda küresel olarak sosyal ve politik arenanın önemli bir konusu olmuştur (Whitmarsh, 2011). Bilimsel ve politikacıların ortak görüşü iklim değişikliğinin önemli bir çevresel problem olduğu ve insanlar ve ekolojik yaşam üzerindeki etkilerinin ilgilenilmesi gerektiği yönündedir (EPA, 2001; IPCC, 2001).

Bu yüzden toplumun iklim değişikliği hakkında bilgi sahibi olması ve iklim değişikliğinin sebep ve sonuçlarının anlaşılması çok önemlidir. Bu noktada çevre eğitiminin iklim değişikliği hakkındaki bilginin yaygınlaştırılmasında ve iklim değişikliğinin sebep ve sonuçları hakkındaki farkındalıklarının arttırılmasında önemli bir rolü vardır. UNESCO (2013; p. 11) eğitimin iklim değişikli hakkındaki önemini "Eğitimin iklim değişikliğine karşı küresel tepkinin gerekli bir unsurdur. Eğitim genç nüfusun iklim değişiklinin etkilerini anlamalarına ve irdelemelerine yardımcı olur, davranış ve tutum değişikliklerini teşvik eder." şeklinde açıklamıştır. Aslında iklim değişikliği Avustralya ve İngiltere gibi bazı ülkelerde fen müfredatına ya da fen

eğitimine entegre edilmiştir. Bazı uyum programları (CCAP, 2014; CAA, 2011) iklim değişikliği hakkında sorumluluk almayı önermektedir (UNDP; 2010). Bir öneride iklim değişikliğinin etkilerini azaltmayı engelleyen etkenlerin üstesinden gelmeyi öneren sürdürülebilir kalkınma eğitimidir (Wibeck, 2014). Sürdürülebilir kalkınma eğitimi farkındalığın arttırılmasını, yeni bakış açılarının, değerlerin, bilgi ve yeteneklerin elde edilmesini ve iklim değişikliğinin azaltılmasını destekleyen davranışlarda değişikliğe sebep olan resmi ve resmi olmayan süreçleri önermektedir (Læssøe, Schnack, Breiting & Rolls, 2009).

Fakat iklim değişikliği son yirmi yılda küresel olarak politik ve sosyal olarak bir konu olmasına rağmen, öğrenci ve öğretmen eğitimi için hazırlanan müfredatta yeterince önemli bir yer edinememiştir (Ünlü, Sever & Akpınar, 2011). Diğer taraftan, Türkiye'deki iklim değişikliği eylem planı (2012) "Üniversitelerde iklim değişikliğine uyum konusunda tartışma zemininin, sertifika programlarının arttırılması, müfredata lisans ve yüksek lisans düzeyinde ilgili derslerin eklenmesi ve araştırma/yüksek lisans programlarının teşviki" önermektedir. İklim değişikliği gibi çevresel konular artarak fen müfredatın parçası haline gelmektedir (Lambert & Bleicher, 2013; MEB, 2013). Çevre için sosyal sorumluk fen eğitimi müfredatında önemli bir yere sahiptir (Shepardson, Niyogi, Choi & Charusombat, 2011). Bu yüzden, çevre eğitimi, fen eğitimi ve sosyal sorumluk arasındaki bir köprü ve çevresel problemlerin engellenmesi için en önemli faktörlerde birisi olarak görülebilir (Wibeck, 2014). Çevre hakkında bilgi ve pozitif tutum sahibi olan bireyler çevre dostu davranma eğilimindedirler (Buhlemeier, Van Den Bergh & Lagerweij, 1999).

Hines, Hungerford ve Tomera (1986) ve Hungerford ve Volk (1990) çevre dostu davranışı çevre eğitiminin mevcut amacı olarak önermiştir. Çevresel davranış hakkında çok fazla miktarda bilgi olmasına rağmen hangi değişkenlerin etkili şekilde bireyleri çevre dostu eylem gerçekleştirmeleri için motive ettiği açık değildir (Hines et al., 1986/87).

Özetle bireylerin çevre dostu davranışlarını etkileyen faktörler hakkındaki literatür incelemesi var olan çevresel tutum, davranış niyetlerinin, bilginin, iklim değişikliği hakkındaki belirsizlik inançlarının ve epistemik inançların değerlendirilmesinin bu değişkenler ve çevre dostu davranışlar arasındaki ilişkinin çevre eğitimi sayesinde anlaşılması için gerekli olduğu ortaya çıkmaktadır.

