INVESTIGATING PRE-SERVICE TEACHER'S ENVIRONMENTAL LITERACY THROUGH THEIR EPISTEMOLOGICAL BELIEFS

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ABSTRACT

INVESTIGATING PRE-SERVICE TEACHER'S ENVIRONMENTAL LITERACY THROUGH THEIR EPISTEMOLOGICAL BELIEFS

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The primary purposes of present study were 1) investigation of epistemological beliefs held by pre-service teachers, 2) investigation of relationship between pre-service teachers' environmental literacy and their epistemological beliefs, 3) investigation of predictors of pre-service teachers' intentions to act environmental behavior. Secondary purpose of the study was to investigate effect of gender, academic major, and grade level on environmental literacy of pre-service teachers.

This study was carried out during the spring semester of 2008. Sample of this study constituted 560 pre-service teachers from a public university in Ankara. In this study data was obtained from the administration of Turkish versions of Schommers' Epistemological Belief Questionnaire and Environmental Literacy Questionnaire.

The data were analyzed by using factor analysis, correlational analysis, multiple regression analysis, and multivariate analysis of variances

(MANOVA). We found five epistemological belief factors which indicated that pre-service teachers held multidimensional epistemological beliefs. Epistemological belief components, innate ability and quick learning, were significantly related with behavior component of environmental literacy. Innate ability, quick learning dimensions of epistemological beliefs and environmental attitude, concern were investigated to be the predictors of behavior mean scores of pre-service teachers'. Moreover, results of this study revealed that gender; academic major and grade level have effect on environmental literacy of pre-service teachers.

Keywords: Environmental Literacy, Epistemological Beliefs, Pre-service Teachers, Gender, Academic Major, Grade Level.

ÖZ

ÖĞRETMEN ADAYLARININ ÇEVRE OKURYAZARLIKLARININ EPİSTEMOLOJİK İNANÇLARI VASITASIYLA İNCELENMESİ

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Çalışmanın öncelikli amaçları 1) öğretmen adaylarının sahip oldukları epistemolojik inançların belirlenmesi, 2) öğretmen adaylarının epistemolojik inançlarıyla çevre okuryazarlıkları arasındaki ilişkilerin belirlenmesi, 3) öğretmen adaylarının çevre davranışlarının belirteçlerinin neler olduğunun belirlenmesidir. Çalışmanın ikincil amacı öğretmen adaylarının akademik çalışma alanlarının, cinsiyetlerinin ve bulundukları sınıfların sahip oldukları çevre okuryazarlıklarına etkilerinin belirlenmesidir.

Bu çalışma 2008 yılı bahar döneminde yürütülmüştür. Çalışmanın örneklemi Ankara'daki bir devlet üniversitesindeki 569 öğretmen adayından oluşmaktadır. Çalışmadaki bilgi Schommer'in epistemolojik inanç anketi ve çevre okuryazarlığı anketlerinin Türkçe versiyonlarının uygulanmasıyla toplanmıştır.

Toplanan veriler faktör analizi, ilişkisel analiz, çoklu regresyon analizi

ve çoklu varyans analizi kullanılarak analiz edilmiştir. Epistemolojik inançların çok boyutlu olduklarını belirten beş faktör bulunmuştur. Epistemolojik inanç faktörlerinin, doğuştan yetenek ve çabuk öğrenme, çevre okuryazarlığının davranış bileşeniyle anlamlı şekilde ilişkili olduğu bulunmuştur. Epistemolojik inanç boyutlarından doğuştan yetenek, çabuk öğrenme ve çevre okuryazarlığı bileşenlerinden tutum ve davranışının öğretmen adaylarının çevre davranışı puanlarının belirteçleri olduğu bulunmuştur. Bunun yanı sıra, çalışmanın sonuçları cinsiyet, akademik çalışma alanı ve bulundukları sınıfların öğretmen adaylarının çevre okuryazarlıkları üzerinde etkisi olduğunu göstermiştir.

Anahtar Kelimeler: Çevre Okuryazarlığı, Epistemolojik İnançlar, Hizmet Öncesi Öğretmen Adayları, Akademik Çalışma Alanı, Sınıf Seviyesi.

To My Parents
Fatma and Metin ÖZTÜRK

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EL: Environmental literacy

EB. Epistemological belief

REB: Responsible environmental behaviour

PTs: Pre service teachers

BHV: Behaviour

ATT: Attitude

CON: Concern

KNW: Knowledge

EME: Elementay mathemetics education

ESE: Elementary science education

ECE: Early childhood education

CEIT: Computer education and ınstructional technologies

FLE: Foreign language education

MANOVA: Multivariate Analysis Of Variances

df: Degree of freedom

CHAPTER 1

INTRODUCTION

1.1 Introduction

Our world, where we live and which offers life to us, has been changed by the human action. Over the past 50 years, Earths' ecosystem has been changed by humans more rapidly than in any period of time in human history. This change has resulted in substantially irreversible loss in diversity of life on Earth (Millennium Ecosystem Assessment, 2005). Global warming deforestation, environmental pollution, and acid rains could be seen as main problems take place as a result of human damages. These problems have been commonly discussed by both scientists and public. Prevention of any kind of human damage can be realized by means of promoting responsible citizenship. During this process awareness towards environmental problems can be increased by improving their knowledge, attitude, and behavior (Hungerford & Volk, 1990).

Environmentally literate person shows action towards environment by using necessary knowledge, skills, and disposition (Roth 1992). The content and the final reports of the conferences, "Human and Environment" carried out in Stockholm in 1972 by United Nations, "Our Common Future" report published in 1984 (Brundtland, 1987), Rio Conference organized in 1992 (United Nations Environment Program (UNEP), 1992) , "Sustainable Development Conference" organized in Johannesburg in 2002 (UNEP, 2002), that carried out since 1970s, are the most important documents noticing the importance and requirement of education in solution of environmental problems and development of environmental literacy of future generations.

Thus, throughout the long history of conferences on environment, it was understood that education on environment is key to reduce environmental problems. The close relationship between environmental literacy and environmental education is given in the next section.

1.2 Environmental Literacy and Environmental Education

Environmental literacy was defined as the capacity of taking suitable action for the stability and the development of environment by Roth (1992) and accepted as one of the major goals of environmental education (Roth, 1992, United Nations Educational, Scientific and Cultural Organization (UNESCO), 1980). Environmental literacy needs an education that makes individuals knowledgeable and skilled for working collaboratively with others to state a dynamic equilibrium between quality of life and environment (Harvey, 1977). Thus, through environmental education students can make more sense out of the environmental problems and grasp a deep meaning of the importance of decision making process to solve environmental problems (Tbilisi Intergovernmental Conference on Environmental Education, UNESCO, 1978).

Disinger and Roth (1992) argued that major components of environmental literacy are knowledge, skills, attitudes, personal responsibility [concern], and active involvement [behavior]. Roth (1992) emphasized that knowledge, skills, and attitudes are important ingredients for performing necessary environmental action or behavior. There have been many attempts to develop environmental models that explain human behaviors regarding environmental issues. For instance, initial environmental models represent a linear relationship among components of environmental literacy. The very first model developed by Ramsey and Rickson (1977) hypothesized that knowledge, awareness, and attitudes leads to environmental behavior. This model was named as K-A-B (Knowledge-

Attitude-Behavior) model by many researchers (e.g. Culen, 2001; Hungerford &Volk, 1990; Marcinkowski, 2001). This hypothesis suggests that increasing environmental knowledge improves the attitudes resulted in behavior toward environmental issues. However, Culen (2001) argued that if K-A-B model would illustrate environmental human behavior, there have been incline in environmentalist behavior in society in last 30 years time period which was the rising age of environmental knowledge and awareness. Thus, the direct relationship suggested by K-A-B model has been improved by researchers through explanatory studies on predictors of environmental behavior. At the middle of 80s, Hines, Hungerford, and Tomerra (1986/87) proposed a responsible environmental behavior (REB) model which states that personal factors and intention to act variables are important predictors of REB and knowledge should cohere with those variables to lead REB. At the beginning of 90s, Hungerford, and Volk (1990) proposed another REB model which was based on the composition of predictors of environmental behavior determined by Hines et al. (1986/87) and other research (e.g. Borden 1984-85; Borden and Powell 1983; Marcinkowski 1989; Ramsey 1989; Sia et al. 1985-86). Thus, Hungerford and Volk (1990) extended Hines model and presented predictor variable levels. These levels started with entry level variables and ended with environmental citizenship behavior. Each predictor variables included major and minor variables. They positioned knowledge in all levels of variables. They concluded that knowledge turns into environmental behavior when it combines with intention to act variable. In brief, knowledge is presented as a critical component of these REB models, but it is clear that it alone is not a determinative factor for responsible environmental behavior (Hungerford &Volk, 1990). Besides, these models also highlighted the importance of personal factors and reasoning about knowledge. Personal factor variable includes individual's locus of control, attitudes and responsibility. Shortly, personal factor variable refers to one's

beliefs to make changes. Other variable, reasoning about knowledge, refers to making decisions about environmental knowledge in using environmental action. These two variables reflect how an individual believe and interpret environmental knowledge. Even though they are stated as important variables, these variables have not been studied by researchers. Actually these two variables indicate the importance of how people see the nature of knowledge. In other words we need to start to think about how people's epistemological beliefs (beliefs about nature of knowledge) have interaction with the components of the REB models. Epistemological beliefs may be one of the factors effecting understanding and reasoning of individuals. Understanding regarding any science topic is related to epistemological beliefs hold by people (Kardash & Scholes, 1996; Schommer, Crouse, & Rhodes, 1992). Thus, one of the reasons of not comprehending the relationship between knowledge and environmental action could be not incorporating beliefs about nature of knowledge into these REB models. In this study, it was assumed that epistemological beliefs may have influence on environmental literacy and REB of individuals. Thereby, this study takes into account sub-dimensions of environmental literacy and epistemological beliefs together. At this point for next two sections, information about epistemological beliefs is presented first then the possible relationships between environmental literacy, environmental action and epistemological beliefs are provided in more detailed.

1.3 Epistemological Beliefs

Epistemology can be defined as the source, nature, limits, methods, and justifications of knowledge (Hofer, 2002). Definition of the personal epistemology shows variability among conducted studies. Historically, the research on epistemological beliefs has started to be studied with Perry (1968). Perry was the first person suggesting the existence of epistemology as

making meaning about knowledge more than the characteristics of individuals. After Perry, studies about epistemology have shifted from philosophical, absolute knowledge, investigation to cognitive oriented studies with time. There are two main ideas dominating epistemology studies. In one of the definitions, the personal epistemology of the individuals depends on their levels of development (King & Kitchener, 1994; Perry, 1970). A gradual developmental model was first proposed by Perry (1970). Then, King and Kitchener (1994) proposed that individuals progress through seven developmental stages that ranges from unquestioning acceptance of knowledge to tentative acceptance of knowledge. That is, the personal epistemology is unidimensional. In contrast to earlier work on epistemological thinking that took a stage like developmental approach, there are some researchers who state that personal epistemology is composed of multiple beliefs (Schommer & Walker, 1997; Schraw, Dunkle, & Bendixen, 1995). In other words personal epistemology is more or less independent belief system more than developmental stages (Schommer, 1990). Schommer (1990) determines five distinct epistemological beliefs: Certain Knowledge (tentative to unchanging), Simple Knowledge (isolated to integrated), Quick Learning (quick to gradual), Innate Ability (fixed at birth to lifelong improvement), and Omniscient Authority (authority to observation and reason). Schommer (1990) proposed that every individual has beliefs regarding the structure, acquisition, justifications, source, and certainty of knowledge. That is, personal epistemology is multidimensional. According to Schommer, individuals have different epistemological beliefs related to nature of knowledge. In addition to findings of her studies, Schommer also made contributions to epistemological belief literature in research method. Such that, epistemological beliefs of the students were studied by using both qualitative (e.g. Perry, 1968) and quantitative researches approaches (e.g. Schommer, 1994). Especially Schommer can be

seen one of the frontiers of the quantitative studies. She developed an epistemological questionnaire. She studied with different age groups to validate the questionnaire. This questionnaire has taken many researchers' attention and utilized in different countries. Also this questionnaire was used in different countries by different researchers for instance by Kardash and Scholes (1996) in USA, Yilmaz-Tuzun and Topcu (2007) in Turkey. These studies revealed that dimensions of the epistemological beliefs show variation depending on the age groups and the regions where the studies applied. Lastly, Schommer's studies also made contribution to teaching and learning. Implications of her findings to the classroom environment can be mentioned as other important contribution of Schommer to the field of epistemological beliefs. In our study we used epistemological beliefs which may influence environmental literacy of PTs.

1.4 Why to Study Relationships between Environmental Literacy and Epistemological Beliefs.

In this study environmental literacy and epistemological beliefs are thought to be related in several reasons. First reason is that epistemological beliefs may influence interpretation of environmental knowledge. "Knowledge" which is the core aspect of the epistemological beliefs could be important in understanding the nature of environmental behaviors. Knowledge is involved as a common variable in all levels of development of REB models. Studies showed that a linear model lines up with the idea that getting more knowledgeable makes individuals more aware and motivated through environment does not bear out for changing environmental behaviors of individuals (Hsu, 2004; Hungerford & Volk, 1990). The REB model of Hines et al. (1986/87) determined number of variables. These variables - "personality factors", "locus of control", and "intention to act", "attitudes"- can be connected with some of the dimensions of epistemology

like “innate ability”, “omniscient authority”, and “certainty of knowledge”. For instance, as indicated by Hungerford and Volk (1990) a person who feels powerless to make changes in society and has an external locus of control will not display environmental citizenship behaviors and needs help to deal with environmental problems. We argued that relationship may also be related to individuals’ epistemological beliefs. For example, similar to external locus of control, a person who holds omniscient authority belief of epistemological beliefs give importance to what scientists or authority tell them to believe or do about environmental issues. In other words this person may show REB without getting necessary information from scientists, politics etc. Similarly, a person who holds simple knowledge belief of epistemological beliefs memorizes knowledge and does not make linkages among environmental knowledge may not show responsible environmental behavior when it is necessary.

Second reason is organization of formal and informal environmental knowledge. Knowledge of environment is composition of informal and formal knowledge coming from different sources such as school, mass media etc. These different knowledge sources (e.g. knowledge of ecology, knowledge of action, knowledge of issues) were also described by Hungerford and Volk (1990) in REB model. Schommer (1998) hypothesized that a person who does not organize knowledge which is coming from different sources may not apply knowledge to perform well on application. . For instance, a person may not apply the ecological knowledge learned in the school (formal knowledge) to the environmental campaigns conducted by mass media (informal knowledge) and may not perform REB. According to given example, individuals may not interpret gathered formal and informal environmental knowledge together and may not act well on environmental problems. At this point epistemological beliefs may serve as good tools for providing interpretation of both formal and informal knowledge.

Third reason for considering epistemology and environmental literacy together is the influence of epistemological beliefs on ill-structured, controversial every-day life problems such as global warming, cloning etc. A recent study carried by Schommer & Hutter (2002) suggests that epistemological beliefs have an effect on everyday life issues. This study revealed that the people who believe in tentative nature of the knowledge (good epistemological beliefs in simple knowledge) are more likely to have willingness in modifying their ideas about everyday life issues and hold multiple perspectives. For instance, a person who believes tentative nature of knowledge may think that everyday environmental problems such as global warming may change and cause hazardous consequences in future despite today's' good conditions. When environmental problems assumed to be one of the everyday life problems, approaching to environmental problems can be seen as closely related to individuals' epistemological beliefs.

However, relationships among epistemological beliefs and environmental literacy components (such as attitudes, knowledge, and behavior) have not been studied. Consequently, in this study how individuals perceive and evaluate environmental knowledge and in which way epistemological beliefs related to environmental literacy of individuals were investigated.

1.5 Environmental Literacy and Demographic Variables

When the factors influencing the EL are investigated, it was found that gender, academic major, and grade level are all arisen as important factors (e.g. Hunter, Hatch, Johnson 2004; Tuncer, Ertepinar, Tekkaya & Sungur 2005; Yilmaz, Boone, & Anderson 2004; Goldman, Yavetz, & Pe'er, 2006, 2007; Moody, Alkaff, Garrison, & Golley, 2005). Thus, similar to earlier studies, this study also investigated effects of these major demographic variables on the EL of PTs.

Research on gender difference revealed a paradox in explaining the effect of gender on environmental attitude, concern, and behavior. There are various studies indicating that females have higher environmental concern, attitude, and behavior than males (Hunter, Hatch, Johnson 2004; Tuncer, Ertepinar, Tekkaya & Sungur 2005; Yilmaz, Boone, & Anderson 2004). On the contrary, some researchers found that males more likely express environmental concern than females (Macdonald & Hara, 1994). Further studies are needed to clarify the inconsistencies about effect of gender on environmental attitude, behavior, and concern.

Moreover, major enrolled is an obvious effect on students' environmental literacy. Higher education is fruitful medium for pre-service teachers (PTs) to develop their environmental literacy. Related literature stated that PTs who enrolled environment affiliated majors such as science, agriculture, geography and life sciences have higher environmental literacy (knowledge, attitude, concern and behavior) than those who enrolled in nonenvironmental affilitiated disciplines such as social studies, history, literature, mathematics, arts, computer sciences or physical education (Goldman, Yavetz, & Pe'er, 2006, 2007; Moody, Alkaff, Garrison, & Golley, 2005). The differences between academic majors chosen in environmental literacy suggested that all departments of school of education faculties need to emphasize environmental literacy skills in their programs.

Finally, research revealed that effect of grade level on environmental literacy components is significant (Alp, Ertepinar, Tekkaya, & Yilmaz 2006; Negev, Sagy, Garb, Salzber, & Tal, 2008). Related literature suggests that individuals at higher grade levels had higher environmental knowledge and attitude scores than the lower graders (Alp, Ertepinar, Tekkaya, & Yilmaz 2006). However, although Negev, Sagy, Garb, Salzber and Tal (2008) agree on environmental knowledge difference among grade levels, they proposed that other components of literacy were not significantly different. Despite

these variations in views among researchers, environmental literacy of individuals may also be affected by their grade levels at their schools. Moreover, we can repeat statement of Tbilisi (UNESCO, 1978) that environmental literacy should be provided for all ages and all groups.

1.6 Situating pre-service teachers (PTs) to Environmental Literacy and Epistemological Beliefs

According to aforementioned demographic variables and related literature, this study investigates the environmental literacy of the pre-service teachers of education faculty through their epistemological beliefs. There are several reasons for why pre-service teachers in faculty of education constitute the sample of this study. First, teachers play an important role in the effectiveness of education and environmental education. The way of teaching will affect the way of students' acting and education. Teachers are models for their students not only for formal education but also for the issues outside the school. At this point, it is obvious that environmental literacy of teachers' have influence on their teaching practices (Hsu & Roth, 1998). The UNESCO-UNEP Environmental Education Program has initiated a teacher education program for both elementary and secondary level teachers. UNEP reports published in 1989 and 1994 stressed the importance of pre-service teacher training by putting the subject into first order to create suitable environmental education programs. Second, other dimension of the study, epistemology, has also apparent effect on teaching of teachers and on the achievement of students (Hofer, 2001; Schommer, 2004; Tsai, 2006; Yilmaz-Tuzun & Topcu, 2007). Also UNEP Report (1994) has listed epistemology into recommended courses in teacher training programs. Education itself is philosophical and ethical establishment and epistemology should be integrated in environmental education programs for pre-service teachers to

improve the justification of knowledge and ethical issues related to environmental problems.

1.7 Significance of the study

Although previously developed environmental literacy models emphasize importance of knowledge, it is not determined as a powerful predictor that leads to environmental citizenry. These findings indicate that knowledge was not analyzed as required. The gap between knowledge and environmental literacy is tried to be filled by examining nature of knowledge and environmental literacy together. The role of the teachers who is perceived as source of knowledge by the students is undeniable in change of society in existing education systems. Thus, the training of the pre-service teachers, educators of future, is important to raise environmentally literate citizens. Understanding the differences in demographics may help to adapt suitable programs by considering PT's learner differences. Thus, the results of this study may influence environmental education programs and approaches. Determination of the relationships between environmental literacy and epistemological beliefs of pre-service teachers, teachers of the future, makes study significant in attaining the goals of environmentally literate citizenship.

1.8 Purpose of the study

The main purpose of the study was to investigate the relationships between environmental literacy (attitude, concern, knowledge and behavior) and epistemological beliefs of pre-service teachers of education faculty of a large public University in Ankara.

1.9 Research Questions

1. What are the epistemological beliefs hold by the students of Faculty of Education?

2. What are the relationships among epistemological beliefs of PTs and their environmental literacy (attitude, concern, knowledge, and behavior)?
3. What is the effect of gender on environmental literacy of the PTs?
4. What is the effect of grade level on environmental literacy of the PTs?
5. What is the effect of enrolled academic major on environmental literacy of the PTs?

1.10 Definitions of the terms

Environmental behavior: Individuals' intentions to take part in pro-environmental behaviors that are measured by use items of Environmental Literacy questionnaire.

Environmental concern: Environmental concern is the term that refers to the sensitivity toward environmental problems and issues.

Environmental attitude: Individuals' feelings and values related to the environment and environmental issues.

Environmental knowledge: Individuals' knowledge of current environmental issues. General definition of the term refers to the information that enables someone to study and reach about physical, social and cultural conditions that effect the development of organisms (DeChano 2006).

Epistemological beliefs: This term refers to ones beliefs about nature of knowledge and learning (Schommer, 2001)

CHAPTER 2

LITERATURE REVIEW

The primary purpose of this chapter is to review 1) definition, history, goals and characteristics of environmental education, 2) definitions, history, goals and components of environmental literacy (environmental behavior, environmental knowledge, environmental attitude and concern), 3) definition, history and research on epistemological beliefs and personal epistemology, and research indicating epistemology and environmental literacy relationship, finally, 5) effects of demographics on environmental literacy.

2.1 Environmental education

Increasing awareness towards environmental issues brought public to be knowledgeable and skilled about environment that they live in. The need for a global environmental citizenry came into prominence. Therefore, it was stated that creating a global environmental citizenry and awareness could be provided by education which rise locally but maintain a global solution about environment (Hungerford & Volk, 1990). Despite three decade history of international effort on environmental education, research studies dates back to mid 50s. In earlier years, studies focused on different terminologies and components of environmental education. There was confusion about origin of the term "Environmental Education". Brennans' (1957) article was denoted as the first academic use of the term as "conservation education" by Roth (1978). Later, definition of Stapp et al. (1979) emphasized a global definition for environmental education as "global citizenry". Disinger (2001) stated the disagreement on a universal definition of environmental education

and referred this confusion as evolution and metamorphosis. This evolving definition process was mediated by the consensus formed in Tbilisi. Accepted definition of environmental education in Tbilisi conference was:

> *Environmental education is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, attitudes, motivations, commitments, and skills to work individually and collectively toward solutions of current problems and the prevention of new ones.* (UNESCO, 1978, p. 1).

In global context, need for environmental education brought out in series of UNEP conferences in last three decades. These conferences were "Human and Environment" carried out in Stockholm in 1972 by United Nations, 1977, Inter-government on Environmental Education in Tbilisi (UNESCO, 1978), "Our Common Future" report published in 1984 (Brundtland, 1987), "Rio conference" in 1992 (UNEP, 1992), Thesolinaki Conference (UNEP, 1997). Human and Environment Conference (UNESCO, 1972) which was the first of chain of conferences declared the responsibility of protection and improvement of environment for the next generations as the primary goal of human. However, this statement was too general to set goals for environmental education. Essentiality of the education for the achievement of this goal was made clear by the follow up Tbilisi Conference (UNESCO, 1978) with a consensus on requirement of worldwide environmental education. Environmental educators agreed that environmental education should be provided for all ages and all groups in both formal and informal education to prepare individuals for life (UNESCO, 1978). They defined this agreement as "environmental citizenry". These outcomes of Tbilisi conference constituted a base for further studies and accepted by most of the environmental educators.

Moreover, process of setting goal was another problematic issue in environmental education until Tbilisi conference. Hungerford and Volk (1991) noted that "…we are uncertain about our goals. We are uncertain what to build into a curriculum. And we are uncertain what instructional strategies to employ" (p.99). Most important implication of Tbilisi declaration was setting goals for the future of environmental education. Tbilisi declaration determined categories of goals under five main topics that are more detailed and objective oriented.

- *Awareness: to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.*
- *Knowledge: to help social groups and individuals gain a variety of experience in, and acquire a basic understanding of the environment and its associated problems.*
- *Attitudes: to help social groups and individuals acquire a set of values and feeling of concern for the environment and the motivation for actively participating in environmental improvement and protection.*
- *Skills: to help social groups and individuals acquire the skills for identifying and solving environmental problems.*
- *Participation: to provide social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems* (UNESCO, 1978, p.3).

These objectives were the initial and long lasting decisions developed by environmental educators from 66 member states, 2 non-member states and 20 non-governmental organizations. The bringing of Tbilisi declaration was more than the previous conferences. First time, need for an environmental citizenship were declared and common objectives for environmental education were determined. These outcomes of Tbilisi would constitute structure of the environmental literacy in the future.

In summary, different sounds on definition and goals of environmental education among environmental researchers temporarily decelerated with a consensus that is fruitful to the development of environmental education research. Moreover, "environmental citizenship" was aimed to overcome environmental problems as a society in a global context by environmental education (Hungerford & Peyton 1976, Hungerford, Volk, & Ramsey, 1989; Stapp et al 1979; UNESCO, 1978, 1980, 1989). Later the idea of environmental citizenship took the form of environmental literacy. Goals determined in international conferences, especially in Tbilisi declaration, constituted the characteristics of environmental literacy. Characteristics and detailed information about environmental literacy were mentioned in the next section.

2.2 Environmental Literacy

Originally, literacy is a term that refers to the ability to read and write (Cambridge, 2009). In recent years it has been extended to variety of definitions such as computer literacy, science literacy, cultural literacy, and etc. Michaels and O'Connor (1990) explained variations due to the re-conceptualization of the literacy term. They explained literacy as a knowledge construction, reasoning, ways of thinking and problem solving process. Considering literacy in the context of environment Stables and Bishop (2001) discussed imprecise nature of term and expresses that it should be paid more attention to what literacy covers in environmental education to make it different from reading environment from the texts.

Historically, environmental literacy has been used since 1960s. It had no conclusive definition until Disinger and Roth's (1992) summary on environmental literacy studies. They defined environmental literacy as "*environmental literacy is essentially the capacity to perceive and interpret the relative health of environmental systems and take appropriate action to maintain,*

restore or improve the health of those systems" (p. 2). Roth (1992) described environmental literacy as a continuum and categorized individual on this continuum under three level; 1) nominal environmental literacy, 2) functional environmental literacy and 3) operational environmental literacy. These levels refer to;

Nominal environmental literacy: a person who is able to recognize many of the terms used in communicating about the environment and provide working definitions of their meaning.

Functional environmental literacy: a person who has a broader knowledge and understanding of the interaction of human social systems and other natural systems.

Operational environmental literacy: A person, who gathers and synthesizes suitable information among alternatives, takes action position to work for sustainability of a healthy environment. (Roth, 1992)

Functional and, especially operational environmental literacy levels corresponds to the main goal of environmental education which aims providing decision making skills and knowledge, complex environmental issues, and taking action position. Supporting this idea, functional and operational literacy levels may also carry weight in relation with reasoning and knowledge construction of individuals.

Moreover, environmental literacy has its unique characteristics both cognitively and affectively. For instance, in formal education environmental issues were mostly included in science curriculum. Science literacy and environmental literacy were sometimes used as synonym in curriculum development. Distinguishing characteristics of the environmental literacy from science literacy was that, although environmental literacy was based on ecological paradigm, scientific literacy is based on mechanical paradigm (Roth, 1992). Therefore, environmental literacy needs to be examined as separate from science literacy. By deciding definition and historical

background of environmental literacy, following section provides information about components of EL. Disinger and Roth (1992) indicated four main components of environmental literacy that were 1) environmental sensitivity, 2) knowledge, 3) skills, 4) attitudes and values, 5) personal investment and responsibility, 6) active involvement. Later after determination of those components Roth (1992) made revisions on environmental literacy components. He stated new categories as follows; environmental sensitivity and attitudes and values were assumed to be under the term "affect", personal investment, responsibility and active involvement were assumed to be under the term "behavior". As a result, four components were addressed– knowledge, skills, affect, and behavior- for environmental literacy. Our study also addresses four components for environmental literacy which were knowledge, attitude, concern (instead affect) and behavior.

In summary, environmental literacy is one of the major goals of environmental education. Environmental literacy has its' unique characteristics being different from other literacy. Environmental literacy includes knowledge, skills, affect, and behavior. Formal education has responsibility to the development of environmental literacy (Roth, 1992). Therefore, it is important to investigate what affects PTs' environmental literacy, because a teacher's environmental literacy greatly influence what he/she teaches in environmental education (Hsu, 1997).

In the next four sections environmental literacy components; attitude, concern, knowledge, and behavior were explained in details, respectively. Furthermore, relationships among environmental literacy components and studies indicating these relationships were reviewed.

2.2.1 Environmental Attitude

Environmental attitudes were defined as combination of factual knowledge and motivating emotional concern which result in tendency to act (Stapp, et al., 1969). Environmental attitudes were defined as one set of educational objectives which aim to help individuals to acquire values and concern for motivation in protection of environment (UNESCO, 1978). Disinger and Roth (2003) stated environmental attitudes as one of the four elements of environmental literacy. Moreover, Hungerford and Volk (1990) indicated attitude of environmental issues as an entry level variable of environmental behavior. Many research conducted on this issue and there is still interest on it. However, in a review of environmental attitudes Haberlein (1981) summarized the current position of environmental attitude studies as: *"Environmental attitudes are fundamentally important, widely discussed, frequently measured, and poorly understood."* (p. 1). Some of conducted attitude studies were summarized as follows to clarify attitude related studies and to provide idea about relationships between environmental attitudes (EA) and other environmental literacy components.

Research on EA revealed interesting results. Ramsey and Rickson (1976) hypothesized that increase in knowledge of an individual causes increase in attitudes which lead to environmental behavior. Moreover, Hines et al. (1986/87) found a positive correlation between environmental attitudes and environmental behavior. In Turkey, Tuncer et al (2009) investigated that attitudes of pre-service teachers highly correlated with environmental use [behavior] variable. On the other hand, an Eastern example of research in attitudes of pre-service teachers in Israel indicates that environmental attitudes of individuals do not lead in environmental behavior (Goldman, Peer & Yavetz, 2007). Some recent cross-cultural studies also critiqued hypothesized linear relationship about environmental attitude and other components of literacy. For instance, De Chano (2006) conducted a study

included data from four countries (Chile, England, Switzerland, and United States). Results of the study did not demonstrate statistically significant correlation between attitude and knowledge for each country. Arbuthnot and Lingg (1975) proposed that Americans have higher environmental attitudes in comparison to French which is a European country. Authors attributed higher attitudes of Americans to their historical closeness to environmental and ecological experiences. On the contrary, Vlaardingerbroek and Taylor (2007) pointed out in a survey study conducted in Lebanon that attitude of prospective students were higher than those live in Australia. As seen from the mentioned variations in studies concerning attitudes; outcomes of our study may contribute attitude literature by reflecting results from Turkey which is a non western country.

In summary, the relationship between environmental attitudes and other component of environmental literacy were not consistent. However, it is obvious that attitudes of individuals have relationship with other EL components.

2.2.2 Environmental Concern

Main goal of the environmental education is building a global society who has concerns about environment and associated problems (UNESCO, 1978). Environmental concern has no unique definition in environmental research. Dictionary definition of concern refers to "worry" (Cambridge, 2009). Environmental concern has been studied since 1970s. The pioneering studies have begun with Dunlap. Dunlap and Van Liere (1978) developed "New Environmental Paradigm" scale to measure the concern of individuals on environmental issues; limits to growth, steady-state economy and balance of nature. Iversen and Rundmo (2002) published a study by collecting data from 1450 Norwegian respondent with survey method by using 15 item environmental concern scales of Wiegel and Wiegel (1978). They proposed

that environmental concern was significantly correlated (0.41) with environmental behavior. Studies conducted in Turkey show similar findings with this research. Tuncer, Tekkaya, Sungur, Cakiroglu, and Ertepinar (2009) applied a study to investigate environmental literacy of pre-service teachers of a public university. Study conducted in Faculty of Education with a sample size 684. Research results revealed that high level of environmental concern is correlated with high level of environmental knowledge and use [behavior]. Moreover, Yilmaz, Boone and Andersen (2004) investigated environmental views of 458 elementary students of public schools randomly selected from urban and suburban areas of Ankara. Results of study revealed that student's science knowledge improved their environmental concern. However, students gave more priority to industrialization and economic growth of country than environmental concern. Berberoglu and Tosunoglu (1995) also found that university students did not concern about environmental problems when compared with technological development. The authors concluded that Turkey is a developing country and industrialization had priority against the environmental protection.

In summary, in last three decades valid instruments were developed for determination of environmental concern of public (Dunlap, 1978; Berberoglu & Tosunoglu, 1995). Although relation of concern with other components of environmental literacy such as knowledge, attitude and behavior have some inconsistency, environmental concern studies draw interest of environmental researchers and constitute important part of our study as an important variable.

2.2.3 Environmental Knowledge

Environmental knowledge is one of the goals of environmental education. Environmental knowledge is required to acquire basic understanding of environment and environment related issues (UNESCO,

1978). NEEFT and Roper (2005) mentioned that knowledge included in environmental literacy was not deep environmental science knowledge. It was general knowledge that public could identify and understand environmental related problems and their causes. Knowledge concept included in our study covers the same knowledge understanding.

In last three decades, numbers of studies have addressed knowledge as a component of both environmental literacy and environmental behavior (Hines et. al., 1986/87; Hsu, 2004; Hungerford & Volk 1990, UNESCO, 1978). Campbell, Waliczek, and Jacicek (1990) conducted a study with a population of 475 students whose grade levels range from 9 to 12 and proposed a strong relationship between knowledge and attitude that promotes environmental behavior. Contrell and Graefe (1997) also indicated that knowledge of ecology may cause a simultaneous increase in individual's environmental behavior with a combination of other variables. Moreover, Hungerford and Volk (1990) classified the knowledge as separate variables (in-depth knowledge of issues, knowledge of ecology, knowledge of consequences of behavior, knowledge of skill using environmental action strategies) and hypothesized that they act synergistically but not as a common knowledge variable. Besides this, it is proposed that although knowledge is a critical component of environmental literacy it is not determinative factor in producing environmental behavior.