Kısaca, iklim değişikliğinin anlaşılması hakkındaki literatür iklim değişikliği hakkına yaygın bir farkındalığın ve genel bir ilginin olduğunu fakat iklim değişikliğine ilişkin kısıtlı bir davranışın olduğunu göstermiştir (Sever, 2013; The World Bank's World Development Report, [WDR] 2010; Kempton, 1997; Poortinga et al., 2011; Kollmuss & Agyeman, 2002). Bu bulgular ışığında iklim değişikliği hakkındaki bilgi, çevresel tutumlar (çevre merkezli ve insan merkezli), iklim değişikliğine ilişkin epistemik inançlar ve insan kaynaklı iklim değişikliği hakkındaki belirsizlik inançlarını kullanarak mevcut çalışmada fen bilimleri öğretmen adaylarının iklim değişikliğine ilişkin çevre dostu davranışların muhtemel etkenleri ortaya çıkarılmaya çalışılmıştır. Bu model iklim değişikliğine ilişkin çevre dostu davranışların karmaşık doğasını aydınlatmada ilk basamak olarak görülebilir. Bu çalışmadaki modele göre fen bilimleri öğretmen adaylarının iklim değişikliği hakkındaki bilgilerinin çevresel tutumlarını, iklim değişikliğine ilişkin epistemik inançlarını, insan kaynaklı iklim değişikliği hakkındaki belirsizlik inançlarını ve davranışlarını direkt olarak etkilediği önerilmektedir. Buna ek olarak, iklim değişikliği hakkındaki bilginin epistemik inançlar üzerinde çevresel tutumlar aracılığıyla dolaylı etkisi olduğu; belirsizlik inançları üzerinde çevresel tutum ve epistemik inançlar aracılığıyla dolaylı etkisi olduğu; davranış üzerinde ise çevresel tutumlar, epistemik inançlar, belirsizlik inançlar üzerinden dolaylı etkisi olduğu önerilmektedir. Özellikle, çevresel tutumların epistemik inançlar, belirsizlik inançları ve davranış üzerinde direkt etkisi olduğu önerilmektedir. Ayrıca çevresel tutumların belirsizlik inançları üzerinde epistemik inançlar sayesinde dolaylı ve davranış üzerinde epistemik inançlar ve belirsizlik inançları sayesinde dolaylı etkisi olduğu önerilmektedir. Daha sonra epistemik inançların belirsizlik inançları ve davranışlarla direkt olarak ilişkili olduğu beklenmektedir. Ek olarak epistemik inançların davranış üzerinde belirsizlik inançları sayesinde dolaylı etkisi olduğu önerilmektedir. Son olaraksa belirsizlik inançlarının davranış üzerinde direkt etkisi olduğu önerilmektedir. Böylece mevcut çalışma fen bilimleri öğretmen adaylarının bilgi, epistemik inançlar, belirsizlik inançları ve insan merkezli ve çevre merkezli çevresel tutumlarını araştırarak iklim değişikliğine ilişkin çevre dostu davranış modeli oluşturmadaki ana belirleyicileri aydınlatmıştır.

2. Yöntem

Bu çalışma nicel bir çalışma olup korelasyon çalışmasıdır. Bu çalışmanın katılımcıları Türkiye'deki devlet üniversitelerinde fen bilgisi öğretmenliği bölümlerinde okuyan 1277 öğretmen adayıdır. Bu katılımcıların 888 (%69.5) kadın iken 385 (30.1%) erkektir.

Veriler katılımcılara verilen demografik bilgi formu, iklim değişikliği hakkındaki bilgi ve bilgiye duyulan güven anketi, çevresel tutum anketi (insan merkezli ve çevre merkezli), iklim değişikliğine ilişkin epistemik inançlar anketi, belirsizlik inançları anketi ve çevre dostu davranışlar anketi ile toplanmıştır.

2.1. Demografik Bilgi Formu

Katılımcıların yaş, cinsiyet, sosyoekonomik durumları ve sınıfı gibi temel bilgileriyle ilgili soruları içermektedir.

2.2. Çevre Dostu Davranış Anketi

Çevreye dostu davranışları belirlemek amacıyla Mertig (2003) tarafından geliştirilmiş, Şahin (2008) tarafından Türkçeye uyarlanmıştır. 14 maddeden oluşan 5'li likert tipi bir ölçektir. Cronbach alpha güvenilirlik puanı .84 olarak bulunmuştur.