When small numbers of studies conducted on environmental knowledge in Turkey were examined, following results were observed. As an example, Tuncer et al. (2006, 2009) conducted series of studies on environmental literacy and relationship between EL components in the last ten years. Tuncer et al. (2009) surveyed environmental literacy of 684 pre-service teachers in a big public university of Turkey. They reported that there were correlation between pre-service teachers' knowledge and concern, between knowledge and environmental use variable which refers to

intention to take part in pro-environmental behavior. Interestingly, no significant correlation between knowledge and attitude was observed. Also Alp, Ertepinar, Tekkaya and Yilmaz (2008) reported that a sample of elementary students of Ankara indicated low level of knowledge, but high level of environmental attitude. Alp et al. (2006) studied with a sample consisting of 1977 students from urban schools and proposed that environmental knowledge does not have a direct influence on responsible environmental behaviors of students but mediated by behavioral intentions and environmental affect.

In summary, environmental knowledge was defined as the goal of environmental education and environmental literacy. Although some research hypothesized a direct relationship between knowledge and environmental behavior (Campbell, Waliczek & Jacicek (1990), later studies hypothesized that there direct but interrelated relationship among different types of knowledge and environmental literacy components (Hungerford & Volk, 1990). A series of environmental knowledge studies reported medium level of knowledge and indirect relationship with environmental literacy components. There is an increasing comment on investigation of how knowledge affects action skills and responsible environmental behavior. Having these characteristics environmental knowledge constitutes important part of this study as a variable.

2.2.4 Environmental Behavior

Behavior is one of the components of environmental literacy. It has a different significance unlike the components of environmental literacy. Such that, Roth (1992) stated that environmental literacy should be observable. That is environmentally literate person needs to display action towards environment using his or her knowledge, skills, and disposition (Roth 1992). Displaying action and active participation, was termed as "responsible

environmental behavior" (Hines et al.1986/87; Hsu 1997; Hungerford & Volk, 1990). Although behavior was one of the environmental literacy components, being different from other components it was indicated as one of the major goals of environmental literacy due to it's' action promoting characteristic in solution of environmental issues (Hsu & Roth 1998). Peer, Goldman and Yavetz (2007) used this term as a synonym of environmental literacy. They suggested that responsible environmental behavior is reflective indicator of environmental literacy. Hsu (1997) discussed that environmental literacy variables would also be predictors of responsible environmental behavior. Therefore, our behavior dimension which refers to intention to take part in pro-environmental behavior involving active participation and active caring towards environmental issues was examined in the responsible environmental behavior context in this section. In following sections characteristics of REB models and their relationship with other components of environmental literacy were explained.

Historically, responsible environmental behavior has been studied by many researchers for last three decades. Up to now numerous REB models were proposed. Initial REB models indicated a linear relationship between responsible environmental behaviors and group of dimensions; knowledge, attitude and concern. This type of model was named knowledge-attitude-behavior (K-A-B) by Marcinkowski (2001), Culen (2001); Hungerford and Volk (1990). Figure 2.1 indicates K-A-B relationship.

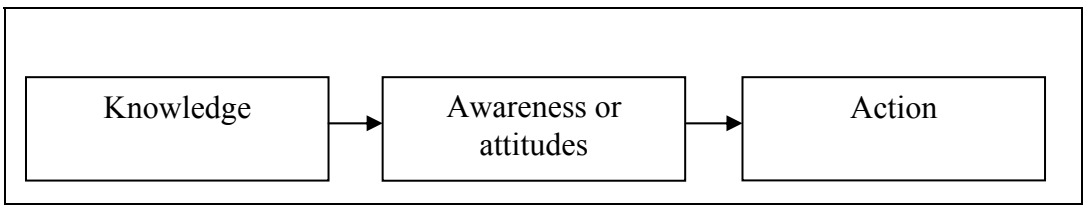

Figure 2.1 Adapted from Hungerford and Volk (1990)

Ramsey and Rickson (1977) carried out a study on a sample of 482 high school seniors. They investigated positive correlation between knowledge and environmental attitudes. In their K-A-B model, they claimed that increased knowledge leads to favorable attitudes which in turn lead to environmental action promoting better environmental conditions. Culen (2001) argued that if K-A-B model illustrates environmental human behavior, there would be an incline in environmentalist behavior in society in last 30 years time period which was the rising age of environmental knowledge and awareness. Zimmerman (1996) and Ballantyne (1996) also argued that this type of conclusions between knowledge and resulted environmental behavior needs to be explained and proven answering "how" question. These critiques on traditional K-A-B model were initiator of explanatory research on responsible environmental behavior. Over time numerous researches investigated various variables associated with responsible environmental behavior in addition to knowledge and attitude variables. The most accepted behavioral models of environmental education were proposed by Hines et al. (1986/87) and Hungerford and Volk (1990). Hines et al. (1986/87) analyzed 128 environmental education studies and proposed predictor variables of responsible environmental behavior as: locus of control, personal responsibility, action skills, knowledge of action strategies and issues, and intention to act as in the figure 2.2.

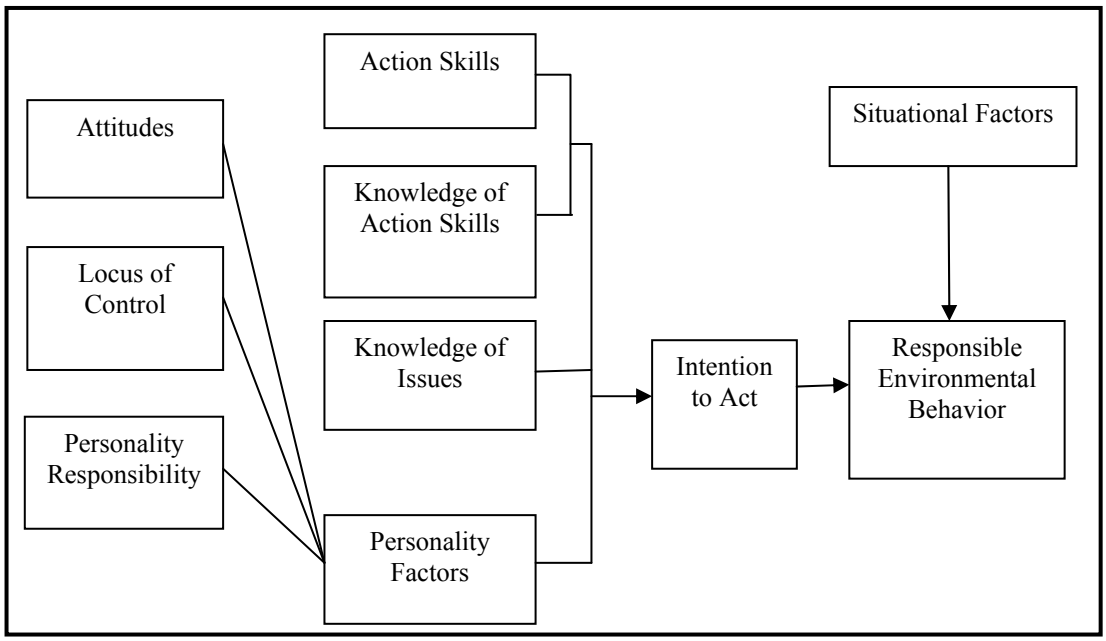

Figure 2.2 The Hines et al. (1986/1987) model of responsible environmental behavior (adapted from Hungerford & Volk, 1990)

On the other hand, action skills, knowledge of issue, and action strategies were expressed as a prerequisite of intention to act variable. They defined personality factor as a good predictor of responsible environmental behavior. Moreover, they mentioned that personality factors and knowledge variables should combine with intention to act variable which turns into responsible environmental behavior. Hines et al. (1986/87) explained this hypothesis by stating that "An individual who expresses an intention to take action will be more likely to engage in the action than will an individual who expresses no such intention…" and added that this variable can be combination of personality factors and cognitive knowledge and skills variables (Hines et al, 1986/87, p.6-7).

Study published by Hines et al. (1986/87) had started development of behaviorist models on environmental behavior and revealed factors affecting acting environmentalist. Although Hines et al. (1986/87) model was a base

study determining the variables related to responsible environmental behavior, a network like relations between variables still indicates the need for further studies. Hungerford and Volk (1990) conducted a research based on the variables of Hines model and other research results which have contributions to literature. In this research, researcher hypothesized three main categories of variables that propose a developmental sequence. These variable categories were entry level variables, ownership variables, and empowerment variables. Some major and minor variables were also classified under these three categories. Next three paragraphs offer brief summaries of three variable categories. Figure 2.3 displays hypothesized variable categories.

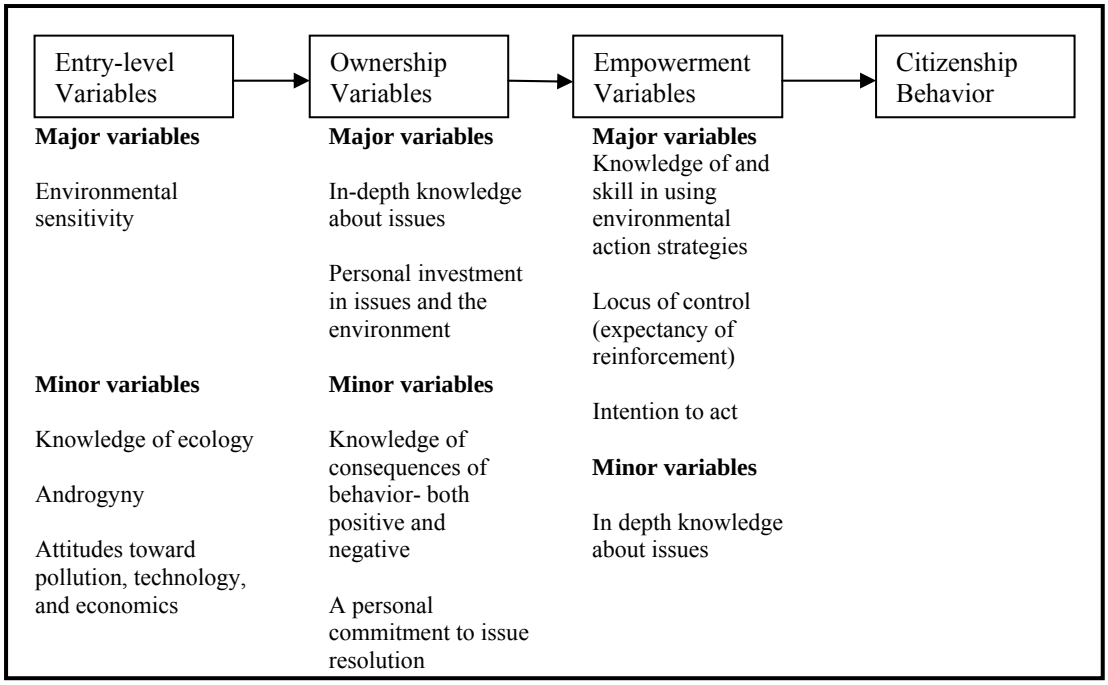

Figure 2.3 Behavior flow chart: Major and minor variables involved in environmental citizenship behavior (adapted from Hungerford & Volk, 1990)

Entry level variables which described as good predictors of responsible environmental behavior are in a linear relationship albeit possible synergetic relation among them. Environmental sensitivity which was a minor variable of entry-level variable defined as an empathetic viewpoint towards the protection of environment. Androgyny was another minor variable which mentions psychological perspective refers to the acting non-traditional sex characteristics. Moreover, knowledge of ecology and attitudes towards pollution and technology were significant predictors, but they were still minor variables

Ownership variables which make environmental issues very personal were described to be critical to environmental behavior. Two major variables defined for ownership variables. Those are in-depth knowledge of issues and personal investment. Knowledge of issues represents individuals' understanding about natural issues, and their implications to both nature and ecology. Personal investment which described as ownership "itself" by Hungerford and Volk (1990) refers to the personal motivation looking at ecological perspective instead of economical perspective. Those individuals give priority to environmental issues more than the sustaining natural sources for only economic benefits.

Finally, empowerment variables which described as having sense of power of chance and solve environmental problems were crucial variables in educating people as responsible citizens. Perceived skills in using environmental action strategy was a major variable of this category which indicates a feeling having "power" to solve environmental problems. Other major variable knowledge of environmental action strategy was a variable to believe to have relationship between behaviors. But Hungerford and Volk (1990) point out that the knowledge of action strategies and knowledge of issues were not separate variables as indicated in flowchart on Hines et al. (1986/87) model, contrarily, they work synergetic. Locus of control was

another variable interrelated with others. It refers to internal reinforcement of an individual for doing something to the protection of environment, unlike an individual with an external locus of control will be reinforced for doing something for nature. As a final, major variable intention to act seem as a variable related to empowerment variable by increasing the occurrence of responsible environmental behavior. Hungerford and Volk (1990) pointed out the relationship between intention to act variables and personal investment, locus of control and perceived skill in taking action.

When general picture of Hungerford and Volk (1990) model examined, it is clear that knowledge was appeared to be in three variable categories; entry-level, ownership and empowerment. Knowledge of ecology, knowledge of consequences of behavior was determined as minor variables. In-depth knowledge about issues and knowledge of skill using environmental action strategies were determined as major variables. However, in-depth knowledge of issues turned into minor variable under empowerment variable category being different from Hines model. Unlike Hines et al. (1986/87) model, knowledge was divided into different categories. This indicated that as a predictor of REB environmental knowledge was composed of various types from different sources.

In summary environmental behavior was defined as fundamental goal of environment education. Several behavior models have been developed under the name of REB models. Despite all critiques on traditional K-A-B model, it was effective by bringing many studies to literature on debates of this research. Moreover, Hines et al. (1986/87) determined existence of how behavioral change is complex and synergetic. Then, Hungerford and Volk (1990) extended Hines model and hypothesized linear variable categories and synergetic relationship among minor and major variables of responsible environmental behavior. Hungerford and Volk (1990) also structured a framework for further studies. It was concluded that although knowledge

was positioned under all levels of variables as major or minor variable, it was not described as direct determinant of responsible environmental behavior. On the other hand, both Hines et al. (1986/87) and Hungerford and Volk (1990) models highlighted the effect of personal factors and reasoning about knowledge on REB. It can be conclude that conversion of knowledge and personal factors into action still was not clear enough.

2.3 Epistemological Beliefs

Epistemology is a term which was originating the words *episteme* "knowledge" and *logos* "science" (Wikipedia, 2009). As understood from the origin of the word, epistemology is a branch of philosophy dealing with the nature of knowledge. Addressed questions in field of epistemology are; what is knowledge?, how is knowledge acquired?, what do people know?, how do we know what we know?, and why do we know what we know?. Epistemology defined as *"…a philosophical enterprise, [which] is concerned with the origin, nature, limits, methods, and justification of human knowledge"* (Hofer, 2002, p. 4). Shortly, epistemology investigates the answer of "knowing how" question.

Personal epistemology of individuals constitutes the focus of this study. From an educational and philosophical perspective, personal epistemology is how individuals develop conceptions of knowledge and knowing and puts them to use in developing understanding of world (Hofer, 2002). Definition of personal epistemology varies depending of study. By this sense, personal epistemology studies have been changed from universal epistemology studies to cognitive oriented study of epistemology which seeks how individuals believe and justify knowledge. Through the development of epistemological beliefs research, personal epistemology is included in educational, developmental and instructional psychologists as well as science and math education and teacher education.

Historically, personal epistemology studies have begun with Perry (1968). It is said to be that Perry's' work led most researchers in the field to develop several approaches and models. One group of researcher was interested in how individuals interpreted their educational experiences. Second group of researcher was interested in how epistemological hypothesis effect thinking. Most recent, third group of researcher lines up with an idea that people had independent epistemological beliefs rather than developmental stages. This group of researcher conceptualized personal epistemology as a more or less independent beliefs system.

William Perry's (1968) scheme of intellectual and ethical development can be thought as a base study to nearly all personal epistemology research. The longitudinal study of Perry has started in early 50s in Bureau of Study Counsel at Harvard College. His work hypothesized a developmental scheme abstracted as *"…representing an evolution in the form of thought and of values…"* (Perry, 1968, p. 1). This scheme derived from student's reports on their experiences during their four years college education in a liberal art college. The sample of study comprised of 31 students (27 men, 4 women) in 1954-1955 classes and 109 students (85 men, 24 women) in 1959-1960 classes for validation of scheme. Students gave their open interview reports at the end of each college year. Results of the study constructed on these interview reports. Perry summarized his findings as cited;

> *"The developmental scheme which we abstracted from these reports traces the evolving forms through which students appear to be construe the world, with special focus on those forms through which they consider the nature and origin of the knowledge, value and responsibility."*(Perry, 1968, p.1).

Perry's scheme of development reflects hierarchical structure. Levels in the development stated as positions instead of stages. Nine positions of

development which clustered under 3 main categories were validated. Those are dualism, relativism, and commitment.

Dualism: Positions 1, 2, 3, refer to individual representing a simple dualistic approach, right-wrong view of world. Authority is expected to know the truth and knowledge is handed down by authority.

Relativism: Position 4, 5, 6, refers to individual representing a contextual relativism, perception of self as a maker of meaning, and intention to commitment. People perceive knowledge as relative and begin to choose their own commitment.

Commitment: Positions 7, 8, 9, refers to individual representing commitment in his\her actual experiences. People take responsibility and make commitment to their values, careers, personal identity. (Hofer & Pintrich, 1997; Perry, 1968).

Perry (1968) stated that developmental scheme of personal epistemology processed by deletion, escape and retreat of one's position. The continuum of personal epistemology which embodies nine positions under 3 categories ranges from simple dualistic approach to contextual relativism resulting in commitment of individuals. In his study, Perry (1968) also made conclusion about role of teachers [which constitute sample of our study] as an authority in development of personal epistemology and reasoning about knowledge. Eventually, Perry (1968) highlighted some limitations of his research. The sample which developmental model derived from was selected from single college students. Interviewers were also the investigators hypothesized schema. Moreover, many of the participants were selected from well educated male groups in Harvard College and small numbers of females were interviewed when compared with number of males. Interestingly, Perry did not conduct further studies to investigate students learning and personal epistemology. Despite these critiques, Perry's work was the fists study investigating college students' way of making meaning.

The second model offered by Belenkey, Clinchy, Goldberger and Tarule (1985) was an investigation research of woman as knower. Perrys' study had limitations due to generalizability of elite male sample to the college students about their way of knowing. Investigation of women's way of knowing served as a validation of Perrys' work addition to male responses. Bleneky et al. (1985) interviewed 135 women of whom 90 of them enrolled in colleges and 30 enrolled in programs to enhance parenting skills. Researcher interested in seeing how college education influences women's way of knowing and how a maternal practice influence woman's thinking. They investigated different epistemological positions of women which derived from interviews and stated them as experience of voice. These positions are *silence, received knowledge (voice of others), subject knowledge (the inner voice), procedural (the voice of reason), and constructed knowledge (integrating the voice).*

Silence position refers to women who live in deep silence and isolation characterized by wordless. These women listens commands of authority and responses even without using words. *Received knowledge (voice of others)* position refers women who listen to what others think and know as a receiver. They use others' words and obey standards and rules of authority. The next position, *subjective knowledge (the inner voice)* refers to women who see their own experience as the only source of truth. They try to get control their own lives out of control of authority. *Procedural knowledge (the voice of reasons)* refers to women who demonstrate applying procedures, evaluating and communicating knowledge. They tent to make reasoning about truth of knowledge. Finally, *constructed knowledge (integrating the voice)* refers to women who see knowledge as a product constructed by knower. "They put the knower back into the known (Belenky et al, 1985, p. 20).

Belenky et al. (1985) extended the findings of Perry's work and filled the gap in personal epistemology of women. However, studying on single women group was criticized by Hofer and Pintrich (1997). They stated,

"Although they acknowledged that similar categories could be found in men's thinking, their study provided no means to asses gender related nature of the findings" (p.96). It can be concluded that despite limitations of study of Belenky et al. (1985), research offered idea of women epistemology and hypothesized developmental position which proposed to be in line with Perry's model of epistemological development for both males and females.

Another developmental model of personal epistemologies of adults which proposed by King and Kitchener (1994) is *Reflective Judgmental* model. It was developed as a result of 15 years longitudinal study with middle aged adults. Results of this study were constructed by interviews of 1700 about four ill structured problems. Authors hypothesized a model that people's personal epistemologies change over time in a developmental fashion from early adolescence to adulthood (King and Kitchener, 2001). King and Kitchener (2001) described the development of reflective judgment under seven distinct but developmentally related sets of assumptions about justification of beliefs and view of knowledge. They summarized those seven stages into three categories: *pre-reflective, quasi- reflective* and *reflective stages.*

Pre-reflective reasoning refers to people who believe that knowledge is gained by authority such as scientists or professors. They believe that known is absolute and correct.

Quasi-reflective reasoning refers to people who believe uncertainty of knowledge and knowledge claims. Although they use in evidence reasoning, they are skeptic and confused about how evidence can be used to reach a conclusion.

Reflective reasoning refers to people who accept uncertainty in knowledge claims. They make conclusions as "most reasonable". Knowledge is evaluated based on evidences and context (King, 2000; King and Kitchener, 2001).

The results of the study were in line with Perry's work of development of epistemologies. The abstracted model describes developmental positions which ranges from certainty of knowledge and influence of authority in reasoning to uncertainty of knowledge and reflection of own reasoning in knowledge claims. In summary, King and Kitchener hypothesized that individuals go through seven developmental stages in development of their personal epistemologies and evaluation of nature of knowledge (Kitchener, Lynich, Fischer & Wood, 1993; Hofer & Pintrich 2001; King & Kitchener, 1994; Kitchener, Lynich,& King, 2000). Moreover, as a result of series of longitudinal studies about reflective judgment conducted, King and Kitchener (1994) proposed that individuals attended a college personal epistemology and knowledge claims of individuals developed through education (Hofer & Pintrich, 2001;King et al., 1993).

Up to now, researcher claimed personal epistemology of individuals' as developmental stages or schema derived from adult and university student samples for both males and females (Belenkey, 1985; Hofer & Pintrich, 1997, 2001; King & Kitchener, 1994; Perry, 1968). Developmental models hypothesized gradual development of personal judgment, reasoning and view of knowledge. According to developmental model individuals require a disequilibrium state to go upper stages. Disequilibrium processes by deletion of one stage or escape from lower to upper stage (Perry, 1968). As a result, in light of these research in cognitive development of personal epistemology, individual's epistemologies are unidimesional.

The most recent approach which focuses on personal epistemology as an epistemological belief system which is more or less independent rather than developmental stages has been proposed by Schommer (1989, 1990, 1992, 1994). Schommer's epistemological belief approach differs by multidimensional nature of personal epistemology of individuals and

contributions on teaching and learning. Moreover, Schommer's research approach was more quantitative and analytical than the previous studies on personal epistemology. In her early report in 1989 and 1990 article, she argued that epistemological beliefs system composed of five more or less independent degrees of beliefs which are 1) the stability of knowledge, ranging from tentative to unchanging, 2) the structure of knowledge, ranging from isolated to integrated concepts, 3) the source of knowledge, ranging from handed down by authority to gathered form observation and reasoning,4) the speed of learning, ranging from quick to gradual learning, 5) the control of knowledge acquisition, ranging from fixed at birth to lifelong improvement.

In 1990 Schommer reported her first study concerning personal epistemology as a system of more or less independent beliefs. Sample of study was compromised of 117 junior college students and 149 university students. Male and female distributions were approximately equal, (120 males, and 143 females). Students were asked to respond to Likert-scale questionnaires that consist of 28 negative and 35 positive items. Those 63 items categorized under 12 subsets that were used as variables in analysis. The questionnaire used in the study was constructed into five hypothesized epistemological belief dimensions that are:

1) Simple knowledge derived from epistemological dimension "structure of knowledge" which refers to knowledge is simple rather than complex.

2) Omniscient authority derived from epistemological dimension "source of knowledge" which refers that knowledge is handed down by authority rather than derived from reasoning.

3) Certain knowledge derived from epistemological dimension "certainty of knowledge" which refers to knowledge is certain rather than tentative.

4) Innate ability derived from epistemological belief dimension "control of knowledge" which refers to the ability to learn is innate rather than acquired.

5) Quick learning derived from epistemological dimension "speed of learning" which refers to learning is quick or not at all. (Schommer, 1989, 1990).

Factor analysis made it possible to determine factors account for participants' response; four factors were generated by principal factoring extraction: Innate ability, simple knowledge, quick learning and certain knowledge. Regression analysis was used to investigate influence of epistemological beliefs on comprehension and learning. Conclusions derived from study were: *a) personal epistemology can be characterized as a system of more or less independent beliefs, b) these beliefs have distinct effects on comprehension and learning, c) epistemological beliefs are influenced by home and educational background d) these effects exists beyond the influence of variables found to influence comprehension and learning, e) these effects are generazilable across two content domains.* These results were also replicated by study of Schommer, Cruse and Rodes (1992) concerning influence of epistemological beliefs on Mathematical text comprehension. Schommer (1994) published a theoretical framework and described it as follows;

1) Personal epistemology may be conceptualized as a system of beliefs.

2) Beliefs within the system are more or less independent.

3) Epistemological beliefs are better characterized as frequency distribution rather than dichotomies and continuum.

4) Epistemological beliefs have both direct and indirect effect on learning.

5) Whether epistemological beliefs are domain general or domain independent will vary over time for any particular individual. (Schommer, 2002, p. 107-108).

Studies of Schommer (1990, 1992, and 2006) provided epistemological belief framework for college students. Further studies were conducted to

investigate how epistemological beliefs were constructed and developed in lower levels of education. Study of Schommer (1993) investigated that sample of research (more than 1000 high school students) reported epistemological beliefs in certain knowledge, simple knowledge, quick learning decreased from freshman to senior years. This claim validated with longitudinal study of Schommer (1997) which depends on 69 secondary students responds to questionnaire as freshmen in 1992 and as seniors in 1995. Results revealed that beliefs in simple knowledge, fixed ability to learn, quick learning and certain knowledge change through high school years. Moreover, Schommer and Walker (1995) proposed that epistemological beliefs are domain independent, in other words, both social sciences and mathematics reported similar level of epistemological sophistication across domains.

Schommer's longitudinal studies mentioned above validated her initial study proposing multidimensional nature of epistemological belief system. Also several researchers conducted studies and validated hypothesized factor structure of questionnaire (Kardash & Scholes, 1995; Schraw,Dunkle & Bendixen, 1995; Yilmaz-Tuzun, Topcu, 2007). This validation period of epistemological beliefs continued with application of studies on teaching and teacher education. For instance, Schommer's study was replicated in Turkey by Yilmaz-Tuzun and Topcu (2007). Researchers administered Schommers' Epistemological Belief Questionnaire to a group of pre-service science teachers in a public university in Ankara. Significant relationship between pre-service science teachers' epistemological beliefs, world views and self-efficacy beliefs were investigated. Schommers' multidimensional hypothesis was also supported with finding of omniscient authority factor as one of the factors which may result due to cultural difference.

2.4 Evidences that supports the relationship which may exists between epistemological beliefs and environmental literacy

In 1995, Schraw ,Dunkle, and Bendixen (1995) conducted a study on influence of cognitive processes on problem solving. Study was conducted with a sample consisting of two hundred twelve (121 females and 91 males) students in educational psychology class at a university. The Schommer epistemological belief questionnaire was validated with extraction of five hypothesized epistemological belief dimensions similar to the Schommers' (1990) findings with addition of omniscient authority dimension. Moreover, second purpose of the study was investigating influence of epistemological beliefs on ill structured problems that have multiple and non-guaranteed or defined solutions. Ill- structured problems defined as problems that have multiple and non guarantieed solutions (Schraw,Dunkle & Bendixen, 1995) that causes conflict, shortly they are controversial issues. Related literature stated that individuals' nature of knowledge (epistemological beliefs) influences their reasoning and perspectives about ill structured and controversial everyday issues (Schommer, & Hutter, 2002; Schraw, Dunkle & Bendixen; 1995). Environmental problems were also classified as one of the controversial issue (Camino, & Calcagno, 1995; Colsto 2000). Personal epistemology perspectives of individuals are somehow in line with environmental literacy components. For instance, epistemological beliefs theories mentioned below were constructed on individuals escape from authoritarian knowledge to individualistic knowledge which based their own reasoning (Hofer, 2001, King Kitchener, 1993; Belenkey et al., 1985, Schommer, 1990, Schraw,Dunkel and Bendixen; 1995). On the other hand, environmental literacy studies also discussed perception of self power which indicates a person who feels powerless to make changes with an external locus of control will not display environmental citizenship behavior (Hungerford & Volk 1991). Moreover, it was argued that individuals values

and view of expert authority which are also components of epistemological beliefs, effect individuals' reasoning and environmental behaviors (Dietz, Stern, & Rycroft, 1989; Dietz,Fitzgerland, & Schwom, 2005). Having this characteristics, epistemological beliefs may effect on construction and reasoning of environmental knowledge. Hypothesized relationship between knowledge and epistemological beliefs may explain directly or indirectly why environmental knowledge does not lead into responsible environmental behavior.

Finally, Schommer proposed effect of epistemological beliefs in daily life in a book published with name of *adult learning and development* in 1998. She mentioned that epistemological belief may influence strategy and application of individual's in daily life. She explained that a person who believes knowledge as isolated bits rather than interconnected network will not organize and integrate knowledge. Thus individual will not perform well on application. This hypothesized indirect effect of belief of knowledge was displayed at figure 2.4. As seen from the figure, if individuals do not believe that knowledge learned from different sources were interrelated, they perceive knowing as recalling, and studying as memorization. Perceiving knowledge as recalling and memorization leads in to poor application or behavior. Daily life of an individual includes reasoning and decision making procedures rather than memorization and recalling of facts.

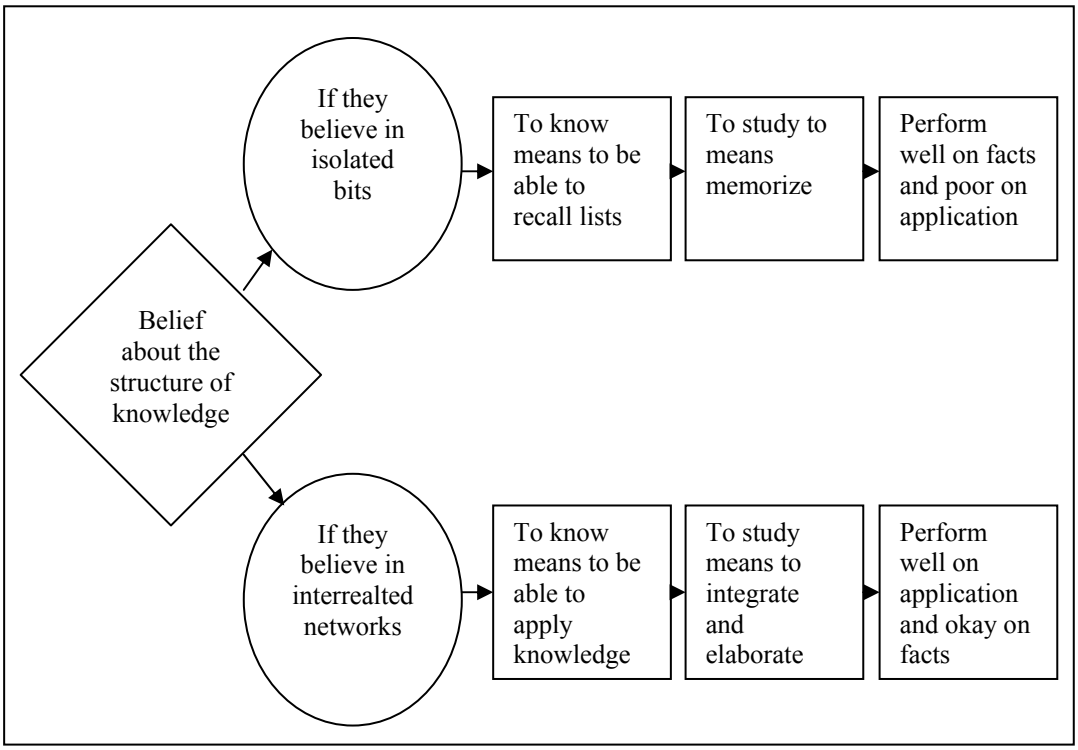

Figure 2.4 The hypothesized indirect effect of beliefs adapted from Schommer (1998).

In relation to environmental literacy, Hungerford and Volk (1990) defined different environmental knowledge categories. Moreover, environmental knowledge is composition of both formal and informal knowledge gathered from formal school education and informal sources such as mass media (Arbuthnot, 1977; Kara, 1999). For instance, Kara (1999) mentioned that environmental knowledge of secondary school students in Hong Kong was shaped by TV news. However, Arbuthon (1977) suggested that information provided by mass media should be supported by educational based knowledge, in other words formal knowledge. Thus, epistemological beliefs may offer as a tool for bringing knowledge from formal and informal sources together to make people behave more environmentalists. They may explain why knowledge is not converted into responsible behavior as stated in K-A-B model.

2.5 Demographic variables and components of environmental literacy

Related literature indicates that many variables have been found to have some degree of relationship with components of environmental literacy. In many of the analysis concerning predictors of environmental literacy revealed that demographic variables were somehow determinative in environmental literacy of individuals. It is apparent that those groups of demographics which are differentiating in literacy are too large to include in a single study. Thus, gender, academic major and grade level were chosen according to the purpose of the study. In the text sections a research base summary of corresponding demographic variables were provided to explain effect of gender, grade level, and academic major on environmental literacy components.

2.5.1 Gender

Environmental literacy was investigated in four dimensions environmental attitude, knowledge, concern, and behavior defined in NEETF (National Environmental Education, Training Foundation) and Roper (2005). There were some studies investigating the gender difference on environmental literacy components. Gender difference is a paradox in explaining the environmental attitude, concern and behavior. There were various studies indicating that females have higher environmental concern, attitude, and behavior than males (Hsu, 1997; Hunter, Hatch & Johnson 2004; Tuncer, Ertepinar, Tekkaya, Sungur 2005; Yilmaz, Boone, & Anderson 2004). Zalenzy, Chua, and Aldrich (2000) conducted a series studies to reveal the gender effect in environmentalism as a composition of attitude, concern and behavior. The results of the study stated that women tended to engage more environmental behaviors than man. Female dominancy on environmental literacy was also replicated by in-depth studies one is which investigates 1) gender differences among children, 2) gender differences among 14 countries

and 3) explaining gender and environmentalism. This research was conducted as three separate studies. In 1st study, a sample of primary and secondary school students (N_1:584, N_2: 709) were surveyed in 2 years period in California by using composition of scales such as environmental attitude, responsibility, concern and knowledge. Authors concluded from 2 surveys that females reposted stronger environmental attitude, concern than males. In 2nd study, graduate level students (N: 2,160) were surveyed among 14 countries from which Europe, Latin America and United States. Study revealed that females also had greater attitude and concern than males in 10 of 14 countries. In 3rd study, 119 university students were surveyed and it was concluded that females have stronger environmental responsibility than females which may indicate one of the gender differences in environmental concern and attitude.