2.3. Bilgi ve Bilgiye Duyulan Güven Anketi

Bu ölçek iklim değişikliği hakkındaki mevcut durum, sebepler ve iklim değişikliğinin sonuçları hakkındaki bazı bilgileri içeren 18 maddeden oluşan 5 li likert tipindeki bir ölçektir. İki kutuplu bu ölçek Sundblad vd. (2008) tarafından geliştirilmiştir. Birinci kutbunda verilen cümleler için doğru ya da yanlış seçenekleri bulunurken ikinci kutupta verilen cevaba ne kadar güven duyduğunu ölçmek için 1'den (Hiç güvenmiyorum) 5'e (Çok güveniyorum)kadar olan güven seviyesini ölçen seçenekler bulunmaktadır. Cronbach alpha güvenilirlik puanı. 61 olarak bulunmuştur.

2.4. Çevresel Tutumlar Anketi

Çevreye yönelik değer yönelimlerini ölçmek için Thompson ve Barton'ın (1994) hazırladığı 23 maddelik 5 li likert tipi kullanılmıştır. Anket 2 boyuttan oluşmaktadır (insan merkezli ve çevre merkezli). Cronbach alpha güvenilirlik puanı insan merkezli ve çevre merkezli boyutları için sırasıyla. 84 ve. 82 olarak bulunmuştur.

2.5. İklim Değişikliğine İlişkin Epistemik İnançlar Anketi

İklim değişikliğine ilişkin öğretmen adaylarının epistemik inançlarını belirlemeye yönelik hazırlanmış bu ölçek 19 madde içeren dört boyuttan (bilginin

kesinliği, basitliği, kaynağı ve gerekçelendirilmesi) oluşmaktadır ve 10'lu likert tipi bir ankettir (Bråten vd., 2009). Cronbach alpha güvenilirlik puanı .81 olarak bulunmuştur.

2.6. Belirsizlik Anketi: İnsan Kaynaklı İklim Değişikliği Hakkındaki Şüphecilik ve İlgisizlik

İnsan kaynaklı iklim değişikliğine yönelik şüpheci inançların belirlenmeye yönelik Whitmarsh (2005) tarafından hazırlanmış bu ölçek 23 madde içeren iki boyuttan (şüphecilik ve ilgisizlik) oluşmaktadır ve 5 'li likert tipi bir ankettir. Cronbach alpha güvenilirlik puanı şüphecilik ve ilgisizlik boyutları için sırasıyla .82 ve.86 olarak bulunmuştur.

3. Bulgular

Yapılan yol analizi sonucunda iklim değişikliğine yönelik çevre dostu davranışların iklim değişikliğine ilişkin epistemik inançlar, belirsizlik inançlar, çevre merkezli ve insan merkezli çevresel tutumlardan etkilendiği fakat iklim değişikli hakkındaki bilgiden etkilenmediği bulunmuştur. Modelin uyum indeksleri X^2=13.50, X^2/df=3.375, RMSEA=0.043, RMR=0.027, GFI=1.00, AGFI=0.98, NFI=1.00, NNFI=0.99, CFI=0.99'dir. Sonuç olarak, model için bazı uyum indeksleri kriterlere göre incelendiğinde fen bilimleri öğretmen adaylarının çevre dostu davranışlar modelinin verilerle iyi uyum gösterdiği bulunmuştur. Model sonuçları incelendiğinde iklim değişikliği hakkındaki bilginin fen bilimleri öğretmen adaylarının insan merkezli tutumlarının %2.4'ünü ve çevre merkezli tutumlarının %4.9'unu açıkladığı bulunmuştur. Sonuçlar iklim değişikliği hakkındaki bilginin (β= .16) fen bilimleri öğretmen adaylarının insan merkezli tutumlarını anlamlı ve pozitif yordadığı bulunmuştur. Ayrıca, bilginin (β= .22) fen bilimleri öğretmen adaylarının çevre merkezli tutumlarını anlamlı ve pozitif olarak yordadığı bulunmuştur. Bu bulgular doğaya yönelik içsel değerler gösteren ve doğayı insanlar için değerli gören ve koruyan fen bilimleri öğretmen adaylarının aynı zamanda iklim değişikliği hakkında bilgili olduklarını göstermektedir.

İklim değişikliğine ilişkin epistemik inançlar ve bilgiler arasında direkt olarak veya dolaylı olarak anlamlı yol bulunamamıştır. Epistemik inançların %32'sinin çevre merkezli (β= .38) ve insan merkezli çevresel tutumlar (β= -.43) tarafından yordandığı bulunmuştur. Çevre merkezli tutumlar pozitif ve anlamlı olarak yordarken, insan merkezli tutumlar negatif ve anlamlı olarak yordamaktadır.

Sonuçlar doğaya olumlu görüşe sahip ve doğayı sadece insanlar için koruma görüşünde olmayan fen bilimleri öğretmen adaylarının iklim değişikliği hakkındaki bilginin değişebilir, gelişen, iç içe geçmiş kavramlardan oluştuğunu ve birden çok kaynaktan doğrulanarak oluştuğuna inanırlar.

İklim değişikliğine ilişkin belirsizlik inançlarının %27'sinin iklim değişikliği hakkındaki bilgi, çevre merkezli ve insan merkezli tutumlar ve epistemik inançlar tarafında açıklandığı bulunmuştur. İklim değişikliği hakkındaki bilginin (β= -.19), insan merkezli tutumun (β= -.12), çevre merkezli tutumun (β= -.25) negatif ve anlamlı şekilde insan kaynaklı iklim değişikliğine karşı belirsizlik inançlarını yordadığı bulunurken, iklim değişikliğine ilişkin epistemik inançların (β= .40) ise pozitif, anlamlı ve direkt olarak yordadığı bulunmuştur. Ayrıca insan merkezli tutumun pozitif ve anlamlı (β= .15) ve çevre merkezli tutumun negatif ve anlamlı (β= -.17) olarak iklim değişikliği hakkındaki belirsizlik inançlarını dolaylı olarak epistemik inançlar aracılığıyla etkilediği bulunmuştur. Bu sonuçlar iklim değişikliği hakkında gelişmiş epistemik inançlara, düşük seviyede bilgi ve çevresel tutumlara sahip fen bilimleri öğretmen adaylarının iklim değişikliğine ilişkin yüksek düzeyde belirsizlik inançlarının olduğunu göstermektedir. Bu bulgular iklim değişikliği hakkında bilgi sahibi bireylerin iklim değişikliğine ilişkin belirsizlik inançlarının daha düşük olacağını göstermektedir.

Çevre dostu davranışların %21'nin insan merkezli ve çevre merkezli tutumlar, iklim değişikliğin ilişkin epistemik inançlar, iklim değişikliğine ilişkin belirsizlik inançlar tarafından açıklandığı bulunmuştur. İklim değişikliğine ilişkin epistemik inançların (β= .37), belirsizlik inançlarının (β= .12) ve çevre merkezli tutumların (β= .09) pozitif, anlamlı ve direkt olarak çevre dostu davranışları yordadığı bulunmuştur. Ek olarak insan merkezli tutumların (β= -.17) çevre dostu davranış üzerinde epistemik inançlar ve belirsizlik inançları aracılığıyla negatif anlamlı ve dolaylı etkisi olduğu bulunurken, anlamlı direkt etkisi olmadığı bulunmuştur. Ayrıca, çevre merkezli tutumların, epistemik inançlar ve belirsizlik inançları aracılığıyla da çevre dostu davranışları etkiledi bulunmuştur. Epistemik inançların da çevre dostu davranışlar üzerinde dolaylı olarak belirsizlik inançları aracılığıyla etkisinin olduğu bulunmuştur. Bu bulgular sonucunda doğaya tek başına değer veren ve korunmasını düşünen, iklim değişikliğine ilişkin yüksek düzeyde epistemik inançlara sahip ve insan kaynaklı iklim değişikline inanan öğretmen adaylarının iklim değişikliğine ilişkin çevre dostu davranışlar göstermesi

beklenmektedir. Ayrıca iklim değişikliği hakkındaki bilginin değişebilir, gelişen bilgi olduğuna, birbiri içerisine entegre edilmiş ve bir çok kaynaktan eleştirilerek toplandığına inanan fen bilimleri öğretmen adaylarının çevre dostu davranışları göstermesi beklenmektedir. Diğer taraftan, elde edilen bulgular doğayı insanların yaşam kalitesini attırdıkları ve onların ihtiyaçlarını karşıladıkları için değer veren fen bilimleri öğretmen adaylarının çevre dostu davranışları daha az yapma eğiliminde olduklarını göstermiştir.