On the contrary, McDonald and Hara (1994) conducted a study which having sample size consisting of 233 males and 306 females. The authors claimed that males were found to be more likely express 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. Some researcher expressed different approaches to explain in which way male and female difference in environmental literacy components. Tindall, Davies and Auboules (2003) tried to explain activism as a differentiating property between males and females. They proposed that although women were more likely engage in environmental behaviors and demonstrated high level of concern, they did not demonstrate high level of activism. Similar results and conclusions were obtained from the results of "General Social Survey 1993" reported by Blocker and Eckberg (1997). They found that women tend to show more environmental concern than man do, but they are not environmentally active than man.

In summary, there are numerous research supported that females demonstrate high level of environmental concern, attitude and behavior than males. Although females' high level of environmental literacy seems to be agreed on, there are opponents of this idea which states that although females have high concern towards environment than males, males are active environmentalist. Moreover, some studies investigated gender as a weak predictor of environmental literacy. Despite these arguments, gender is a predictor variable of environmental studies and it is clear that it is needed to have further studies to overcome inconsistency in research findings.

2.5.2 Academic Major

Higher education is a fruitful medium for PTs to develop their environmental literacy. Major enrolled education is an obvious effect on students' learning. Related literature stated that PTs who enrolled environment-affiliated majors such as science, agriculture, geography, and life sciences have higher environmental literacy; knowledge, attitude, concern, and behavior than those whose enrolled in non-environment affiliated disciplines such as social studies, history, literature, mathematics, computer science, arts, or physical education (Goldman, Yavetz & Pe'er, 2006 and 2007; Moody, Alkaff, Garrison & Golley, 2005). Goldman et al. (2006) surveyed environmental literacy of 765 pre-service teachers from different academic majors in Israel. The analysis indicated significant mean differences among academic major groups. They hypothesized that students who enrolled environmentally affiliated fields (environmental science, agriculture, geography, land of Israel studies, natural and life sciences) have higher environmental behavior scores than students in non-environmentally affiliated fields (social studies, history, literature, mathematics, physics, computers, arts, physical education). Peers, Goldman and Yavetz (2007) declared results of the study related to environmental attitudes and concern.

It was concluded that environment related majors have more environmental attitude and concern than those enrolled non-environmentally affiliated majors.

Tikka, Kuiten, and Tysys (2000) investigated effect of environmental backgrounds of individuals on their environmental literacy components. Sample of the study consists of 464 students from 17 different academic majors. Different background information and demographics were also included in the to the study. Data collected during 1994. The results of the study showed that individuals having biology background exhibited positive attitudes toward environment and they had high level of environmental knowledge. However, individuals having economy and technology background exhibit negative attitudes towards environment.

There are some studies which are consistent with the role of academic major on environmental literacy of individuals studied in Turkey. Sample of the study consists of 850 subjects from preservice teachers of Faculty of Education. ANOVA analysis reported statistically significant mean difference among enrolled academic majors of preservice teachers. Results indicated that preservice teachers enrolled in elementary education have more positive attitudes than secondary mathematics education students and social science students. Ozden (2008) interpreted these results as pre-service teachers enrolled in elementary teaching have taken science courses like physics, chemistry and biology and additionally courses related environment and environmental problems different from math and social science teaching departments.

In summary, literature indicates that students in environment affiliated departments have more environmental knowledge and attitudes towards environment than students in non-environment affiliated departments. Therefore, academic major considered as an important variable

in investigating environmental literacy of individuals. Thus, replication of study regarding types of departments may enhance understanding about EL.

2.5.3 Grade Level

The last demographic variable covered in our study is academic major. This part of the review aims to provide information about studies investigated grade level and environmental literacy relationship. There were many studies reporting significant relationships between grade level and components of environmental literacy (Alp, Ertepinar, Tekkaya, Yilmaz 2006; Negev, Sagy, Garb, Salzber & Tal, 2008). Alp et al. (2006) conducted study partially investigating the effect of grade level on components of 6th, 8th and 10th grade level students in capital city of Turkey. Students (N=1.977) which were randomly selected from 22 schools were participated in study. Results revealed that there was statistically significant effect of grade level on environmental knowledge and attitudes scores of students. It was reported that 8th graders had higher environmental knowledge scores than 6th graders, 10th grader had higher knowledge scores than 6th and 8th graders. Researchers concluded that environmental knowledge increases when students passes upper grade levels. One other study was conducted in Israel which is a nonwestern country like Turkey. The authors conducted a national survey to evaluate environmental literacy of 6th and 12th grade levels including the knowledge, attitude and behavior components. Survey results were collected from 1,591 6th grade and 1,530 12th grade students. Authrs reported that knowledge scores of 12th graders were significantly higher than 6th graders. Moreover, no statistically significant results were found for attitude and behavior components of environmental literacy. Authors concluded that the more students go upper grade level, the more they have environmental knowledge.

Finally, research revealed that effect of grade level on environmental literacy components is significant (Alp, Ertepinar, Tekkaya, & Yilmaz 2006; Negev, Sagy, Garb, Salzber & Tal, 2008). Related literature suggests that individuals at higher grade levels had higher environmental knowledge and attitude scores than the lower graders (Alp, Ertepinar, Tekkaya, & Yilmaz 2006). However, although Negev, Sagy, Garb, Salzber, and Tal (2008) agree on environmental knowledge difference among grade levels, they proposed that other components of literacy were not significantly different. Despite these variations in views among researchers, environmental literacy of individuals may also be affected by their grade levels at their schools. Moreover, we can repeat statement of Tbilisi (1978) that environmental literacy should be provided for all ages and all groups.

CHAPTER 3

METHODOLOGY

This chapter aims to provide brief information about research design, sampling, measurement instruments, data collection procedure, and statistical techniques utilized in the analysis of the data for entire study.

3.1 Research design

Design of the study was based on survey research and correlational research. Survey research describes some aspects or characteristics of sample of a group through asking questions (Fraenkel & Wallen, 2005). This study aims to describe epistemological beliefs and environmental literacy of PTs selected from a Faculty of Education. Study also describes effect of demographic variables on environmental literacy of PTs. However, collected data concerning dimensions of both questionnaires were used for inferential purposes and some relationships among dimensions were investigated. Having these features this study shows characteristics of an explanatory study rather than being a descriptive study. Other research design which we used in our study is correlational research. This type of research design refers to determination of relationship among two or more variables without influencing them. In this study relationship between epistemological belief dimensions and environmental literacy components were investigated by using correlational analysis. Moreover, predictors of environmental literacy were defined by using multiple regression analysis and factor analysis was used to define factor structure of PTs' epistemological beliefs. Therefore, having these correlational techniques study also shows correlational research design characteristics.

3.2 Sample

The sample of this study included a heterogeneous group of PTs coming from different regions and cities of Turkey. Target population was all pre-service teachers in Faculty of Education at Middle East Technical University which is the prestigious research university and academic establishment of Turkey. The population of the study was 1466 PTs. The sample of the study that reached was 560 subjects. The rate of respondents to the total population was 38 % of our population. The samples of the study were recruited from 560 pre-service teachers from undergraduate programs of Faculty of Education.

The departments involved in our study were Elementary Science Education (ESE), Elementary Mathematics Education (EME), Early Childhood Education (ECE), Computer and Instructional Technologies Education (CEIT), and Foreign Languages Education (FLE). Of these participants 173 of them were males and 377 of them were females. Distribution of sample according to the enrolled academic majors and grade levels were displayed in Table 3.1.

All participants were selected from undergraduate level departments which offer Bachelor of Science degree. However, there were undergraduate departments such as Secondary Physics Education and Secondary Chemistry Education that were 5 year education departments offering master degree in faculty of education. These groups were not included in this research, since students of these departments take most of their courses from chemistry and physics departments until their last years of school different from other groups.

Table 3.1 Descriptive statistics for departments and grade levels

Department	N	Percentage
ESE	139	25%
EME	96	17%
ECE	91	16%
CEIT	112	20%
FLE	122	22%
Grade Level		
Freshman	171	31%
Sophomore	129	23%
Junior	130	23%
Senior	129	23%

EME= Elementary Mathematics Education, ESE= Elementary Science Education, ECE= Elementary Childhood Education, CEIT= Computer Education and Instructional Technologies, FLE= Foreign Languages Education.

3.3 Instruments

Two instruments were utilized in this study. These were Schommers' Epistemology Questionnaire (SEQ) and Environmental Literacy Questionnaire (ELQ). Both questionnaires are composed of close ended questions that indicate self-reported responses of participants. In following two sections SEQ and ELT were examined in detailed.

Schommers' Epistemological Questionnaire (SEQ)

SEQ was developed to measure college students' epistemological beliefs by Schommer (1990). This questionnaire was the first measurement tool for determination of epistemological beliefs with quantitative method. The questionnaire includes 63 items. For each item students rated their degree of agreement on a scale ranges from strongly disagree to strongly

agree. Overall of items indicates simple or less developed epistemological beliefs. Due to the reversed scoring, a participant who got higher scores from questionnaire would be thought of as having less developed epistemological beliefs. There are 12 subsets in the questionnaire and 5 hypothesized epistemological dimensions that were derived from subset dimensions. The 12 subset dimensions and 5 hypothetical dimensions were presented in Table 3.2.

Table 3.2 Hypothetical dimensions and sub dimensions of SEQ.

Hypothetical Dimension	Subset Dimension	Number of items
Simple Knowledge	Seek single answers	11
	Avoid integration	8
Certain Knowledge	Avoid ambiguity	5
	Knowledge is certain	6
Omniscient Authority	Do not criticize authority	6
	Depend on authority	4
	Cannot learn how to learn	5
Innate Ability	Success is unrelated to hard work	4
	Ability to learn is innate	4
	Learning is quick	5
Quick Learning	Learn first time	3
	Concentrated effort is a waste of time	2

Table is adapted from Schommer (1990)

As presented in the Table 3.2, the items loaded in 12 subsets are unequally distributed. Moreover, subsets that loaded in 5 hypothetical epistemological belief dimensions are distributed unequally. Schommer (1990) focused on 5 hypothetical dimensions which derived directly from 12 subsets, indirectly from 63 items. SEQ was translated into Turkish language and validated by Topcu and Yilmaz-Tuzun (2007). In this study translation was conducted by two Turkish experts and translation into Turkish was compared by bilingual experts in field of epistemology in USA (Topcu & Yilmaz-Tuzun, 2007). SEQ was also piloted with 40 preservice science teachers and similar results were captured for factor analysis with Schommer's (Ozturk, Adibelli, Tuncer, Yilmaz-Tuzun, Cihangir, & Tuncay, 2008). Schommer carried out numerous validation studies (Schommer, 1990, 1992, 1993). She found four factors reflecting personal epistemological beliefs of individuals that are a) Simple Knowledge, b) Innate Ability, c) Quick Learning, and d) Certain Knowledge. Omniscient Authority factor have not been found in Schommer's studies yet. However, Yilmaz-Tuzun and Topcu (2007) have found this factor in their study with preservice science teachers in Turkey. Relaibility analysis conducted by Schommer (1993) reported inter-total item correlations ranges between .51 and .78. Yilmaz-Tuzun and Topcu (2008) found inter-total item reliabilities for items that compose each factor between .20 and .60. Reliability results of this study will be discussed in more detailed in result chapter under factor structure of SEQ.

3.4 Environmental Literacy Test (ELT)

The Environmental Literacy Test was second tool used for the purposes of this research. The questionnaire was designed to assess college students' environmental literacy in four dimensions, with each of these dimension is to be measured by a distinct set of questions knowledge

(11items), attitudes (7 items), uses [behavior] (19 items), and concerns (8 items) about the environment. The instrument was composed of close ended items which made it easy for statistical analysis. Knowledge component of questionnaire addresses respondents' knowledge about current environmental issues. The knowledge components were developed by National Environmental Educational and Training Foundation (NEEFT) and Roper. It has been used for assessment of Americans' environmental Literacy for ten years of period (Coyle, 2005).

The environmental attitude items targeted feelings and values related to environment while the environmental use [behavior] dimensions measured individuals' responsibility toward the environment and their intention to be a part of environmental behavior. Concern dimension items focused on participants' sensitivity toward environmental problems. In addition, 13 demographic questions were asked to determine respondents' self evaluation of their environmental background and personal information such as age, grade, gender, and parents' level of education.

The self-completed written instrument was originally developed in English and subsequently translated, adapted, and evaluated into Turkish. The Turkish version of the questionnaire was peer-reviewed by three experts in the field of science education and one expert in the field of environmental science (Tuncer et. al., 2009). Some revisions were made to the questionnaire based on this peer-review. The Turkish version of the questionnaire was pilot tested and validity has been previously confirmed by Tuncer et al. (2009). The internal consistency of the knowledge, attitudes, uses, and concerns dimensions were found to be 0.88, 0.64, 0.80, 0.88, using Cronbach alpha respectively (Tuncer et al., 2009). The internal consistency of the knowledge, attitudes, uses, and concern components in our study were found to be .42, .51, .81, .81. using Cronbach alpha respectively. The reason for low Cronbach Alpha values in knowledge may be caused due to small number of items.

According to the Palland (2007) it was possible to get low correlations (Cronbach' Alpha levels below .5) in factors consisting of 10 or less items.

For the environmental knowledge items, correct items were coded as 1 and incorrect items and "I do not know" item were coded as 0 for 11 items. For the other components that are Likert type scale, a point range from 1 to 5 were assigned, 1 to "strongly disagree", 2 to "disagree", 3 to "undecided", 4 to "agree", and 5 to "strongly agree".

3.5 Data collection

Data collection procedure was carried out during the spring 2008 semester. Data collection has started with getting required permission for conducting research involving human subjects from Ethical Committee of Middle East Technical University (See appendix A). Before administration of instruments, purpose of the study was explained to the subjects and consent forms were distributed. All participants participated in this research voluntarily. Two questionnaires of the research, these are SEQ and ELT, were administered to the subjects in classrooms environment. Each questionnaire was administered to the subjects by the same researcher to ensure the consistency of data collection procedure. Completing each survey took approximately 20 minutes. Totally, administration of both questionnaires was completed in a single class hour.

3.6 Data analysis

Collected data was analyzed by using SPSS 15.0 (Statistical Package for Social Sciences). For the consistency of the data each questionnaire pair (SEQ and ELQ) were compared by examining data of randomly selected subjects. Several analysis including descriptive analysis, MANOVA, correlational and multiple regressions analysis were conducted. Correlational and multiple regression analysis were used to investigate relationship between environmental literacy and epistemological beliefs of

PTs. MANOVA analysis were performed to investigate whether gender, grade level, and academic major effect environmental literacy of PTs. We will discuss these analyses in detail under the related topics in results section.

3.7 Assumptions and Limitations of Research

3.7.1 Assumptions

1. PTs participated in study responded to the items of two instrument sincerely.

2. SEQ and ELT were administered under standard conditions.

3.7.2 Limitations

1. Evaluation of epistemological beliefs and environmental literacy of PTs by the use of self-reported, close-ended measures might not represent the complete objectivity.

2. A qualitative study might be conducted to make clear statements with respect to the results of the quantitative analysis.

3. The study was limited to a single public research university, so results may not be generalize to a region or entire country.

4. Responses of participants to translated measures might not match literal meaning of original survey.

CHAPTER 4

RESULTS

This chapter presents the results of the study which were computed to provide solution to our research questions. The results were presented responding our research question in given sequence at introduction chapter.

4.1 Factor Structure of SEQ

This study was intended to investigate relationship between PTs' epistemological beliefs and their environmental literacy. Before investigating this hypothesized relationship, we first intended to understand which epistemological beliefs were hold by pre-service teachers of Faculty of Education. This investigation provided idea about reliability and explanatory information about epistemological beliefs. This study was also a validation of SEQ by multidimensional factor structure hypothesized by Schommer.

Research question 1: What are the epistemological beliefs hold by the students of Faculty of Education?

Principal factoring extraction analysis was used to define factor structure of SEQ and number of factors obtained from our sample. 12 subsets were computed with mean scores of relevant items. Mean scores of these 12 items were used as variables of factor analysis. Assumptions of analysis were checked before interpreting the results of factor analysis. The assumptions for principal component analysis were listed as; 1) sample size, 2) factorability of correlational matrix, 3) linearity and 4) outliers among cases. Each assumption was explained in detailed in following paragraphs.

1. Sample size. It was indicated that factor analysis are less reliable with small sample size (Pallant, 2007). It is suggested to have at least 300 cases for a factor analysis (Tabachnik & Fidel, 2001). On the other hand, it is recommended that 5 cases for each item were adequate in most cases (Tabachnik & Fidel, 2001). In all cases our sample size met the sample size assumption with a number of 560 subjects to 63 items in SEQ.