4. Tartışma

Bu araştırmada, çevre dostu davranışlar, iklim değişikliğine ilişkin epistemik inançlar ve belirsizlik inançlar, çevre merkezli ve insan merkezli tutumlar ve iklim değişikliği hakkındaki bilgi arasındaki ilişkiyi ortaya koyan bir yapısal model önerilerek değerlendirilmiştir. Yapılan yol analizi sonucunda çevre dostu davranışların iklim değişikliğine ilişkin epistemik inançlar, belirsizlik inançları ve çevre merkezli tutumlar tarafından pozitif direkt ve dolaylı olarak etkilenirken, insan merkezli tutumlar tarafından negatif ve dolaylı olarak etkilendiği bulunmuştur. İklim değişikliği hakkındaki bilginin ise çevre dostu davranışlar üzerinde dolaylı ve direkt anlamlı etkisi bulunamamıştır.

Beklendiği gibi mevcut sonuçlar insan kaynaklı iklim değişikliğine kadar çok inanılırsa çevre dostu davranışı o kadar çok ortaya çıkma olasılığının yüksek olduğunu göstermiştir. Belirsizlik inançları insan kaynaklı iklim değişikliği hakkındaki şüpheci inançları ve insanların iklim değişikliği üzerindeki etkilerine dair şüpheci inançlar olarak görülmektedir. İlgili alan yazında davranış ve belirsizlik inançları arasında benzer sonuçlar bulunmuştur. Örneğin, Whitmarsh (2011, 2005) çalışmalarında marjinal şekilde şüpheci inançlara sahip olmayan bireylerin yaygın şekilde olduğunu ve toplumun insan kaynaklı iklim değişikliği hakkında bazı şüpheci inançları olduğunu bulmuştur. Bunlardan birisi medyanın insan kaynaklı iklim değişikliği hakkında gereğinde fazla endişe uyandırdığını bunun medyanın yaptığı etkileyici benzetmelerden kaynaklandığı bulmuştur. İklim değişikliğine ilişkin davranışların ortaya çıkmasında bilgi eksikliği, belirsizlik inançları, bilgi kaynaklarına az güven duyulması ve iklim değişikliğinin uzak bir tehdit olarak görülmesinin engel olduğu belirtilmiştir. O'Neill ve Nicholson-Cole (2009) çalışmalarında panik yaratan ve korku temelli medyanın toplumun iklim değişikliğine karşı sorumluluk almalarını engellediğini ve insanların iklim

değişikliğine yönelik inanç, değer ve davranışlarını şekillendirdiğine vurgu yapmışlardır. Ayrıca iklim değişikliğine yönelik davranışların iklim değişikliği hakkındaki bilgiden, güvenilir bilgi kaynaklarından, toplumun özel değer ve inançlarından da etkilenebileceğini öne sürmüşlerdir. Mevcut çalışmadaki sonuçlarla Lorenzoni ve arkadaşlarının (2007) çalışma sonuçları birbirini doğrulamaktadır. Lorenzoni ve arkadaşları (2007) iklim değişikliğine yönelik davranışların bilgi eksikliğinden, belirsizlik inançlarından, bilgi kaynaklarına duyulan güven eksikliğinden, politik eylemlerden, sosyal norm ve beklentilerden etkilendiğini bulmuşlardır. Islam, Barnes ve Toma (2013) İskoçlu çiftçilerin iklim değişikliğine yönelik belirsizlik inançlarına orta seviyede sahip oldukları bulmuşlardır. Benzer şekilde mevcut çalışmadaki fen bilimleri öğretmen adayları gibi İskoç çiftçilerde medyanın iklim değişikliği hakkında çok fazla endişe yarattığını ve medya raporlarının güvenilir olmadığını ve ayrıca iklim değişikliğinin onların yaşamları üzerinde sel ve hastalıklar gibi direkt etki oluşturmayacağını düşünmektedirler.

Mevcut çalışma belirsizlik inançlarına ek olarak iklim değişikliğine ilişkin epistemik inançların çevre dostu davranışların bir diğer önemli belirleyicisi olduğu göstermektedir. İklim değişikliğine ilişkin epistemik inançlar çevre dostu davranışları direkt ve belirsizlik inançları aracılığıyla dolaylı olarak etkilemektedir. Bu bulgular ışığında iklim değişikliğine ilişkin gelişmiş epistemik inançların çevre dostu davranışları artırmada ve ek olarak daha az belirsizlik inançlarının daha fazla çevre dostu davranmaya sebep olacağı önerilmektedir. Diğer bir deyişle iklim değişikliği hakkında bilginin oluşturulmasında araştırma kullarının kullanımının gerekliliğine ve bilgi kaynaklarını sadece kendi tecrübelerine ve gördüklerinden çok eleştirel değerlendirme ve karşılaştırmayla oluşturan, bilginin uzmanlar tarafından aktarılmasından çok kişilerinin kendi bilgilerini yapılandırdığına inanan, bilginin kesin ve doğru olduğundan çok değişen ve gelişen bilgi olduğunu düşünen, bilginin özel gerçekler ve detaylardan çok ilişkili ve karmaşık teorilerden oluştuğunu düşünen bireyler iklim değişikliğine yönelik çevre dostu davranışlar göstermeye daha yatkındır. İklim değişikliğine ilişkin gelişmiş epistemik inançlara sahip olan fen bilimleri öğretmen adaylarının ve çevre dostu davranışları göstermesi şaşırtıcı bir sonuç değildir. Bu bulgular literatürdeki çalışmalarla uyumludur (Braten vd., 2009; Stromso vd., 2010). Beklenildiği gibi Braten ve arkadaşlarının üniversite öğrencileri arasında iklim değişikliğine ilişkin epistemik inançlar hakkındaki yaptıkları çalışma sonuçlarıyla uyumludur. Örneğin, üniversite öğrencileriyle çalışan Stromso vd.

(2010) üniversite öğrencilerinin bilginin kaynağı olarak kişisel bilgi ve yorumlarını gördükleri ve dış otoritelere daha az güvendikleri, iklim değişikliyi hakkındaki bilginin birden çok kaynaktan kontrol etmeye ve karşılaştırmaya yatkın oldukları sonucuna varmışlarıdır. Yazar bu sonuçlarını iklim değişikliği hakkındaki bilgi kaynaklarına atfetmektedir. Braten ve arkadaşlarının kişisel epistemolojinin karşılaştırılması, keşfedilmesi ve ek olarak çevre dostu davranış eğilimlerin belirlenmesi için İspanya ve Norveçli üniversite öğrencileriyle yaptıkları çalışmada, İspanyol üniversite öğrencileri iklim değişikliği hakkındaki bilginin değişebilir, teorik, karmaşık, birden çok kaynaktan karşılaştırılarak, kişisel karar ve yorumlar altında oluşturulmasını düşündükleri sonucuna varmışlarıdır. Fakat Norveçli üniversite öğrencileri iklim değişikliği hakkındaki bilginin kalıcı, uzmanların görüşlerine ve kanıtlanmış gerçeklerin birikiminden oluştuğunu düşündükleri bulunmuştur. Ayrıca, her iki ülkedeki üniversite öğrencileri iklim değişikliği hakkında sorumluk almaya eğilimli oldukları bulunmuştur. İspanyol öğrencilerin Türk fen bilimleri öğretmen adaylarının sonuçlarıyla tutarlılık gösterdiği bulunmuştur. Braten ve arkadaşları epistemik inançlar arasındaki farklılığı iklim değişikliğine ilişkin epistemik inançların kültürel olarak yerleşikliğine bağlamaktadır.

Epistemik inançlar ve belirsizlik inançları dışında, çevresel tutumlarında fen bilimleri öğretmen adaylarının çevre dostu davranışlarını eklediği bulunmuştur. Fen bilimleri öğretmen adaylarının insanların yiyecek tüketimi gibi temel ihtiyaçlarına bakmaksızın doğanın korunması gerektiğine inanırken, öğretmen adayları insan yaşamının kalitesini artırmak ve sürdürmek için doğanın korunması hakkında karasız kalmışlardır. Çevre merkezli çevresel tutumlar çevre dostu davranışlar üzerinde pozitif olarak direkt ve dolaylı etkiye sahipken, insan merkezli çevresel tutumlar negatif ve epistemik inançlar ve belirsizlik inançları aracılığıyla dolaylı bir etkiye sahiptir. Bu bulgular çevreyi kendi değeri, ekosistemin korunması ve insan olmayan canlıların korunması için çevrenin korunmasını düşünen fen bilimleri öğretmen adaylarının çevre dostu davranışlarını göstermeye daha yatkın oldukları bulunmuştur. Diğer taraftan, insanların ihtiyaçlarının tüm değerlerin üzerinde olduğunu ve çevrenin korunmasının insanların ihtiyaçlarını karşılayacak olması sebebiyle çevreyi koruyan fen bilimleri öğretmen adaylarının çevre dostu davranışları göstermeye daha az yatkın oldukları bulunmuştur. Bu bulgular Thompson ve Barton (1994) araştırma sonuçları ile uyumluluk göstermektedir. Onlar çevre merkezli ve insan merkezli