2. Factorability of correlational matrix. For a suitable factor analysis that could be considered suitable it was required to have at least some correlations of r= .3 and above (Tabachnik & Fidel, 2001). When correlational matrix results were examined it was revealed that our data set generated correlations r= .3 and above. Thus we conclude that we have factorable correlation matrix for SEQ.

3. Linearity. Factor analysis was based on correlations and it was assumed that the relationship between variables was linear. A spot check of some variables was recommended by Tabachnik and Fidel (2001). Linearity of our sample was met.

4. Outliers. Factor analysis defined as sensitive to outliers (Pallant, 2007). Before analyzing our data, outliers checked and removed from our data. This assumption was also met.

Next, principal factoring extraction analysis was conducted. KMO value was suggested to be .6 and above (Tabachnick and Fidel, 2001). Our analyses reported .825 which is appropriate for factor analysis. Barlett's Test of Sphericity value was significant supporting the factorability of the correlational matrix.

Principal factoring extraction with orthogonal varimax rotation revealed the presence of 5 factors with eigen values exceeding 1 (1 was set as cut-off point) explaining 21.90 per cent, 16.25 per cent, 9.83 per cent, 9.06 per cent and 9.03 percent of the variance respectively. Five generated factors account for 66.08% of the variance. Same procedures with Schommer's were

followed in naming generated factors. She used descriptive names for high loadings subsets of items. In naming factors, subset loadings exceeding .50 were considered. Factors were named as, 1) Innate Ability that involves "Can not learn how to learn" and "Success is unrelated to hard work" subsets, 2) Quick Learning that involves "Learn the first time" and "Learning is quick" subsets 3) Omniscient Authority that involves "Depend on authority" subset, 4) Certain Knowledge that involves "Avoid ambiguity" subset, and 5) Simple Knowledge that involves "Seek single answers" subset. Factor structure was displayed in Table 4.1.

Table 4.1 Factor Loadings of Principal Component Factor Analysis

	Factor loading				
Subset	1	2	3	4	5
1. Can not learn how to learn	**.741**	.233	-.164	-.148	-.049
2. Knowledge is certain	.725	-.236	.241	.255	.154
3. Do not criticize authority	.695	.250	-.241	.041	.123
4. Concentrated effort is waste of time	.583	.467	-.020	-.014	-.119
5. Avoid integration	.558	.324	.090	-.022	.027
6.Success is unrelated to hard work	**.520**	.359	.216	-.335	-.147
7. Learning is quick	.301	**.709**	.053	.097	.078
8. Learn the first time	.234	**.651**	-.305	-.005	-.111
9. Ability to learn is innate	.041	.613	.385	.145	.294
10. Depend on authority	-.019	.008	**.856**	.041	-.025
11. Avoid ambiguity	-.004	.144	.070	**.924**	.013
12. Seek single answers	.042	.048	-.012	.021	**.949**
Eigen values	3.55	1.44	1.04	1.01	0.88
% of variances	21.90	16.25	9.83	9.06	9.03

Inter-item correlations between items of concerning factors were found to be between .20 and .50. Those were lower than Schommers' average findings that range .51 to .78. This may be due to two reasons. Firstly, as seen from the factor loading some of the subsets did not load into hypothesized factors and they correlated with other factors. This may indicate that the some of the items were not differentiating items in Turkish context. Thus, some of the items overlapped. Secondly, number of selected subsets decreased the number of items correlated (in some cases number of items correlated was two items). According to the Pallant (2007) it was possible to get low correlations (Cronbah' Alpha levels below .5) in factors consisting of 10 or less items.

In sum, five factors on the SEQ for this group of subject are innate ability, quick learning, omniscient authority, certain knowledge and simple knowledge. These results revealed that pre-service teachers constituting our sample develop a set of more or less independent epistemological beliefs. This was indicated by PTs having five factors rather than one single belief structure.

4.2 Relationship between Epistemological Beliefs and Environmental Literacy of PTs.

Research question 2: What are the relationships between epistemological beliefs of PTs and their environmental literacy (attitude, concern, knowledge and behavior)?

At this part of result section, relationship between epistemological beliefs and environmental literacy of PTs were investigated. Two main analyses were conducted in investigation process. These are correlational analysis, which enabled us to determine whether there was a relationship between these two construct, and multiple regression analysis, that enables

in which way environmental behaviors of PTs related to combination of epistemological belief dimensions and environmental literacy components.

4.2.1 Correlation Analysis

Subquestion1. Are there any significant correlations among epistemological belief factors and environmental literacy components of PTs?

Correlational analysis were used to better understand whether there are relationships among epistemological belief factors which were innate ability, omniscient authority, quick learning, certain knowledge and simple knowledge and environmental literacy components which were knowledge, attitude, concern, and behavior.

Before interpretation of the results preliminary analysis were conducted to check the assumptions of correlational analysis. Normality, linearity and homoscedasticity were three assumptions to be checked. The bivariate plots for variables were examined for normality, linearity and homoscedasticity. According to results no assumptions were violated. Pearson product moment correlation coefficients were calculated. Alpha level was determined at .05 (two-tailed) as significance level of analysis. Listwise deletion was performed with subjects, N= 555. Results of the bivariate correlation revealed that components of environmental literacy were significantly correlated with epistemological belief dimensions. Results were as shown in Table 4.2.

Innate ability factor was negatively correlated with behavior component of environmental literacy at α= .05 with r= -.224, p= .000 values and with concern component of environmental literacy at α= .05 with r= -.119, p= .005 values.

Quick learning factor was negatively correlated with behavior component of environmental literacy at α= .05 with r= -.241, p= .000 values

and with attitude component of environmental literacy α= .05 with r= -.117, p= .006 values.

Behavior component of environmental literacy was positively correlated with attitude r= .359 and with concern r= .291 and knowledge r= .114.

Table 4.2 Intercorelations among Environmental Literacy Components and Epistemological Belief Dimensions.

	IN	QC	AUT	CRT	SPL	BHV	ATT	CON	KNW
IN	1.000	____							
QC	.533*	1.000	____						
AUT	-.017	-.059	1.000	____					
CRT	-.076	.079	.111*	1.000	____				
SPL	.003	.033	.047	.102	1.000	____			
BHV	-224*	-241*	-.004	-.096	-.076	1.000	____		
ATT	-.026	-117*	-.001	-.082	-.006	.359*	1.000	____	
CON	-119*	-.062	-.068	-.108	-.081	.291*	163*	1.000	
KNW	.022	-.063	.077	-.106	-.051	.114*	.091	.105	1.000

***** Correlation is significant at the 0.05 level (2-tailed) - Environmental Literacy (KNW: Knowledge. ATT: Attitude. BHV: Behavior. CON: Concern). Epistemological Belief Dimensions (SPL: Simple Knowledge. CRT: Certain Knowledge. AUT: Omniscient Authority. IN: Innate Ability. QCK: Quick Learning.)

4.2.2 Multiple Regression Analysis

Subquestion 2: To what extend can environmental behavior of PTs be predicted by each of the following environmental literacy components and epistemological belief dimensions: a) attitude, b) concern, c) knowledge, d) innate ability, e) omniscient authority, f) quick learning, g) simple knowledge, e) certain knowledge?

Stepwise multiple regression analysis was used to explain how accurately PTs' environmental behaviors can be predicted from a linear combination of environmental attitudes, concerns, knowledge and epistemological belief dimensions: innate ability, certain knowledge, simple knowledge, omniscient authority and quick learning. Before starting analysis, assumptions of multiple regression analysis were checked as follows;

1. Sample size. It was argued that with small sample size, obtained results were not be generalized (Pallant, 2007). Moreover, stepwise regression analysis was required to have a ratio of 40 cases for every independent variable (Tabachnik, & Fidell, 2007). When minimum sample sizes for eight independent variables were calculated, the number generated was approximately 320. We met this assumption with having 560 subjects. Sample size assumption was not violated.

2. Multicollinearity and singularity. Correlations among independent variables were checked. Results obtained from analysis revealed that correlation values among independent variables were between .001 and .49. Pallant (2007) suggested that those correlation coefficients below .9 were acceptable for MRA. Thus, multicollinearity assumption was not violated.

3. Normaility, linearity, homoscedasticity, independence of residuals. This assumption was checked by inspection of normality plots of the standardized residuals and scatter plots provided by MRA. A linear line and

plots indicated that normality, linearity, homoscedasticity, independence of residuals assumptions was not violated.

4. Outliers. Tabachnik and Fidell (2007) suggested that multiple regression analysis was very sensitive to outliers. To check the scatter-plots of outliers were examined and subjects showing outlier property were removed from data. This assumption was also met.

Results of the analysis indicated that, for environmental behavior mean scores, three of the predictor variables (attitude, innate ability, concern and quick learning factor scores) significantly contributed to the model. Altogether, they explained 24.2% (adjusted R^2 = .236, F (4, 547) = 43.667, p < .01) of the variability of behavior mean scores on those four independent variables. The β values for environmental behavior were .308 for environmental attitude, - .146 for innate ability, .209 for environmental concern scores, and - .130 for quick learning.

Positive β values for the predictor variables attitude and concern indicate that PTs who had higher environmental behavior mean scores has also had higher environmental attitude scores and higher environmental concern scores.

Negative β values for the predictor variables innate ability and quick learning indicate that PTs who had higher environmental behavior scores had lower innate ability scores (which means that PTs who intent to act in environmental behavior believe that environmental problems can be changed and our ability is not fixed at birth.) and had lower quick learning scores (which means that PTs who intent to act in environmental behavior also believe that they can learn how to solve environmental problems with time, since ability to learn is gradual.)

4.3 Effect of Demographic variables on Environmental Literacy of PTs.

At this part of result section MANOVA analyses were conducted to investigate effect of gender, grade level, and enrolled academic major on environmental literacy.

Research question 3: Are there any significant differences between males and females with respect to environmental literacy components; attitude, concern, knowledge and behavior of PTs?

Research question 4: Are there any significant differences among grade levels -freshman, sophomores, juniors, and seniors- with respect to environmental literacy components; attitude, concern, knowledge and behavior of PTs?

Research question 5: Are there any significant differences among ELE, EME, ECE, ESE, and CEIT groups with respect to environmental literacy components; attitude, concern, knowledge and behavior of PTs?

Firstly, one-way between groups analysis of variance was performed to investigate the effect of gender, grade level, and academic major on environmental literacy. Four dependent variables were used. These were attitude, concern, knowledge, and behavior. The independent variables were gender, grade level, and academic major. Preliminary assumption testing was performed to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices and multicollinearity.

Normality of dependent variables was checked. Skewness values range from -0.7 to -0.1 for attitude, concern, knowledge, and behavior variable. Kurtosis vales range from 0.0 to -0.1, for attitude, knowledge, concern, and behavior variables. According to the results, normality

assumption was not violated. Skewness and Kurtosis values displayed in table 4.3.

Table 4.3 Skiwness and Curtosis Values for Environmental Literacy Components.

DV	N	Mean	Skewness	Kurtosis
BHV	548	4.11	-.149	-.167
ATT	548	3.41	.097	.150
CON	547	3.86	-.798	.321
KNW	550	.55	-.239	.072

Outliers were defined and deleted by checking multivariate normality. For the linearity assumption, matrixes of scatter plots were generated for each pair of our dependent variables, separately for our independent variables. No evidence of non-linearity was observed. For multicollinearity and singularity assumption Pallant (2007) suggested that moderate correlations were needed for conducting MANOVA. Correlations among dependent variables attitude, concern, knowledge, and behavior were between 0.1 and 0.3. This assumption was not violated. Results of Levene's test of equality of variances were not significant for all dependent variables. This result referred that equality of variances assumption was met. Table 4.4 shows the results.

Table 4.4 Results of Levene's test of equality of variances

DV	*F*	*df 1*	*df2*	*Sig.*
Behaviour	1.04	37	504	.408
Attitude	1.07	37	504	.359
Concern	1.22	37	504	.172
Knowledge	.07	37	504	.841

Significant at .05 alpha levels.

Box's test was conducted to test homogeneity of variance-covariance matrices. Box's M test value was p= .154. In our analysis Box's test was not significant p >.001 and we used Wilks' Lambda value. The results of the preliminary analysis revealed that we met assumptions of for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices and multicollinearity.

Having met the assumptions, the MANOVA analysis was run to examine whether there were statistical mean differences for the independent variables; gender, grade level, and academic major with respect to dependent variables attitude, concern, knowledge, and behavior. MANOVA results were presented in the Table 4.5.

Table 4.5 MANOVA results with respect to dependent variables ATT, KNW, CON, and BHV

IV	*Wilks' Lambda*	*F*	*df*	*Signifcance*	*Eta squared*
Gender	.934	8.810	4	.000	.066
Grade level	.929	3.121	12	.000	.024
Academic Major	.932	2.232	16	.003	.017

Significant at .05 alpha level

The results given in the table above revealed that there was a significant difference between males and females, among grade levels and among enrolled academic majors with respect to dependent measures. Also significant results of multivariate test permitted us to investigate further in relation to each of dependent variables. Between-subjects effects were examined to better understand the difference in relation to each of our dependent variables.

In follow up analysis Bonferroni adjustment was used to reduce chance of Type I error as suggested by Tabacknick and Fidel (2007). In its simplest form, Bonferroni adjustment was division of alpha level to the number of dependent variables. In this case alpha level .05 divided to four which was number of our dependent variable. Thus, significance level was reduced to .0125 from .05. Results were displayed in table 4.6.

Table 4.6 Follow-Up Pairwise Comparisons

	Dependent Variable	*df*	F	Significance(*p)*
Gender	BHV	1	14.37	.000*
	ATT	1	4.79	.029
	CON	1	10.78	.001*
	KNW	1	9.41	.002*
Grade Level	BHV	3	2.60	.051
	ATT	3	1.04	.371
	CON	3	3.23	.022
	KNW	3	7.11	.000*
Academic major	BHV	4	3.82	.005*
	ATT	4	1.85	.117
	CON	4	1.26	.282
	KNW	4	2.87	.023

Significant at alpha level .01

Concerning gender, there was a statistically significant difference between males and females on behavior, concern, and knowledge mean scores. There was no statistically significant mean difference between males and females with respect to attitude scores.

When the results of the grade level considered separately, there was statistically difference among grade levels with respect to knowledge mean scores. No significant mean difference was found among grade levels with respect to attitude, concern, and behavior mean scores.

Lastly, statistically significant difference among departments was investigated with respect to behavior mean scores and no significant difference was found for attitude, concern and knowledge mean scores.

Post hoc analyses were performed for the gender, grade level and academic major variables to find how those independent variables affect environmental literacy components (attitude, concern, behavior, and knowledge). Each pairwise comparison was tested by using Bonfferoni adjustment at the .050 divided by 4 or .0125. According to the results of follow up analysis, females have significantly higher environmental behavior, and concern on environmental literacy than males. However, males have statistically significant environmental knowledge than females. Moreover, environmental knowledge scores of senior PTs were significantly higher than freshman and sophomore PTs. No significant differences were concluded for independent variables gender and grade level on dependent variables apart from results mentioned above. Results of post hoc analyses were displayed in table 4.7.

Table 4.7 Multiple Comparisons for BHV, ATT, CON, and KNW Components.

	BHV		ATT		CON		KNW	
IVs	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male	3.997	.032	3.331	.035	3.665	.067	.584	.013
Female	4.141	.020	3.435	.022	3.931	.043	.536	.009
Freshman	4.003	.039	3.349	.044	3.653	.084	.531	.017
Sophomore	4.039	.033	3.444	.037	3.755	.071	.529	.014
Junior	4.126	.038	3.388	.042	3.861	.080	.550	.016
Senior	4.120	.036	3.368	.040	3.952	.076	.622	.015

When academic major of PTs was taken into consideration, post hoc analysis reported statistically significant mean differences among academic majors. According to the results, PTs enrolled in FLE have significantly higher environmental behavior than PTs enrolled in EME. PTs enrolled in ECE department have significantly higher environmental behavior than those enrolled in EME department. Mean scores of departments with respect to dependent variables BHV, ATT, CON, and KNW were presented in Table 4.8.

Table 4.8 Multiple comparisons of BHV, ATT, CON, and KNW according to Academic Majors

Academic major	BHV		ATT		CON		KNW	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
ESE	4.117	.035	3.438	.038	3.863	.074	.576	.015
EME	3.961	.038	3.298	.042	3.875	.081	.512	.016
ECE	4.054	.058	3.415	.064	3.638	.123	.581	.024
CEIT	.4.068	.037	3.358	.041	3.859	.079	.571	.016
FLE	4.153	.041	3.427	.046	3.749	.088	.560	.017

To sum up, first, epistemological belief that were hold by PTs was explored. Five hypothesized epistemological belief factors were investigated for the sample of study. Secondly, relationship between PTs environmental literacy and epistemological beliefs were investigated. Correlational analysis revealed that epistemological belief dimensions were in relation with environmental literacy components. Multiple regression analysis revealed that innate ability and quick learning dimensions of epistemological beliefs were significantly predictors of behavior component of environmental literacy. Moreover, effect of demographics; gender, academic major, and grade level on both epistemological beliefs and environmental literacy were investigated. Results referred that gender; academic major and grade level have effect on environmental literacy.

CHAPTER 5

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

This chapter represents the discussions, conclusions drawn from results of the study and implications and recommendations for further studies.

5.1 Discussion

Discussion section of this chapter was divided into three main parts according to results of the three main analysis which were presented in result section. These were factor structure of epistemological beliefs hold by PTs, relationships among epistemological belief dimensions and environmental literacy components, and finally effect of demographics on environmental literacy components.

First, factor analysis indicated satisfactory results in defining epistemological belief structure of PTs in Turkish context. Factors found in this study indicate that PTs have more or less independent epistemological beliefs, in other words multidimensional epistemological beliefs. Unlike developmental approach, multidimensional epistemological belief approach indicates that PTs may hold more than one epistemological belief factor at the same time. This finding is consistent with multidimensional epistemological beliefs approach that Schommer (1990) proposed. Also, Yilmaz-Tuzun and Topcu (2008) stated that multidimensional epistemological belief theory was more appropriate for pre-service science teachers in Turkey. Our findings indicated similar results with previously conducted relevant studies. Although unidimensional theory expects to see one factor hold by PTs, we observed multiple epistemological belief factors

in our study. Thus, it might be considered that PTs' have more or less independent epistemological beliefs.

Moreover, we have found five factors that were omniscient authority, innate ability, simple knowledge, quick learning and certain knowledge for epistemological beliefs hold by PTs. Shortly, Schommer's hypothesized five factor structure was observed in our study. In literature, determination of types of epistemological beliefs varied depending on method and sample of studies. Results of the previous studies reported 3 to 4 epistemological belief factors. For example, although Schommer (1990) hyphothesized five factors, she reported 4 of them in her studies except "Omniscient Authority" factor. However, Yilmaz-Tuzun and Topcu (2008) reported that they determined omniscient authority factor in Turkey. They also argued that investigation of omniscient authority factor in Turkey may be caused by its' unique culture. Having four factors and one additional authority factor made our results consistent with previous studies of Schommer (1990), Schraw ,Dunkle, and Bendixen (1995), Yilmaz- Tuzun and Topcu (2008). Obtaining omniscient authority factor in Turkey may be due to their educational experiences, because PTs previous learning experiences effect their professional development in teacher education programs (Yilmaz- Tuzun & Topcu, 2008). Namely, PTs might have been exposed to expository teaching methods in their formal education before entering to university. At this type of education teacher or scientist was perceived as source of knowledge. Therefore, this type of method may have led students to comprehend distinction between depending on authority or reasoning about knowledge.

Second, correlational and multiple regression analysis were conducted to investigate whether there were relationships among epistemological belief dimensions and environmental literacy components. Correlational analysis revealed that behavior component of environmental literacy negatively correlated with innate ability and quick learning factors of epistemological

beliefs and positively correlated with attitude, concern and knowledge components of environmental literacy. We interpreted these findings as; PTs who intend to behave environmentalists also have sophisticated epistemological beliefs with respect to innate ability and quick learning dimensions of epistemological beliefs. Moreover, it was also concluded that environmental behaviors have positive relationship with environmental attitude, concern and knowledge. However, the relationship between behavior and knowledge was very low.

Multiple regression analysis conducted to investigate the direction and the magnitude of relationships in-detail. Result of the regression analysis revealed that attitude, concern, innate ability and quick learning were predictors of environmental behavior. Specifically, behavior scores of the PTs were found to have a significant relationship with innate ability, quick learning dimensions of epistemological beliefs and environmental attitude, concern components of environmental literacy. When we examined (positive) relationship among attitude, concern and behavior, it was concluded that the more PTs intend to behave environmentalists the more they have positive attitudes towards environment, and have concern regarding environmental problems. Related literature indicates consistent relationship among these components. For instance, Tuncer et al (2009) proposed that the more pre-service teachers have environmental attitudes and concern the more they have environmental uses [behavior]. Hines et al (1986/87) also indicated positive relationship between responsible environmental behavior and attitudes towards environment. A similar finding which refers to individuals having higher attitudes towards environment also displays higher environmental behavior was also reported by NEETF and Roper (2005). Hungerford and Volk (1990) also stated that if one concerns regarding environmental problems and has positive attitudes, it is expected to observe environmentalist behavior.

Considering the relationships among epistemological beliefs and environmental literacy, which is the main purpose of the study; multiple regression analysis revealed that PTs' environmental behaviors have significant relationships (negative) with innate ability and quick learning dimensions of epistemological beliefs. These relationships suggest that when PTs' intention to perform environmental behavior increases, their beliefs about learning ability is not fixed at birth (Innate ability) is also getting sophisticated. This finding suggests that if one beliefs that capacity of learning can be enhanced, his/her potential of dealing with environmental problems can also be improved. In other words, dealing with environmental problems requires continual development of one's skills, knowledge, and approaches to these problems. People can achieve this goal only if they believe that they can develop their abilities of learning in time. This finding also supports the "perceived skill in using action strategies" idea of Hungerford and Volk (1990). They argued that when a person believes in her skills to resolve environmental issues, they also display more environmental behaviors. In our study, PTs might think that their ability to learn can be improved and they have skill to learn how to solve environmental issues. Therefore, PTs who have sophisticated beliefs in innate ability also have behavioral intentions to solve environmental issues. Moreover, Schommer (1998) stated that "strong believers in malleable ability to learn will interpret a mistake as opportunity to learn. They will experience an increased intensity of interest in studying and problem solving" (p. 134). In our study , PTs having sophisticated beliefs in innate ability might interpret environmental challenges as opportunity to learn how to solve environmental issues and they might keep holding intentions to behave for the solution of environmental problems. According to the results 5.6 % percent of the variance in environmental behavior was achieved this goal and it is

important to cause more people to gain sophisticated beliefs about learning ability.

Moreover, quick learning finding indicates that pre-service teachers intend to act as environmentalist if they believe they can learn how to solve environmental problems, in other words learning ability is gradual (Quick learning) rather than being quick. This relationship suggests that when PTs' intention to perform environmental behavior increases, their beliefs about their learning ability is not quick (Quick learning) is also getting sophisticated. This finding suggests that if one believes that his/her learning of dealing with environmental problems does not happen instantly and it requires time, he/she can learn dealing with environmental problems in a gradual time span. In other words, dealing with environmental problems requires time to overcome and they are achievable. Consistent with our findings, Schommer (1998) stated in her study that "speed of learning is likely to influence adults anticipated time investment in studying and problem solving" (p. 134). Her statement mentions that a strong believer of gradual learning will anticipate series of sessions to solve a problem. However, she mentions that strong believers in quick learning will spend limited time to solve a problem. In our study, believing gradual learning might lead PTs to invest time for the solution of environmental problems. PTs might think that environmental problems are achievable and it is needed to invest time for the solution of problems. For this reason PTs might have higher intentions to behave environmentalist if they believe in gradual learning for the solution of environmental problems.

Moreover, studies indicating effect of epistemological beliefs on ill structured everyday life issues, such as environmental problems, state conclusions that are consistent with our findings. For example, Schommer (2002) mentioned that people who believe knowledge is tentative, in other words changing, they more likely willingness to modify their ideas about ill

structured everyday life problems which do not have one single definite solution. As observed in results of our study, PTs who believe that learning is not an instant process and required time for learning may change, intend to show responsible environmental behavior towards environmental problems.

When multiple regression analysis summerized, results indicated that attitude, concern, innate ability and quick learning altogether explained the 24.6 % of the variance in environmental behavior. Totally, epistemological beliefs constituted approximately 1/3 of total variance explained in model. It can be concluded that epistemological beliefs have undeniable effect on environmental behavior and it was observed that one who has higher environmental behavior intentions also has more sophisticated epistemological beliefs in innate ability and quick learning dimensions.

Interestingly knowledge component of environmental literacy did not significantly contribute to the model, although it was found to have low correlation. This means that knowledge is someway related but it is not one of the predictors of environmental behaviors of PTs. Similar findings were also reported by the previous studies. Hungerford and Volk (1991) indicated that although knowledge correlated with behavior, it is not determinative factor of environmental behavior. As mentioned in literature review part, different types of knowledge originating from different formal and informal sources might not be interpreted or reasoned to display responsible environmental behavior.

Moreover, considering knowledge results we can conclude that although environmental knowledge correlates with behavior and varies depending on gender and grade level, it is not contributed to the model as a predictor variable of behavior. Increasing knowledge does not lead into increase in attitude, concern and behavior. By this way, epistemological belief results support our argument which hypothesizes effect of epistemological beliefs on environmental literacy defining how individuals

perceives environmental knowledge and makes reasoning about it. In this research, PTs environmental knowledge observed to be not productive in their environmental literacy. PTs might not have required epistemological beliefs and interpretation skills to evaluate and reason environmental knowledge provided in school environment. They might not possess enough environmental knowledge to display environmental behavior. Moreover, it should be investigated by further studies that what level of environmental knowledge is required to display environmental behavior and what type of knowledge best leads into environmental behavior.

Finally MANOVA results which investigate effect of demographic variables on environmental literacy of PTs were evaluated at this part of discussion chapter. MANOVA analysis explored female favoring results concerning environmental a) behavior, and b) concern. As it is expected, females have more intention to act environmentalist than males. Females also have more concern towards environmental problems than males. However, males reported significantly better knowledge than females according to results of MANOVA.

Female favoring results were also obtained by previous studies (Alp, 2005; Hsu, 1997; Hunter, Hatch & Johnson 2004; Tuncer, Ertepinar, Tekkaya, Sungur 2005; Yilmaz, Boone, & Anderson 2004; Zalenzy, Chua, and Aldrich, 2000). Female favoring results may be due to the sex roles of individuals in their daily life. Tikka et al (2000) stated that females have more environmental attitude and responsibility towards environment that they lived in. Since females have traditionally responsibility for looking after their children and home, environmentalist behavior may be perceived as taking benefit from environment and caring their offspring. In our study, female PTs' traditional sex roles might lead their higher environmental behavior and concerns. Homecare responsibility of females in Turkey might be considered

as a factor affecting female favoring results in environmental behavior and concern of PTs.

Studies also stated that although females display more environmental attitude and concern, males have greater environmental knowledge than females. Consistently, knowledge difference in gender was defined as a "gap" in NEETF and Roper (2005) report. Our findings consistently support this idea. According to NEETF and Roper (2005), although males and females have the same level of education, males reported higher level of environmental knowledge. Moreover, this study also mentioned that knowledge gender gap is true for all age groups and begin to form early. It was stated that, in educational perspective, higher knowledge levels of males may be due to their knowledge and involvement in science and technology. In our study, male PTs' interest in technology and science might lead their higher level of environmental knowledge than females. In Turkey which is developing country, involvement of females in science and technology is not same as males do. Position of males in society may influence their environmental knowledge acquisition throughout their formal and informal education. These reasons might cause lower environmental knowledge results of females.

As a result, gender was observed as a significant predictor of environmental literacy. Studies carried out in this issue will provide valuable knowledge to the field to better interpret the differences between females and males. Results indicated the need for environmental literacy for all society by being aware of gender difference.

One other demographic variable investigated in this study was the effect of grade level on environmental literacy of PTs. Significant differences was found among grade levels corresponding to environmental knowledge. It was observed that environmental knowledge increases when the participants' grade levels increases. Senior PTs' knowledge scores were

found to be significantly higher than freshman and sophomore PTs. Similar findings were also reported by earlier studies. Alp, Ertepinar, Tekkaya, Yilmaz (2006) reported grade level has significant effect on environmental knowledge of individuals. According to this study, students in higher grade levels have high environmental knowledge scores when compared with those students in lower grade levels. Negev et al. (2008) also reported knowledge differences favoring higher graders. Alp et al (2006) related higher scores of higher graders with their experiences with nature that makes understanding of basic environmental issues easier. PTs experiences with nature and their higher education might provide them environmental knowledge. Moreover, elective courses related with environmental issues might lead increase in their environmental knowledge. It is expected to get higher knowledge in higher grade levels of PTs education.

Finally, MANOVA analysis revealed that PTs enrolled in FLE and ECE departments have significantly higher environmental behaviors when compared with EME students. When mean scores were examined for each department, it was observed that EME and CEIT groups responded minimum scores for environmental behavior. Ozden (2008) indicated consistent results with our findings. Author stated that PTs enrolled in mathematics department reported less environmental behavior than other group which was elementary education. Goldman et al. (2006) also mentioned similar results for their study in Israel. They stated that environment affiliated academic majors have higher behavior scores than non-environment affiliated ones such as mathematics education department. Tikka et al (2006) also founded that biology and forestry majors' student reported higher level of environmental activity when compared technical majors such as engineering and economics. However, compared academic majors in these two studies were not identical, instead authors made generalizations about majors as environment affiliated, science background

or pure science departments. In our study, FLE and ECE students' high environmentalist behaviors might be caused by their interest in daily life issues than mathematics department. Since, subject and education of EME is more technical and domain specific when compared with other departments included in our study, they might not be as close as to environmental issues like other departments. High number of female students in FLE and ECE departments might also lead higher behavior scores.

5.2 Conclusion and Recommendations

In this study, firstly PTs epistemological beliefs were determined and relationships among epistemological beliefs and environmental literacy components were explored. Secondly, effects of gender, grade level and academic major on environmental literacy components were investigated.

Results of the study suggest that epistemological beliefs of PTs develop as more or less independent beliefs. This means that PTs possess different epistemological dimensions rather than single level unidimensional development which was proposed in developmental theories. Having idea about epistemological beliefs hold by PTs is important, because it was indicated that epistemological beliefs strongly influence individuals' interpretation and integration of knowledge (Schommer, 1990). Moreover, Schommer (2001) also pointed out that if teachers know weak and strong points of students' epistemological beliefs, they can identify cognition and affect of students. By this way, epistemological beliefs also influence learning and teaching styles of PTs who are going to be teachers of future. But to handle this, first teachers should develop their epistemological beliefs. The teachers may provide teaching strategies that help students acquire well structured personal epistemologies. Therefore, teacher training programs may play critical role in developing PTs epistemological beliefs.

Furthermore, results of the study suggest that there is a relationship between epistemological beliefs and environmental literacy of PTs. This relationship is that; the more PTs believe that their learning abilities can be improved and then they perform environmentalist behaviors. As seen from this study being aware of our ability to learn affects our application on environmental issues. It is obvious that epistemological beliefs have effect on environmental literacy of PTs as well as their teaching and learning. Therefore, personal epistemologies of PTs should be taken into consideration in teacher training programs for both improvement of their teaching and environmental literacy which they transfer their students.

Interestingly knowledge was not found as a predictor of behavior. In light of this finding we can question the importance of environmental knowledge in having environmentalist people. If knowledge is an important aspect of environmentalist behavior then the educational effort in all around the world would have resulted in having many environmentalists. However, today we have many people with good environmental knowledge but not good at in protecting environment. Even though, not all the politicians are environmentalist in this respect. So not the knowledge but how we are looking or interpret this knowledge or nature of it is important, which is called as epistemological beliefs in this study. As seen from the study knowledge based method may not be effective in improving environmental attitudes and behaviors. As well as knowledge acquisition, way of knowing and reasoning skills should me mentioned and implemented in curriculum. This requirement was also stated by UNEP (1994). UNEP recommended epistemology and nature of knowledge courses for teacher training programs on environmental education.

Effects of demographics on environmental literacy of the preservice teachers were explored as a secondary objective of this study. Findings of the study indicate that gender, grade level, and academic major have significant

effect on components of environmental literacy. As a demographic variable, gender draws attention by affecting more than one component of environmental literacy. Gender appeared to influence behavior, concern and knowledge of PTs. Thus, being aware of gender effect on environmental literacy of PTs may help us to develop suitable curriculum for all gender groups. Because as stated in Tbilisi declaration (UNESCO, 1978), environmental citizenship should be provided for all ages and all groups in society without considering their differences. Besides gender, it was observed that environmental knowledge increases with grade level. Despite this increase in knowledge, no significant increase in environmental behavior was observed. This indicates that we need to focus on how PTs interpret and reason environmental knowledge. Further studies should be conducted to better understand effect of personal epistemologies on environmental behavior of individuals.

Furthermore, differences among departments need to be paid attention. All kind of teachers without departmental difference are responsible in solution of environmental problems. Existing environmental problems endeavors go beyond accepting environmental issues as a domain specific subject matter. Environmental literacy should be brought to all members of the society without major selection, gender and grade level. Every member of society is responsible for being aware of environmental behaviors. Thus, PTs have additional importance in developing environmental attitude, concern, and positive behavior of their students through their formal education.

As a developing country Turkey needs more attention on environmental education. Every year millions of students graduate from schools while millions of them just enter to school. In such a society, teachers have amplifying effect maintaining environmental literacy skills. This role of teacher is the key element of accomplishing in creating national and global

environmental literacy in public. Moreover, in Turkey university students give more importance to technological development than environmental problems (Berberoglu & Tosunoglu, 1995). This priority given to the development of technology should not pass in front of protection of environment. This failure was observed in many of developed countries in which environmental problems could not be changed back into former conditions. Mayur (1979) stated that some amount of pollution can be seen as prize of development of a country, but it can not be allowed to damage environment on which man has to depend. OECD simulation report (2008) indicated that if developing countries, like Turkey, do not attach importance to environmental problems against development of country, we will face irreversible damage in environment in twenty years. Being aware of these conditions, PTs should believe that environmental challenges are achievable and affordable. By this respect, effect of epistemological beliefs on behavioral intentions of PTs should be taken into consideration. Since their ideas and way of knowing possibly effect characteristics and reasoning of their students, this study may provide inferences to build an environmentally literate country and a global literacy. What was assumed at the beginning of the study was supported with findings. For now we know that developing epistemological beliefs may play critical role to have sophisticated environmental literacy.

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APPENDIX A

Permission of Ethical Committee

İlköğretim Fen ve Matematik Eğitimi
22.12.2008
SBE/2008 - 117

1956

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17.12.2008

SOSYAL BİLİMLER ENSTİTÜSÜ MÜDÜRLÜĞÜ'NE

İLGİ: 4.12.2008 tarih ve B.30.2.ODT.0.41.72.00/2008/400-1796-12751 sayılı yazınız.

İlgi yazınız ile İlköğretim Fen ve Matematik Eğitimi Anabilim Dalı Yüksek Lisans Programı öğrencilerinden Gökhan ÖZTÜRK'ün, 4.12.2008-1.1.2009 tarihleri arasında yüksek lisans tezi kapsamında "Öğretmen Adaylarının Çevreye Karşı Tutum, Davranış ve Epistemolojik İnançları Arasındaki İlişkilerin Belirlenmesi" başlıklı tez çalışmasına ilişkin olarak Üniversitemiz Eğitim Fakültesi'nde okuyan yaklaşık 800 öğrenciye uygulama yapma isteği Rektörlük Makamınca uygun görülmüştür.

Gereğini bilgilerinize arz ederim.

Saygılarımla.

Nesrin ÜNSAL
Öğrenci İşleri
Dairesi Başkanı

APPENDIX B

Environmental Literacy Questionnaire

Knowledge

1. Çok çeşitli bitki ve hayvan türleri çok farklı ortamlarda yaşamaktadır. Bu düşünceyi tanımlamak için kullanılan sözcük hangisidir?
    a. Çokluk
    b. Biyolojik çeşitlilik
    c. Sosyo-ekonomi
    d. Evrim
    e. Bilmiyorum

2. Karbon monoksit hava kirliliği yaratan önemli bir kirleticidir. Aşağıdakilerden hangisi en önemli karbon monoksit kaynağıdır?
    a. Fabrikalar ve işyerleri
    b. İnsanların nefes alması
    c. Motorlu araçlar
    d. Ağaçlar
    e. Bilmiyorum

3. Türkiye'de elektrik üretimi büyük ölçüde nasıl gerçekleşmektedir?
    a. Petrol, kömür ve odun yakılarak
    b. Nükleer santraller ile
    c. Güneş enerjisi ile
    d. Hidroelektrik santrallerle
    e. Bilmiyorum

4. Akarsu, deniz, okyanus kirliliğinin en temel nedeni nedir?
    a. Şehir çöplerinin boşaltılması,
    b. Bahçe ve caddelerden akan sular
    c. Kumsal ve plajlardan atılan çöpler
    d. Endüstriyel atıkların boşaltılması
    e. Bilmiyorum

5. Aşağıdakilerden hangisi yenilenebilir bir kaynaktır?
    a. Petrol
    b. Demir madeni
    c. Ağaçlar
    d. Kömür
    e. Bilmiyorum

6. Ozon, atmosferin üst katmanlarında koruyucu bir tabaka oluşturur. Ozon bizi aşağıdakilerden hangisinden korur?
    a. Asit yağmurlarından
    b. Küresel ısınmadan
    c. Sıcaklıktaki ani değişmelerden
    d. Zararlı, kansere neden olan güneş ışığından
    e. Bilmiyorum
7. Türkiye'de çöplerin büyük bir kısmı nasıl bertaraf edilir?
    a. Denizlere atılarak
    b. Yakma tesislerinde yakılarak
    c. Geri dönüşüm merkezlerine gönderilerek
    d. Çöp depolama alanlarında depolanarak
    e. Bilmiyorum
8. Türkiye'de çevreyi korumaya yönelik kararlar alan resmi kurumun adı nedir?
    a. Çevre ve orman bakanlığı
    b. TEMA
    c. Tabiatı koruma vakfı
    d. Bilmiyorum
9. Aşağıdaki evsel atıklardan hangisi zararlı atık olarak adlandırılabilir?
    a. Plastik ambalajlar
    b. Cam
    c. Piller
    d. Yemek artıkları
    e. Bilmiyorum
10. Hayvan türlerinin nesillerinin tükenmesinin an yaygın sebebi nedir?
    a. Pestisitler hayvanların ölmesine yol açar
    b. Yaşam alanları insanlar tarafından yok edilmektedir
    c. Avcılık çok artmıştır
    d. İklim değişiklikleri hayvanları etkilemektedir
    e. Bilmiyorum
11. Bilim adamları nükleer atıkların depolanması ile ilgili çalışmalarında henüz sonuca ulaşamamışlardır. Şu anda dünyada üretilen nükleer atık depolama yöntemi nedir?
    a. Nükleer yakıt olarak kullanılmaktadır
    b. Başka ülkelere satılmaktadır
    c. Çöp depolama alanlarında depo edilmektedir
    d. Depolanmakta ve kontrol altında tutulmaktadır
    e. Bilmiyorum

Attitude

12. Aşağıdaki tümceler insan ve çevre ilişkisini yansıtmaktadır. Lütfen düşüncelerinizi, her tümce için seçeneklerden birini işaretleyerek belirtiniz.

		Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
A	Dünyanın insan yaşamını destekleme kapasitesini doldurmak üzereyiz.					
B	İnsanların doğaya müdahale etmesi genellikle felaketle sonuçlanır.					
C	Dünyada herkese yetecek miktarda doğal kaynak vardır, sorun bu kaynaklardan nasıl yararlanacağımızı öğrenmektir.					
D	Bitki ve hayvanlar da insanlar kadar var olma hakkına sahiptir.					
E	Doğadaki denge modern endüstriyel toplumların etkileri ile rekabet edebilecek güçtedir.					
F	Özel yeteneklerimize rağmen biz insanla hala doğa yasaları ile mücadele ediyoruz.					
G	'ekolojik kriz' olarak adlandırılan olaylar fazlasıyla abartılmıştır.					
H	İnsanlar doğanın geri kalan bölümüne hükmetmektedirler.					
I	İnsanlar önünde sonunda doğayı kontrol edebilmek için yeterli bilgi edineceklerdir.					
J	Eğer her şey bugünkü gibi devam ederse, yakında büyük bir ekolojik facia ile karşılaşacağız.					

Behaviour

13. Lütfen aşağıda verilen her tümce için seçeneklerden birini işaretleyiniz

		Kesinlikle katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
A	Soyu tükenmekte olan türler için özel alanlar ayrılmalıdır					
B	Su kalitesi ile ilgili yasalar daha yaptırımcı olmalıdır					
C	İnsanların et ihtiyaçlarının karşılandığı hayvanlar korunması gereken en önemli türlerdir					
D	Zehirli yılanlar ve böcekler insanlar için tehdit oluşturdukları için öldürülmelidirler					
E	Sulak alanların tarımsal ve endüstriyel kullanımlara açılması gerekmektedir.					
F	Herkesin çevre sorunlarının farkında olması çok önemlidir.					
G	Şahıslar sahip oldukları alanları istedikleri şekilde kullanmakta serbest olmalıdır					
H	Çevre sorunlarının çözümlenmesinde kişisel sorumluluklarım olduğunu düşünüyorum					
I	Hükümet, bitki ve hayvanların korunması amacı ile özel mülkiyet alanlarının kullanımını denetlemelidir					
J	İnsanlar çevreye verdikleri herhangi bir zarardan sorumlu tutulmalıdır					
K	Bütün bitki ve hayvanlar çevrede önemli bir role sahiptir					
L	Teknolojik değişimlerin çevre için yararları olduğu kadar zararları da vardır					
M	Hükümet geri dönüşümün zorunlu olması yönünde yasalar hazırlamalı ve uygulamalıdır					
N	Hava kirliliği ile ilgili yasalar yeteri kadar serttir					

O	Çevre problemlerinin çözümünde bilim ve teknoloji çok önemlidir					
P	Çevre problemlerinin çözümünde kültürel farklılıklar çok önemlidir					
R	İnsanların değer yargılarının değişmesi çevre problemlerinin çözümlenmesinde önemli rol oynayacaktır					
S	Toplumsal aktiviteler çevre problemlerinin çözümünde önemli bir yer tutar					
T	Yaşam alışkanlıklarındaki değişimler (tüketim gibi) çevre problemlerinin çözümlenmesinde önemli rol oynayacaktır.					

Concern

14. Aşağıda verilen çevre problemleri ile genel olarak ne kadar ilgilisiniz lütfen her madde için seçeneklerden birini işaretleyiniz.

		Çok ilgili	Biraz ilgili	Çok az ilgili	İlgisiz	Kararsızım
A	Hava kirliliği					
B	Ses kirliliği					
C	Su kirliliği					
D	Endüstriyel atıklar					
E	Evsel katı atıklar					
F	Kalitesiz içme suyu					
G	Kapalı alanlarda oluşan hava kirliliği					
H	Ozon tabakasının incelmesi					
I	Küresel ısınma					

15. Cinsiyetiniz nedir?

16. Hangi yılda doğdunuz?

17. şu anda kaçıncı sınıftasınız?

18. Aşağıdaki aktiviteleri bir yıl içinde hangi sıklıkta yaparsınız?
    a. Kamp
    b. Açık havada yürüyüş
    c. Kuş gözleme
    d. Balık tutma
    e. Avcılık
19. Şimdiye dek yaşadığınız bölge aşağıdakilerden hangisi ile tanımlanabilir?
    a. Kırsal alan, çiftlik

b. Küçük kasaba (nüfusu 25.000 ile 100.000 kişi arasında)
c. Büyük şehir (nüfusu 100.000 kişiden fazla)

20. Anne ve babanızın çevre problemlerine ilgisi konusunda ne düşünüyorsunuz?
    a. Çok
    b. Yeteri kadar
    c. Az
    d. Hiç
    e. Kararsızım
21. Anne ve babanız çevre korumacı davranışlar konusunda ne kadar aktiftir?
    a. Çok aktif
    b. Biraz aktif
    c. Aktif değil
    d. Kararsızım
22. Anne ve babanızın eğitim seviyesi hangi düzeydedir?

APPENDIX C

Turkish Translation of Schommers' Epistemological Questionnaire

		kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1	Eğer bir şeyi anlayabileceksen, onu ilk duyduğunda sana anlamlı gelecektir.					
2	Kesin olan tel şey, hiç bir şeyin kesin **olmadığıdır.**					
3	Okulda başarılı olmak için yapacağın en iyi şey çok soru **sormamaktır.**					
4	Nasıl çalışman gerektiğini anlatan bir ders faydalı olacaktır.					
5	Bir kişinin okuldaki eğitiminden kazanacakları, öğretmenin kalitesine çok bağlıdır.					
6	Okuduğun herşeye inanabilirsin.					
7	Öğretmenlerimin gerçekten ne kadar bildiğini çok sık merak ederim.					
8	Öğrenme yeteneği doğuştan gelen bir kabiliyettir.					
9	Neye inandığı konusunda karar verememiş öğretmeni dinlemek rahatsız edicidir.					
10	Başarılı öğrenciler herşeyi çok çabuk anlarlar.					
11	İyi bir öğretmenin işi, öğrencilerini merak ettiği konulardan uzaklaştırmaktır.					
12	Eğer bilim adamları yeterince sıkı çalışırsa, hemen hemen herşeyin doğrusunu bulabilirler.					
13	Bilim otoritelerini sorgulayan insanlar, kendilerine olması gerektiğinden fazla güvenenlerdir.					
14	Farklı konu başlıklarından, hatta farklı derslerden öğrendiğim bilgileri birleştirmek için elimden geleni yaparım.					
15	En başarılı insanlar öğrenme yeteneklerinin nasıl geliştiğini keşfeden insanlardır.					
16	Profesörlerin size anlattıkları şeyler aslında gerçeklerinden daha basittir.					
17	Bilimsel çalışmaların en önemli özelliği çok hassas ölçümler ve dikkatli çalışmalardan oluşmasıdır.					
18	Benim için çalışmak; okuduğum şeyden, detaylı bilgiler yerine genel bir fikir elde etmektir.					
19	Öğretmenler yeri geldiğinde en iyi öğretim metodunun ne olduğuna karar verebilmelidirler.					
20	Zor bir kitabın bölümlerinin tekrar tekrar okumak, o bölümleri anlamana **yardım etmez.**					
21	Bilim adamları en sonunda doğruları bulurlar.					
22	Yazarın amacını bilmeden, onun kitabının vermek istediği fikri asla **bilemezsin.**					
23	Bilimsel çalışmanın en önemli kısmı, orijinal düşüncesidir.					

24	Bir kitabın bölümünü ikinci kez okumaya zaman ayırabilirsem, bu ikinci okumadan çok şey öğrenirim.
25	Öğrencinin bir kitaptan sahip olacağı bilginin miktarı daha çok kendi kontrolündedir.
26	Dahi olmanın %10'u yetenek, %90'ı çalışmaktır.
27	Bilimsel otoritelerin anlaşamadıkları konular hakkında düşünmeyi ilginç bulurum.
28	Herkesin nasıl öğrenebileceğini öğrenmeye ihtiyacı vardır.
29	Kitapta zor bir kavram ile karşılaştığın zaman yapacağın en iyi şey kendi kendine anlamaya çalışmaktır.
30	Bir cümlenin hangi durum için söylendiğini bilmiyorsan anlaşılması zordur.
31	Genellikle iyi bir öğrenci olmak, bilgileri ezberlemeyi gerektirir.
32	Akıllı cevapları bilmek değil, cevapların nasıl bulunduğunu bilmektir.
33	Kelimelerin çoğu tek bir anlama sahiptir.
34	Gerçek hiçbir zaman **değişmez**.
35	Bir insan okuduğu şeyin ayrıntılarını unutsa bile, eğer o konu hakkında yeni fikirler üretebiliyorsa o kişinin oldukça akıllı olduğunu düşünürüm.
36	Hayatımda zor bir problemle karşılaştığımda aileme danışırım.
37	Tanımları kelime kelime öğrenmek, sınavda başarılı olmak için her zaman gereklidir.
38	Çalışırken belirli (spesifik) gerçekleri ararım.
39	Eğer bir insan bir şeyi kısa bir zaman içerisinde anlayamazsa, onu anlamak için çalışmaya devam etmelidir.
40	Bazen bir öğretmenin verdiği cevapları anlamasan da kabul etmelisin.
41	Eğer üniversitedeki profesörler bilimsel teorilerden çok, bilimsel gerçeklere dayanarak eğitim verirlerse, öğrenciler üniversitelerden daha çok şey öğrenirler.
42	Sonu belli olmayan filmleri **sevmem.**
43	Bir konuda ilerlemek, gelişmek çok çaba gerektirir.
44	Kesin cevabı belli olmayan problemler üzerinde çalışmak tam bir zaman kaybıdır.
45	Eğer bir konuyu iyi biliyorsan, o konu hakkında yazılmış bir kitaptaki bilginin doğruluğunu değerlendirmelisin.
46	Uzmanların tavsiyeleri bile, sık sık sorgulanmalıdır.
47	Bazı insanlar doğuştan öğrenme kapasiteleri yeterli doğarlar, diğerleri ise sınırlı öğrenme kabiliyetine mahkûmdur.
48	Hiçbir şey kesin değildir, ölüm dışında.
49	Gerçekten zeki öğrencilerin okulda başarılı olmaları için çok sıkı çalışmalarına **gerek yoktur.**
50	Zor bir problem üzerinde uzun zaman çok sıkı çalışmak, sadece gerçekten zeki öğrenciler için iyi bir sonuç verir.
51	Eğer bir insan bir problemi anlamak için çok çalışırsa, kafası karışmış bir şekilde bu işi bırakacaktır.
52	Bir kitaptan öğrenebileceğiniz bilginin hemen hemen hepsini ilk okumada edinirsiniz.
53	Genellikle çok zor kavramları; dışarıdan gelebilecek dikkat dağıtıcı

	şeyleri azalttığında ve iyice konsantre olduğunda öğrenebilirsin.
54	Bir kitabı anlayabilmenin en iyi yolu kitabın içindeki bilgileri kendi anlayacağın şekilde tekrar organize etmendir.
55	Okulda ortalama bir başarıya sahip olan öğrenci hayatının diğer kısımlarında da ortalama bir başarıya sahiptir.
56	Bilgileri düzenli olan bir insan, kafası boş bir insandır.
57	Bir alanda uzman olan kişi, o alanda doğuştan kazanılmış özel bir yeteneğe sahiptir.
58	Ders planlarına sıkı sıkıya bağlı olan ve özenle ders notlarını organize eden öğretmenleri gerçeken takdir ediyorum.
59	Fen dersindeki en iyi şey, bu dersteki çoğu problemlerin sadece tek bir doğru cevabının olmasıdır.
60	Öğrenmek, bilginin yavaşça üst üste inşa edildiği bir işlemdir.
61	Bugünkü bilimsel gerçekler, gelecekte hayal ürünü veya hikaye olabilir.
62	Kendi kendinize öğrenmenizi sağlayan kitaplar çok fazla **yardımcı olmaz.**
63	Bir konu hakkında bir kitaptan öğrendiğiniz bilgileri, o konu hakkında sahip olduğunuz bilgilerle birleştireceğiniz zaman kafanız karışacaktır.