çevresel tutumların çevre dostu davranışları olumlu etkilediğini fakat altında yatan güdülerin farklı olduğunu açıklamışlardır. Çevre merkezli tutuma sahip bireylerin çevreyi sadece çevrenin iyiliği için korurken, insan merkezli tutuma sahip bireylerin çevreyi kendi ihtiyaçları, yaşam kalitelerini sürdürmek ve artırmak için korudukları bulunmuştur. Yazarlar ayrıca öğrencilerin ve toplumun çevre hakkındaki farkındalığını artıran bir programın yapılması gerektiği ileri sürmüşlerdir. Çünkü çevre merkezli tutumlara sahip bireylerin gelişmesiyle çevre dostu davranışların gerçekleşme olasılığının artacağını ileri sürmüşlerdir.

İklim değişikliği hakkındaki bilginin çevre dostu davranışların belirlenmesinde önemli bir etkisi olduğu bulunamamıştır. Bu sonuçlar Lorenzoni ve arkadaşlarının (2007) araştırma sonuçlarıyla tutarlılık göstermemektedir. Lorenzoni vd. (2007) iklim değişikliği hakkındaki bilgi eksikliğinin iklim değişikliği hakkında sorumluluk almaya önemli bir engel olduğunu bulmuşlardır. Ancak Kollmus ve Agyeman (2002) çevre ile ilgili konularda bilginin direkt olarak davranışı etkilemediği rapor etmişlerdir. Çünkü çevre hakkındaki farklı bilgilerin olduğunu ve eğer bireyler nasıl çevre dostu davranışları göstereceklerini bilmezlerse çevre dostu davranış göstermeyeceklerini ve çevre hakkındaki temel bilginin çevre dostu davranışı arttırmada etkisi olmadığını belirtmişlerdir.

Sonuç olarak mevcut çalışma iklim değişikliğine ilişkin gelişmiş epistemik inançlar, insan kaynaklı iklim değişikliğine daha fazla inanan ve ilgilenen ve çevre merkezli tutuma sahip fen bilimleri öğretmen adaylarının çevre dostu davranışları göstermeye daha yatkın oldukları bulunmuştur. Ayrıca, iklim değişikliği hakkındaki bilginin çevresel tutumlar üzerinde pozitif etkisi olduğu, belirsizlik inançları üzerinde de negatif etkisi olduğu bulunmuştur.

Bu çalışma sonuçları insan kaynaklı iklim değişikliğinin engellemek ve Türk toplumunda çevre dostu davranışların yaygınlaştırılması için bir strateji geliştirmek için kullanılabilir. Bilgi, cinsiyet, politik görüş ve bilginin kaynağı gibi değişkenlerin çevre dostu davranışlar üzerindeki etkisi gelecek çalışmalarda araştırılabilir. Ayrıca, coğrafik farklılığın çevre dostu davranış modellemesinde etkisi araştırılabilir. Bu çalışmada geliştirilmiş olan çevre dostu davranış anketi özellikle iklim değişikliği konusuna odaklanmadığı için özellikle iklim değişikliğine yönelik çevre dostu davranışları kullanan bir anket geliştirilerek ülke genelinde bir çalışma yapılabilir.

Appendix D: Thesis Photocopying Permission Form

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☒

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : HİĞDE
Adı : Emrah
Bölümü : İlköretim Fen ve Matematik Eğitimi

TEZİN ADI (İngilizce) : Identifying Determinants Of Pro-Environmental Behaviors: A Case For Climate Change

TEZİN TÜRÜ : Yüksek Lisans ☒ Doktora ☐

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz. ☒

TEZİN KÜTÜPHANEYE TESLİM TARİHİ: