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ROLE OF EXTRA-CURRICULAR ACTIVITIES ON STUDENTS' KNOWLEDGE, SKILLS, AND ATTITUDES TOWARD CLIMATE CHANGE, CLIMATE CHANGE ADAPTATION AND MITIGATION

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ABSTRACT

ROLE OF EXTRA-CURRICULAR ACTIVITIES ON STUDENTS' KNOWLEDGE, SKILLS, AND ATTITUDES TOWARD CLIMATE CHANGE, CLIMATE CHANGE ADAPTATION AND MITIGATION

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The purpose of the present study was to investigate the role of extra-curricular activities on developing students' knowledge, attitude, and skills with regard to climate change, climate change adaptation and mitigation through a case study.

This case study was conducted two school semesters; the first in the Spring academic year 2011-2012, the second in the Fall academic year 2012-2013. 18 Green Team Student Club members and two biology teachers from a private high school in Çankaya district in Ankara constituted the participants of the present study. Data were collected through both quantitative and qualitative data collection instruments with an emphasis on qualitative data for in-depth analysis; CLIMES Student Questionnaire, semi-structured pre/reflective/final interview forms and semi-structured observation form. Descriptive analysis of quantitative data were given by

means of frequencies and percentages; while, qualitative data was analyzed using content analysis method.

The findings revealed that the students lacked knowledge about climate change mitigation and adaptation, and also had misconceptions at the beginning of the case. Besides, although they were aware of climate change and willing to take actions, their pre-actions were limited to switching off lights, or turning off electronic devices when not in use. Through engaging in the extra-curricular activities, the Green Team Student Club members developed knowledge, attitudes, and skills with regard to climate change, climate change adaptation and mitigation. They learned new concepts and eliminated most of their misconceptions. Moreover, they became more willing to take action and also make other school stakeholders actively participate in climate change adaptation and mitigation processes. Finally, the results revealed that extra-curricular activities helped the students develop lifelong learning skills such as problem solving, research, and communication skills that they would need for climate change adaptation and mitigation.

Keywords: Extra-curricular activities, climate change, climate change adaptation, climate change mitigation, environmental education, climate change education

ÖZ

PROGRAM DIŞI ETKİNLİKLERİN ÖĞRENCİLERİN İKLİM DEĞİŞİKLİĞİ, İKLİM DEĞİŞİKLİĞİNE UYUM VE İKLİM DEĞİŞİKLİĞİNİ AZALTMA KONULARINDA BİLGİ, VE BECERİ VE TUTUMUMLARINDAKİ ROLÜ

Yıldırım, Özlem Fatma

Yüksek Lisans, Eğitim Bilimleri Bölümü
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Bu çalışmanın amacı, iklim değişikliği, iklim değişikliğine uyum ve iklim değişikliğini azaltma ile ilgili program dışı etkinliklerin öğrencilerin bilgi, beceri ve tututmlarını artırmadaki rolünü bir örnek olay incelemesiyle değerlendirmektir.

Bu örnek olay araştırması, 2011-2012 akademik yılı bahar dönemi ve 2012-2013 akademik yılı sonbahar dönemi olmak üzere iki dönem boyunca sürmüştür. Ankara'da, Çankaya bölgesindeki özel bir okulun 18 Yeşil Takım Öğrenci Kulübünün üyesi ve iki biyoloji öğretmeni bu çalışmada yer aldılar.

Çalışma verileri, nicel ve nitel veri toplama araçları kullanılarak toplanmıştır. Nicel veri toplama amacıyla CLIMES Öğrenci Anketi; nitel veri toplama amacıyla

yarı yapılandırılmış ön görüşme formu, etkinlik sonrası görüşme formu, son görüşme formları ve yarı yapılandırılmış gözlem formu kullanılmıştır. Nicel verilerin betimsel analizi yapılmış ve sonuçlar sıklık ve yüzdeler halinde verilmiştir. Nitel veriler ise içerik analizi yöntemi kullanılarak çözümlenmiştir.

Sonuçlar, öğrencilerin çalışmanın başında iklim değişikliği, iklim değişikliğine uyum ve iklim değişikliğini azaltma konularında ön bilgilerinin eksik olduğunu ve bu konular hakkında kavram yanılgılarına sahip olduklarını göstermiştir. Bunun yanı sıra, öğrencilerin iklim değişikliğinin farkında olmalarına ve eyleme geçmede istekli olmalarına rağmen, iklim değişikliğine uyum ve iklim değişikliğini azaltma yönündeki ön davranışlarının kullanılmadığında ışıkları söndürmek ya da elektronik aletleri kapatmak gibi eylemleri içerdiği gözlenmiştir. Öğrenciler, program dışı etkinliklere katılarak bilgi, iklim değişikliği, iklim değişikliğine uyum ve iklim değişiklini azaltmaya yönelik beceri ve tutum geliştirdiler, yeni kavramlar öğrendiler ve pek çok kavram yanılgılarını giderdiler. Bunun yanı sıra, harekete geçmek ve okuldaki diğer paydaşların da iklim değişikliğine uyum ve iklim değişikliğini azaltma süreçlerine katılmalarını sağlamak için daha istekli oldular. Son olarak, program dışı etkinliklerin öğrencilerin iklim değişikliğine uyum sağlamak ve iklim değişikliğini azaltmak için ihtiyaç duyacakları hayat boyu öğrenme becerilerinden problem çözme, araştırma yapma ve iletişim kurma gibi becerileri geliştirmesine yardımcı olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Program dışı etkinlikler, iklim değişikliği, iklim değişikliğine uyum, iklim değişikliğini azaltma, çevre eğitimi, iklim değişikliği eğitimi

To my beloved family…

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LIST OF ABBREVIATIONS

CLIMES	Climate-friedly School Management in European Schools
IPCC	International Panel on Climate Change
MoEF	Ministry of Environment and Forest
MoEU	Ministry of Environment and Urbanisation
MoNE	Ministry of National Education

CHAPTER I

INTRODUCTION

This is a case study conducted at a private school in Ankara in order to investigate the role of extra-curricular activities on developing students' knowledge, attitudes, and skills with regard to climate change, climate change adaptation and mitigation. In this section, background of the study, purpose of the study and in line with the purpose, research questions are given. Next, the significance of the study and definitions of the terms are stated.

1.1. Background of the Study

Today's world has a crucial, scientific, and environmental problem: climate change. According to Intergovernmental Panel on Climate Change (IPCC, 2007a), changes in climate are now observable. It causes non-linear reactions that change the equilibrium of nature, and may result in extreme-weather events and natural disasters which affect the socio-economic structure of countries. The Fourth Assessment Report of IPCC (2007a) revealed that the average temperature of the Earth has already warmed up by close to 1°C since the beginning of the industrial revolution and it is expected to warm up to 5°C by the end of 21st century unless measures are taken on climate change mitigation. Early effective, planned measures reflecting the intensity and scope of change will help minimize negative impacts and maximize potential benefits of climate change (Bardslay & Bardslay, 2007).

Although governments have been developing strategies and action plans in order to mitigate and to adapt to climate change, either globally or nationally, these strategies and action plans still lack a sustainable solution for raising awareness

among people, and making them actively participate in mitigation and adaptation processes as active citizens (The Ministry of Environment and Forest [MoEF] & United Nations Development Programme [UNDP], 2011).

As human-induced climate change is happening, it is important to examine what people know and their actions are on climate change adaptation and mitigation are important. When the literature on perceptions of people on climate change are searched, it can be claimed that although today, information about climate change is more accessible than the past, public concern is still low, and citizens make no account of climate change (Nisbet & Kotcher, 2009). In Western countries, people are aware of that climate change is happening and the impacts of it will be observed more in the future (Lorenzi & Pidgeon, 2006); however, there is a lack of emphasis on taking action among public (Moser & Dilling, 2004). Similarly, in their synthesis research on public attitudes towards climate change, Upham et al. (2009) concluded that while public supports actions on climate change mitigation, individual, social and structural barriers limits their willingness to change personal behavior. Moreover, common misconceptions about climate change are determined in the literature. Gowda, Fox and Magelky (1997) synthesized common misconceptions about climate change that are exaggerating temperature changes, the cause-effect relation between climate change and ozone layer depletion and a confusion of climate and weather.

This leads encouraging people for taking action on climate change with specific training programs and educational approaches (Burandt & Barth, 2010) that educating people seems to be accepted as a basic and conscious way of handling environmental problems (Yücel & Morgil, 1998) to provide basis for the development of understanding, skills, and attitudes that has an impact on individuals' behaviors (Teodorescu & Oros, 2010). In this respect, Aydın (2010a) defined the main objectives of environmental education as *raising awareness among public, making people actively participate in coping with environmental problems, and developing positive attitudes towards environment*.

Therefore, many countries have integrated climate change into their education policies (e.g. USA, UK, Germany). Also in Turkey, policies are made by ministries in order to raise awareness among public and to take actions on climate change (e.g. Ministry of National Education, Ministry of Environment and Urbanisation). In this respect, aims of the environmental education is determined as *creating cognitive, affective and behavioral awareness among students and supporting them to be well educated citizens about environment* (State Planning Organization, 1994) which is parallel to United Nations Educational, Scientific, and Cultural Organization (UNESCO) (1978) definition of environmental literacy including five essential components: awareness, knowledge, attitudes, skills, and participation.

As mentioned above, it is a fact that climate change is happening, and educating people about climate change and the actions to be taken is essential. However, 'Does environmental knowledge promotes environment-friendly attitudes and actions?' is still a controversial issue in the literature. Some studies claim the positive correlation between environmental awareness with environmental knowledge, attitudes and responsible behavior (e.g. Brynjgard, 2001; Karch, 2002; Korhonen & Lappalainen, 2004; Palmerg and Kuru, 2000); whereas, some others propose that despite the fact that knowledge is the basic step for constructing better understanding of environment, it is hard to claim that environmental knowledge can promote behavioral or affective changes (Kuhlemeier, Bergh, & Lagerweij, 1999; Pooley & O'Connor, 2000).

Similarly, in Moser and Diling's (2007) study supports the second claim that information provision is not enough to encourage behavioral changes. As reasoned action and Icek Ajzen's theory of planned behavior claim, people show higher intention (motivations) in and they are more likely to act the suggested behavior when their attitude is positive toward to that behavior, and they think other people expect from them to perform the behavior (subjective norm) (Sheppard, Hartwick, & Warshaw, 1988). Therefore, it is essential to make people be aware of their responsibilities and to encourage them to be active participants of mitigation and adaptation processes.

In this respect, when the place of environmental education, particularly climate change education in the formal curricula, are examined, it is seen that formal curricula have some limitations with regard to teaching about climate science. Climate change mitigation and adaptation should be integrated into curricula in order to help the students develop skills that they need while evaluating resources, constructing climate change knowledge, and apply critical thinking (Bardslay & Bardslay, 2007). When the current Turkish elementary science curricula, high school science and social science curricula are examined, they cover few topics on climate change issues; nevertheless, the concepts can be claimed to only help students construct a basic theoretical knowledge, instead of helping them develop skills and positive attitudes (Çakçı & Oğuz, 2010). Moreover, Erdoğan, Marcinkowski and Ok (2009) analyzed the studies on K-8 environmental education in Turkey conducted between 1997 and 2007. The results supported the claim that there is lack of emphasis on the affective and behavioral dimension of environmental education.

In addition to lack of emphasis on attitude and behavioral dimensions in environmental education, another controversial issue in the literature is when it should start and how it should be integrated into the curricula. To start with "when", Aydın (2010a) claims environmental skills should be acquired at earlier ages; therefore, the environmental education should start at pre-school level. However, the author remarks that climate change education is most effective when given at high school level. Continuing to "how the climate change should be integrated into the formal curricula", as Bangay and Blum (2010) notes, centralization causes a drawback in climate change education because although national and international changes in climate are emphasized in the formal curricula, local changes are mostly neglected. These findings guided the researcher to examine how climate change change education takes place within the the school context.

Inadequacy of the formal curricula in developing skills and attitudes toward climate change leads educators apply for extra-curricular activities (Karatas, 2011; Stocklmayer & Gilbert, 2003) because complementary to formal curricula, they provide a learning environment for students that they can actively participate in and

practice the things they learn in theory (Karakuş, Aksoy, & Gündüz, 2012). In this context, literature has some studies highlighting the role of extra-curricular activities that participation in extracurricular claimed to increase interpersonal competence, self-concept, high school grade point average (GPA), school engagement, and educational aspirations (Elder & Conger, 2000; Marsh & Kleitman, 2002; Youniss, McLellan, & Yates, 1999).

Similarly, Stearns and Glennie (2010) defined extracurricular activities as schools' resources that students spend their time and energy for that they are interested in and stated the potential of extracurricular activities on helping students develop non-academic, civic, and political skills. In turkey, extra-curricular activities have started to be implemented mostly within the scope of student clubs and based on the regulations in the Ministry of National Education (MoNE), the aims of social clubs at primary and high school levels were set as "*social clubs serves to help students increase self-esteem and responsibility, and study on the topics and skills that they are interested in"*.

Moreover, although there are few research studies on climate change education in Turkey, the role of extra-curricular activities in developing students' knowledge, attitude, and skills on climate change is less common.

In the light of the points mentioned above, this case study aims to assess the role of extra-curricular activities in developing students' knowledge, attitudes and skills with regard to climate change, climate change adaptation and mitigation.

1.2. Purpose of the Study

Climate change is happening and it affects even socio-economic structures of the societies. In the literature, educating people is claimed to be the most important part of climate change adaptation and mitigation, however, the current formal Turkish curricula lack the affective and behavioral dimension of climate change education. These points make educators ask questions about how education helps

students develop knowledge, skills and attitudes in order to construct their own and society's futures (Bardsley, 2007; Bell, 2004). Therefore, this study aims to determine whether this can be achieved through extra-curricular activities. For this purpose, a case study at a private school in Ankara was conducted and the role of extra-curricular activities on developing students' knowledge, attitudes, and skills with regard to climate change, climate change adaptation and mitigation was tried to be determined.

1.3. Research Questions

In this study, the role of extra-curricular activities on developing students' climate knowledge, attitudes and skills with regard to climate change, climate change adaptation and mitigation were assessed. These following research questions guided the present study:

1. How do extra-curricular activities help students develop knowledge, attitude, and skills about climate change, climate change adaptation and mitigation?
    1.1. How do students perceive the role of extra-curricular activities in developing their knowledge, attitude, and skills with regards to climate change, climate change adaptation and mitigation?
    1.2. How do teachers perceive the role of extra-curricular activities in developing students' knowledge, attitude, and skills with regards to climate change, climate change adaptation and mitigation?

1.4. Significance of the Study

In this section the purposes which make this study significance are examined. Firstly, this study was designed as a case study and a case study allows the researcher to focus on the study to answer "how" and "why" questions when behavior of those involved in the study are not manipulated, or to cover contextual conditions relevant

to the phenomenon under study, and boundaries are not clear between the phenomenon and context (Yin, 2009). Therefore, this study is significant in that it examine how extra-curricular activities in school club context help students develop knowledge, attitude, and skills with regard to climate change, climate change adaptation and mitigation.

Secondly, when the literature on climate change education is reviewed, the research studies mostly examines students' understanding of the greenhouse effect (Shepardson, Niyogi, Choi, & Charusombat, (2009); the thematic overview of public opinion, perception and understanding of global climate change (Leiserowitz, 2007). Similarly, the literature on climate change education in Turkey does not provide a perspective to enhance climate change education; rather, it gives one an understanding of how people, mostly students, perceive climate change and its impacts (e.g. Bahar, 2000; Çakcı & Oğuz, 2010). Additionaly, the results of research studies on climate change reveal that elementary students had limited information and different conceptual misconceptions about the problem of global warming (Andersson & Wallin, 2000; Boyes & Stanisstreet, 1993); besides, high school students (Boyes & Stanisstreet, 2001), prospective and in-service teachers (Boyes, Chambers, & Stanisstreet, 1995; Summers, Kruger, Childs, & Mant, 2000) have also some common misconceptions about climate change and global warming. This study is significant in terms of evaluating the effectiveness of extra-curricular activities in providing students a conceptual understanding of climate change, climate change adaptation and mitigation.

Thirdly, educating people is one of the most essential parts of climate change adaptation and mitigation processes, yet, the literature reveals that there are some common misconceptions among students and there exists a lack of conceptual understanding of what climate change. Gökçe and Kaya (2009) claim that Turkish curricula do not include climate change as a main unit; rather, it is mostly given as a subtopic under the units such as Ecology, Population, Energy, etc. Hence, the present study is significant in that it investigates how extra-curricular activities can be used to overcome the deficiencies in the formal curricula.

Next, although constructing knowledge is the initial step to develop students' positive attitudes and skills with regard to climate change, the literature also indicates that developing knowledge and/or attitudes may not lead to action (Courtney-Hall & Rogers, 2002; Kollmuss & Agyeman, 2002). Climate change is an environmental, scientific problem (Solomon et al., 2007). Dupigny-Giroux (2010) defines science literacy as generally referring to "…the knowledge, skills and attitudes needed to apply inquiry or problem-based approaches to new situations and decision making" (p.1). Therefore, people should take responsibilities to participate actively in the climate change debate and to be able to make logical well-reasoned decisions (Pettenger, 2007). Investigating the role of extra-curricular activities on developing students' not only knowledge, but also attitudes and skills with regard to climate change, climate change adaptation and mitigation make this study significance.

Furthermore, many countries (e.g. USA and UK) have been developing action plans and revising their curricula. "Educating for a Sustainable Future", a program prepared by UNESCO, accepts environmental education as an important tool in the cause of sustainable development. For UNESCO, ESD (Education for Sustainable Development) aims not only developing knowledge and a conceptual understanding, but developing skills, values and perspectives (UNESCO, 1997). In line with the aims of environmental education, many countries have developed projects for a sustanaible future (e.g. Twenty First Century Science (UK), Do not Let Our Future Melt [TEMA &TURMEPA, Turkey], The Footprints of Tomorrow [TOCEV & MoNE, Turkey], Green Pack [REC & MoNE]). However, these projects, particularly the ones implemented in Turkey mostly aim to raise awareness among people, yet, less try to develop attitudes and skills. Beside, they are mostly conducted at elementary school level. This study is signifinace in that it evaluates how extra-curricular activities help high school students develop attitudes and skills with regard to climate change, climate change adaptation and mitigation to shed a light for those who are interested in climate change education.

Lastly, when the experimental studies in which activities or different teaching material and methodologies on climate change were implemented are analyzed, it

can be concluded that the studies are implemented for respectively a short time of periods. For example, Oluk and Özalp (2007) designed an experimental study with 40 7^{th} grade students to determine the impacts of cartoons to teach global environmental problems: global warming, ozone depletion, and acid rain problems. Two cartoons were prepared to be used in the experimental group while teaching the concepts. Based on the pre-test post-test, and the interviews results, the authors concluded that experimental method helped the students increase attention towards science lessons, and lessons were claimed to be enjoyable. Similarly, Aivazidis, Lazaridou, and Hellden (2006) conducted a study to compare a traditional and an online environmental education program in terms of their effectiveness in developing knowledge and promoting attitudes toward environmental issues. 297 2^{nd} grade students (aged 13–14 years) participated in the study, and the study lasted for 10 weeks (45 min. for each week). The findings of the study revealed that compared to the students who were taught traditionally, the students received computer-assisted instruction (CAI) showed a significantly more increase in posttest knowledge scores. Additionally, Taber and Tylor (2009) studied on effective strategies for teaching children about global warming. For this purpose, they developed a hands-on science unit dealing specifically with global warming was prepared and taught over a period of eight weeks. Data were collected through pre- and post-testing, and post intervention interviews. The findings of the study indicated a significant increase in students understanding of the science of climate change. Considering these studies, the present study is significant in terms of studying on the case for a longer duration (20weeks, 1.5 hours each week) that gave relatively more reliable results about the changes in students' behaviors and attitudes.

In conclusion, although the findings of the study are specific to Middle East Technical University (METU-DFHS), the results may help educators and policy-makers about integration of climate change into their curricula through implementing extra-curricular activities.

1.5. Definitions of the Terms

In this part, definitions that may provide readers a better understanding of the terms will be given. Definitions include climate change and some related concepts mentioned in this study, and also some other terms related to education are given.

Climate change: There exist many definitions of climate change. Some accept it as a long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years, such as temperature, rainfall, snow, or wind patterns lasting for decades or longer ("Climate Change", 2013; "Glossary of Climate Change Terms", 2013). On the other hand, there are some other definitions, such as *changes in climate persisting for comparable time periods because of directly or indirectly affected by human activities deforming the composition of the global atmosphere* highlighting human effects on climate change (IPCC TAR, 2001a; "United Nations Framework Convention on Climate Change [UNFCC] / Article 1: Definitions", 2013). In this study, the term climate change is used referring to the definitions those highlighting human effects on climate change.

Climate change adaptation: Definitions of climate change adaptation are similar to each other that each of them includes a meaning as a process of solving climate change problems and keeping them under control. It also aims to benefit from the advantage of potential consequences of climatic events (IPCC TAR, 2001a; UK Climate Impact Programme [UKCIP], 2003).

Climate change mitigation: The term climate change mitigation refers to any actions taken to permanently prevent or reduce the risks of climate change. It can include complex strategies or just simple ones ("UNEP-Climate Change Mitigation", n.d). Besides, some definitions highlight reducing the amount of human-induced greenhouse gases (e.g. IPCC, 2007b, "Global Greenhouse Warming", 2013).

Carbon footprint: "…a certain amount of gaseous emissions that are relevant to climate change and associated with human production or consumption activities" (Wiedmann & Minks, 2007, p.2).

> …a technique for identifying and measuring the individual greenhouse gas emissions from each activity within a supply chain process step and the framework for attributing these to each output product (we [The Carbon Trust] will refer to this as the product's 'carbon footprint')." (CarbonTrust 2007, p.4)

"…the 'Carbon Footprint' is a measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in tonnes of carbon dioxide" (ETAP, 2007). In this study, carbon footprint refers to Wiedmann and Minks's definitions.

Curriculum: There are many definitions of curriculum based on different approaches. For example, Franklin Bobbitt (as cited in Olive, 2009) defined curriculum as the series of things that children or youth should experience to gain the abilities an adult should have. On the other hand, Caswell and Campbell (1935) viewed curriculum as all the experiences children have under the guidance of their teachers (as cited in Ornstein & Hunkins, 2004). In this study, the term curriculum is used referring to Caswell and Campbell's definition stressing all the experiences children have.

Formal curriculum: It can be defined as "the planned program of objectives, content, learning experiences, resources and assessment offered by a school" ("UNESCO-The Curriculum, 2010). William (2010), highlights that formal curriculum should include knowledge, skills, and understandings that have educational value to both the individual and society.

Extra-curricular activities: They are the activities implemented without the scope of a course and no grading is done at the end of them (Grove, 2013). "They offer intrinsic values to the student who enters into them sympathetically and intelligently, and who undergoes the discipline required by them" (Goldberg, 1946). According to McGaha and Fitzpatrick (2010), extra-curricular activities are that students participate in school and *neighborhood*. Keser, Akar, and Yıldırım (2011) claim that extra-curricular activities may take place after and during school programs, and both in or out of school buildings. Similarly, Bartkus, Nemelka, Nemelka, and Gardner (2012) make a synthesis of the definitions of extra-curricular activities as:

> Extracurricular activities are defined as academic or non-academic activities that are conducted under the auspices of the school but occur outside of normal classroom time and are not part of the curriculum. Additionally, extracurricular activities do not involve a grade or provide academic credit and participation is optional on the part of the student.

As seen, all the definitions somehow overlap with each other. Therefore, in this study, the term extra-curricular activity refers to partially Bartkus and his colleagues' definition given above.

CHAPTER II

LITERATURE

Literature part includes what the literature says about climate change education and why climate change education is important. For this reason, this chapter initiates with, basic theoretical information on what climate change is and what its impacts because importance of climate change education can be noticed with an enhanced theoretical knowledge about climate change. Next, relevant literature is reported.

2.1. What Is Climate Change?

The climate system of the Earth has changed naturally during its history of 4.5 billion years due to the degradation of the equilibrium of the natural balance; however, effects of the changes is known only for Quaternary . 20,000 years before of the present, the cold weather effecting north hemisphere, affected north part of the continental Europe and caused glaciations leading 125cm decrease in the sea level causing Siberia and Alaska became a single mainland. This lasted for 4,000 years, then glaciers started to melt and the temperature increased (Ahrens, 1994). 11000 years before the present, the temperature decreased rapidly and glaciations ware seen again in the north of the Europe and north-east of the ABD. After 1,000 years, the temperature started to increase and 8,000 years before the present, glaciations were totally disappeared. 6,000-6,500 years before, the average temperature was 1 °C more and this as *Mid-Holocene Warm Period*. In this period, plants grew up, a variety of eco-systems emerged, and the climate was similar to today. The following years a general cooling was appeared causing glaciations occurred in mountains like in the Alps.

When the last 1,000 years of earth's climate is examined, in 1200s although there was a mild climate, some extreme weather events such as storms, floods, heavy rainfall, and aridity occurred. Then, from mid of 1500s to end of 1800s,"Little Ice Age" caused glaciations again in north Europe and ABD. However, after the mid of 19^{th} century, human actions started to affect the climate in addition to natural changes. Changes in climate is now observable that there is an increase of the average global air and ocean temperature, melting of ice has become wide-spread and the average sea level has raised worldwide (IPCC, 2007a) (Figure 2.1). Also, today most of the observed global warming over the past fifty years evidently derived from human activities (United Nations Environment Programme / United Nations Framework Convention on Climate Change [UNEP/UNFCCC], 2002). For this reason, climate change is accepted one of the major environmental problems the world is facing due to human actions. (Solomon et al., 2007).

Naturally, the atmosphere has GHGs (H2O, CO2, CH4, N2O and O3) and they help keeping the balance between coming short-wave sun light into the earth's atmosphere and back reflected long-wave radiation (Figure 2.2). Human actions like using fossil fuels, deforestation, aerosols, industry, and trash dumps increase the amount of natural greenhouse gases causing global warming. To illustrate, 11 of the 12 years (1995–2006) ranked among the 12 warmest years in the instrumental record of global surface temperature since 1850 (IPCC, 2007a) and the increase in the global temperature of the earth surface was reported as 0.61C (0.4–0.81C) in the IPCC's Third Assessment Report (IPCC, 2001a). Also, according to the IPCC's Fourth Assessment Report (2007a) the value increased up to 0.741C (0.57–0.951C) compared to the previous century. The temperature increase is widespread across the world and the northern Polar Regions are observed evidence for this. Also, not only there is a warming of the climate system observed on the earth's surface and up in the atmosphere, but also in the upper few hundred meters of the oceans, hence in the land.

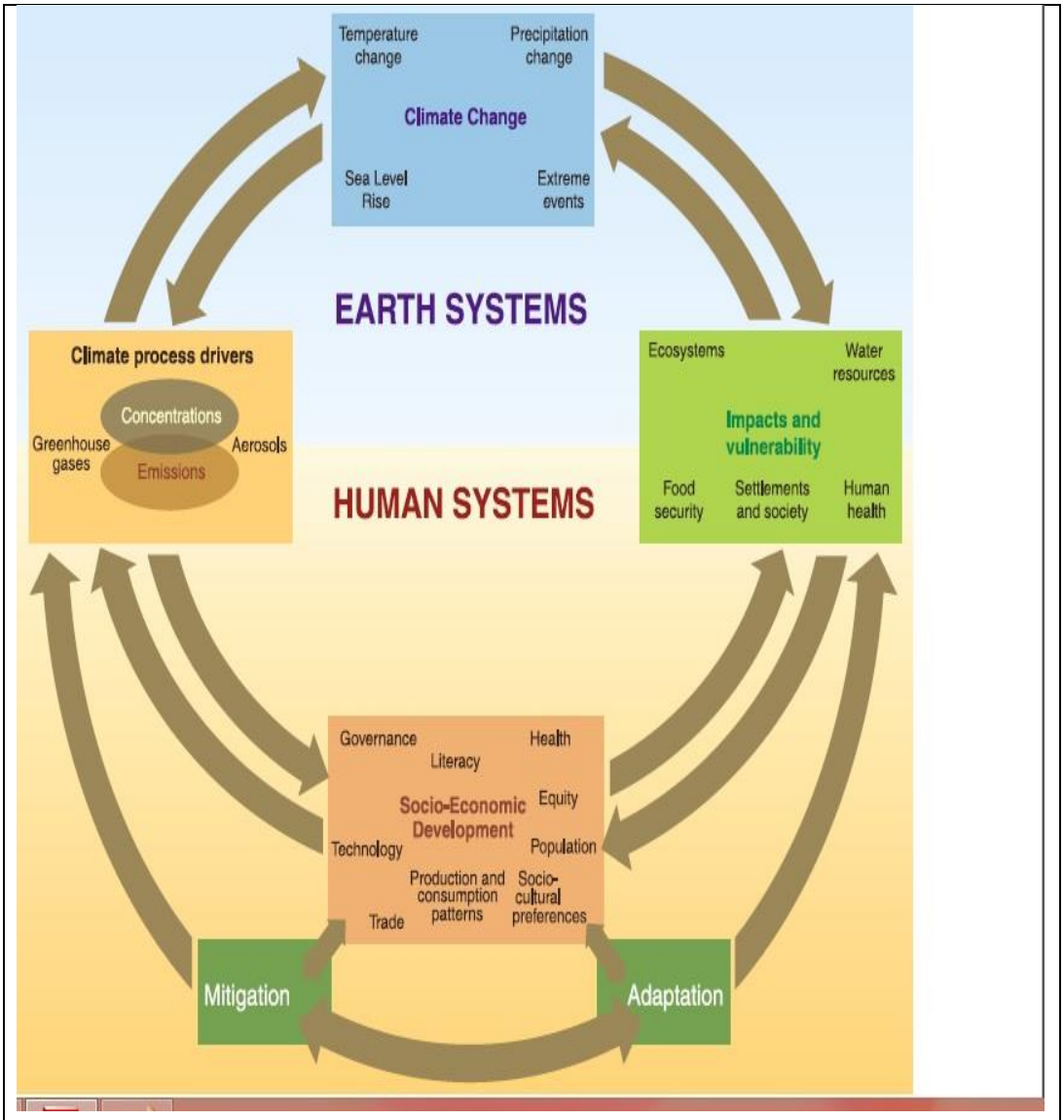

Figure 2.1 Schematic framework representing anthropogenic drivers, impacts of and responses to climate change and their linkages. Taken from "IPCC 4th Assesment Report: Climate Change 2007: Synthesis Report", p. 26.

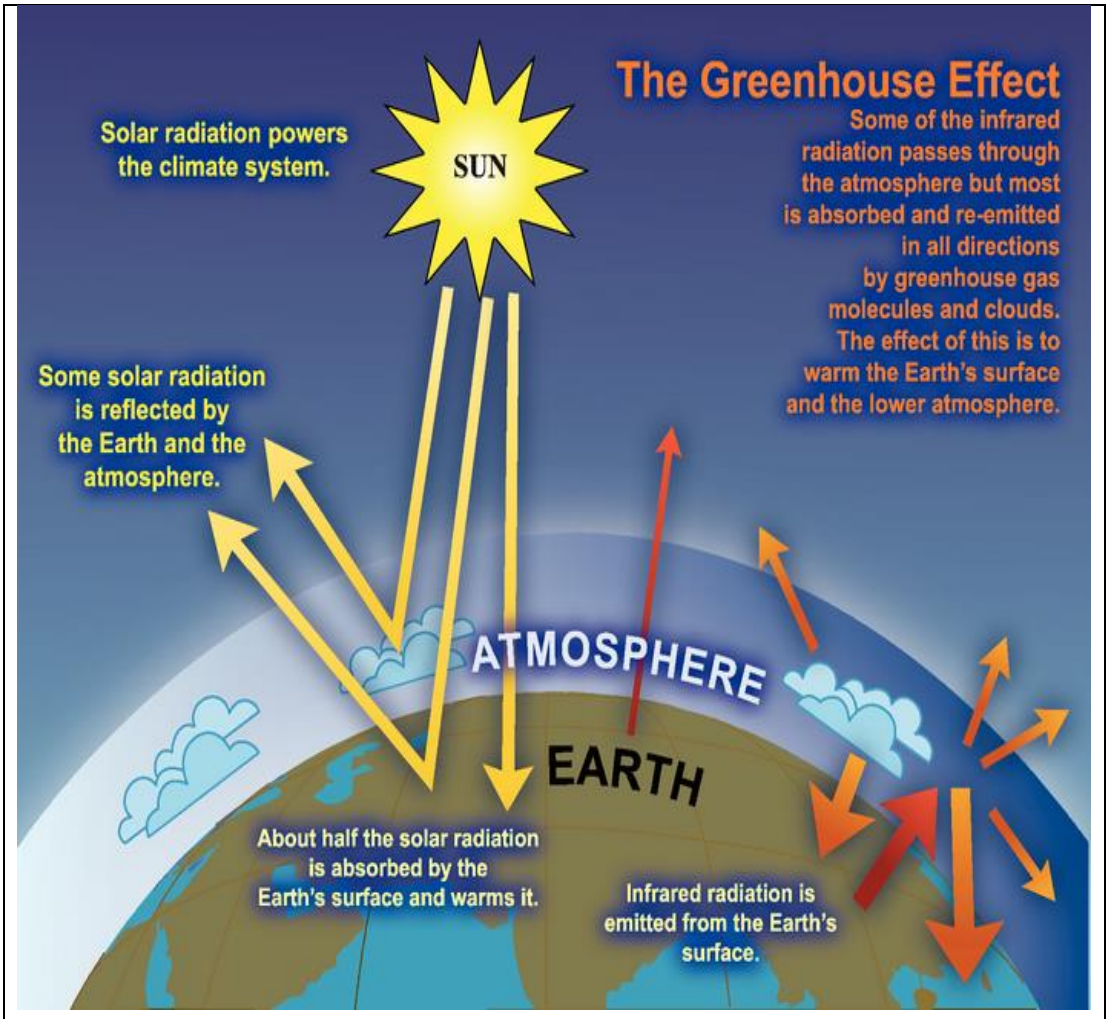

Figure 2.2 An idealized model of the natural greenhouse effect. From "IPCC Fourth Assessment Report: Climate Change 2007 Working Group I: The Physical Science Basis", in Chapter 1, p. 115.

According to 4th IPCC Report, global warming is inevitable and that human activity is likely to be the main cause (2007a) addition to the natural causes like the orbit of the earth around the sun, dislocations and misalignments in the axial of the earth, ocean current systems, and greenhouse effect. Human actions, effecting climate change, are mostly on adding greenhouse gases (GHGs) to the atmosphere. The report also claim that as human activities continue to add GHGs – carbon dioxide, methane and nitrous oxides – to the Earth's atmosphere, global temperatures are expected to rise, causing the Earth's climate to change.

Global changes that have been determined from the past till now are the increase in temperature by 0,5 ºC in the past century, the increase in sea level by 20 cm from the beginning of this century, the increase in rainfall on the sub-tropical latitudes. Global warming has increased seriously in the course of the past 10 years. These climate changes may affect precipitation patterns, severe and extreme weather events, and, over time, environmental systems. Furthermore, human health and agriculture may be sensitive to climate change. As human beings we should take an action even some may propound it is too late for this, still something can be done at least for adaptation and mitigation because human actions increase the amount of GHGs and particles in the atmosphere and cause ozone layer depletion leading global warming. It can be observed that there is an increase in the global average surface temperature and global average sea level addition to a decrease in the snow cover of Northern Hemisphere (see Figure 2.3).

Global changes that are expected till year 2100 are 3 ºC increase in temperature, 70cm (30-110cm) increase in sea level, decrease in agricultural areas and the food production of the world. Even if emissions caused by humans are being stopped till 2100, 1-2 ºC increase in temperature is still expected. 2,5 ºC (1,5–4,5 ºC) global warming is expected by double increase of the concentration of CO_2 (IPCC, 1996). The effects of global warming are not only limited to melting of ice, raise in the sea level, nor climate shifts, but also it is expected that the earth will be vulnerable to extreme weather events (storms, heavy precipitation, etc.) causing floods, aridity and desertification, epidemics (Öztürk, 2002; The Ministry of Environment and Urban Planning [The MoEU], 2012; Türkeş, Sümer, & Çetiner, 2000).

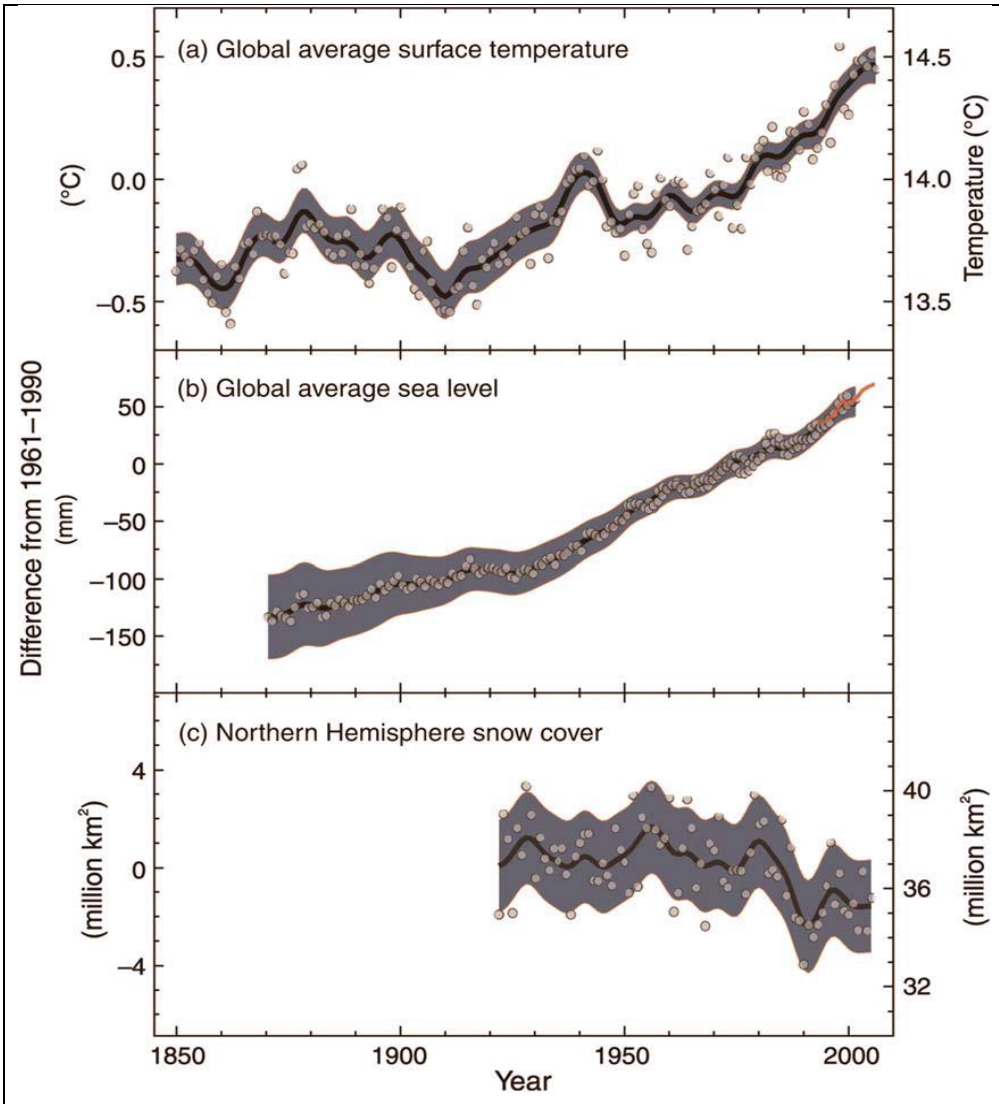

Figure 2.3 Changes in Temperature, Sea Level, and Northern Hemisphere Snow Cover. From From "IPCC Fourth Assessment Report: Climate Change 2007", p.31.

To summarize, the observed effects of climate change are listed below:

- The global average surface temperature has increased.
- The global average sea level has increased.
- In the last few decades, middle latitudes have started to enlarge through high latitudes.
- Some plants and animal species are in extinction.
- Snow and ice mantle has decreased both in area and volume.

- In the last 10 years, the number of atmosphere originated disasters has increased globally.
- Many tropical diseases spread through high latitudes and epidemics have increased in spite of the developments in the technology.
- Ecosystems will also be affected by these changes.

As seen, climate change is not only an environmental, but also a socio-economic problem we globally face. It affects air, water, ecosystems and biodiversity, human health, and socio-economic conditions of civilizations. As The United States Global Change Research Program (2009) defined climate science literacy as: "understanding your influence on climate and climate's influence on you and society", adding recognition of sources of greenhouse gases and perception of basic weather and climate science, we should be aware of our role for adaptation and mitigation of climate change. Also, we should determine what the impacts are and how human beings will be vulnerable to those changes in climate.

2.2. The Impacts of Climate Change

The impacts of climate change can be observed in many topics and Figure 2.4 shows a general overview of them. To understand the importance of the issue, one should primarily know the history of Earth's climate, how the current situation, and what the future assumptions are. In this study, the impacts will be explained in five topics: air pollution, water, eco-systems and biodiversity, human health, and socio-economic conditions.

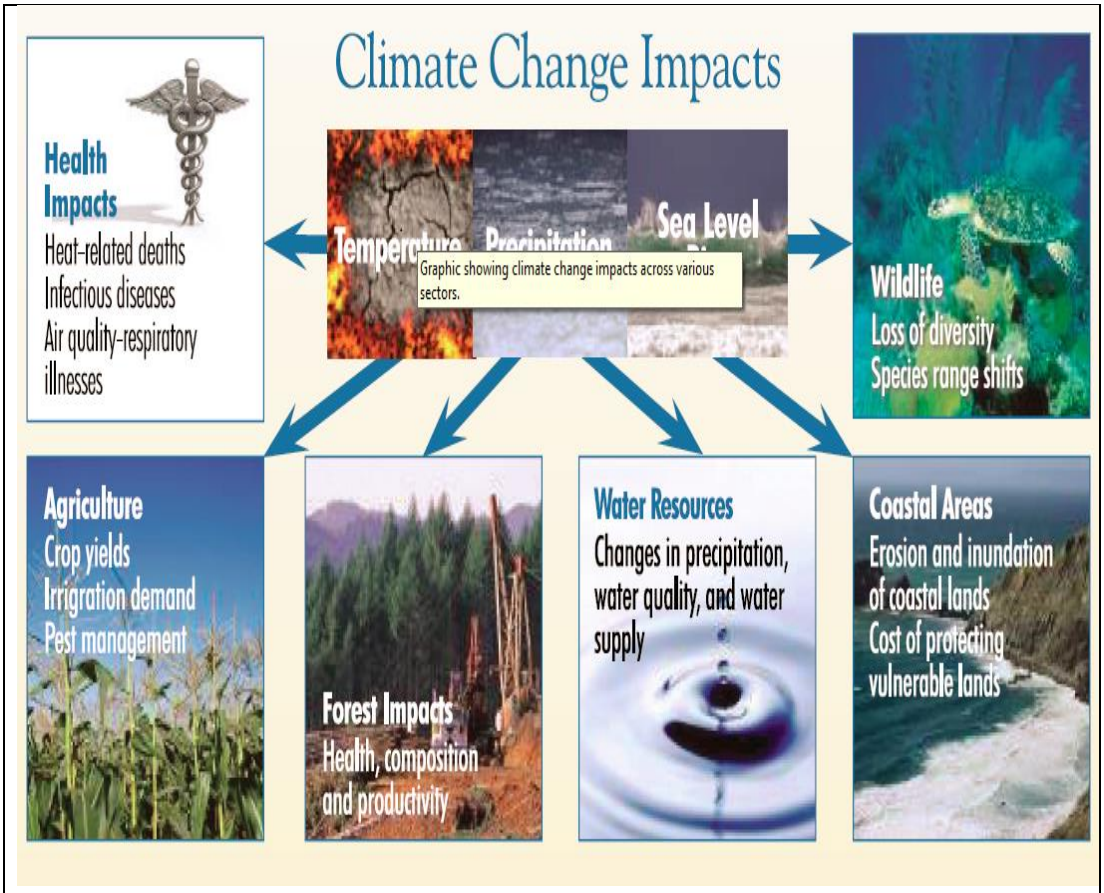

Figure 2.4 Climate change impacts. From "Frequently asked questions about global warming and climate change: Back to basics" by United states, Environmental Protection Agency (US-EPA), 2009, p.6.

2.2.1. Air Pollution

After the industrial revolution, with the developments in transportation and industry, the usage of fossil fuels increased rapidly causing air pollution. The middle of the 19th century was the era in which people started to struggle with air pollution; however, they could not prevent the dramatic increase in the usage of fossil fuels.

There are two main causes of air pollution: one of them is natural air polluters, and the other is anthropogenic air polluters. Volcanism, forest fires, *and* agricultural activities are among the natural air polluters. CO, CO_2, and methane are examples to them. The other, equally important air polluters are anthropogenic sources derived from human activities, such as transportation, and fossil fuels used in

heating and industry (Figure 2.5). These air polluters are not only causing global climate change; also they have some negative impacts on human health, forest and agricultural lands, and biodiversity (Saral, 2011; Tacer, 2011; Yener, 2011). Due to irreversible consequences of air polluters, most countries have been trying to take action; for example, using renewable energy sources. Solar panels, wind turbines, geothermal energy, hydroelectric power stations, bio-energy, and ocean power are example of renewable energy sources (Yener, 2011).

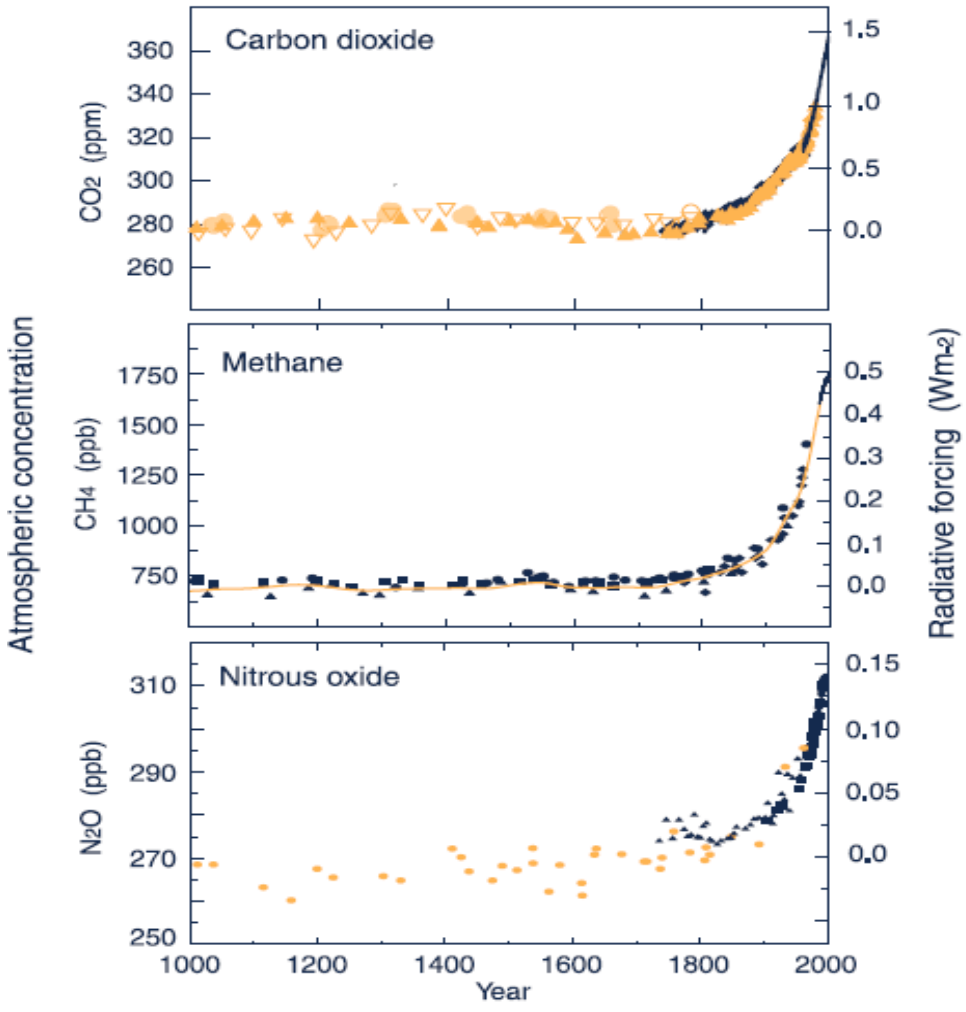

Figure 2.5 Indicators of human influence on the atmosphere during the Industrial Era. From "IPCC Climate Change 2001: The Scientific Basis. Summary for Policymakers", page 6.

As Figure 2.5 indicates, there has been a significant change in the atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) over the past 1000 years. In order to reduce the emissions of GHGs of countries, t*here have been such global attempts like the Kyoto Protocol, "*an international agreement linked to the United Nations Framework Convention on Climate Change, which **commits** its Parties by setting internationally binding emission reduction targets" ("Kyoto Protocol", 2013, para.1). The protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. Its first commitment period started in 2008 and ended in 2012, and the second commitment period applies to emissions from 2013 to 2020.

Even individual nisus can help to decrease the effects of air pollution. However, governments also should consider limiting their CO_2 emissions and keeping them under control. Such attempts will help to mitigate climate change in terms of reducing GHGs emissions.

2.2.2. Water

Water is a basic need of humankind and 70% of the earth is covered by water; however, 97.6% of this water is salt water in the seas and cannot be used for human needs. The ground water is only 2.4% of total amount and also only 10% of then can be classified as fresh water which can be used for human needs meaning just 0.3% of the water in the Earth (Fındık, 2007). As seen even in these conditions, when the growing population of the world is considered, the amount of potable water is so small; on the other hand, the recent research shows that water sources are one of the most vulnerable elements to climate change not only in terms of the amount of it, but also the quality of it that acid rains will increase, floods will be seen more often, and evaporation will happen in a shorter time than the present; thus, it will be more difficult to find potable water (IPCC, 1992; IPCC, 2007; Rodríguez-Camino, 2010).

Countries are classified according to their water sources per person as (Findik, 2007; Unal, 2011):

- more than 10,000 m³ - water rich countries,
- 3,000-10,000 m³ - countries with adequate water,
- 1,000-3,000 m³ - countries has water shortage,
- less than 1,000 m³ - water poor countries

According to these figures, Turkey has a water shortage with 1,600m^3 water per person. When an increasing population and the fact that we will have arid climate because of climate change are considered, it is expected that Turkey will become a water poor country by 2030 (Zoray & Pır, 2007). Therefore, research reveals that policy-makers should take immediate action on preserving water sources by considering global and local changes in climate (Aksay, Ketenoğlu, Kurt, 2005; Arıkan & Özsoy, 2008).

2.2.3. Ecosystems and Bio-diversity

Biodiversity can be defined as the diversity and variability of living organisms and the ecologic environments; ecosystem diversity refers to a dynamic term with interactions between plants, animals, micro-organisms and even land, water, air, and minerals (Çepel & Ergün, 2002). As defined in the 2nd IPPC Assessment Report:

> Ecosystems contain the Earth's entire reservoir of genetic and species diversity and provide many goods and services including: (i) providing food, fibre, medicines and energy; (ii) processing and storing carbon and other nutrients; (iii) assimilating wastes, purifying water, regulating water runoff, and controlling floods, soil degradation and beach erosion; and (iv) providing opportunities for recreation and tourism (IPCC,1995, p.6).

Nature used to be in a balance and it managed to adapt to natural climatic changes; however, since the industrial revolution, there has been a dramatic increase in natural gas emissions, such as methane and carbon dioxide, causing global warming. Although species have adapted to environmental changes for millions of years, biodiversity (the number and variety of plant and animal species in a particular location) is likely to be affected by the rapid changes in climate; species cannot adapt are at risk of extinction (US/EPA, 2010a).

As climate change have affected water, air, and human beings, it also affected ecologic systems; for example,

> Terrestrial ecosystems including tundra, boreal forest, and mountain regions which are sensitive to warming, Mediterranean-type ecosystems because of reduction in rainfall; and tropical rainforests where precipitation declines; coastal ecosystems such as mangroves and salt marshes, due to multiple stresses; marine ecosystems including coral reefs due to multiple stresses; and the sea ice biome because of sensitivity to warming will be affected (Rodríguez-Camino, 2010, p. 39).

Reports on the impacts of climate change on biodiversity reveals that increases in global average temperature exceeding 1.5 °C to 2.5°C and atmospheric CO_2 concentration, major changes in ecosystem structure and function, species' ecological interactions and shifts in species' geographical ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services are inevitable (IPCC, 2007a). It is estimated that some species will increase in abundance and/or range while others will decrease; hence, this will affect ecosystems' structure and composition (IPCC, 1992). To illustrate, in some marine and freshwater systems, shifts in ranges and changes in algal, plankton, and fish abundance are with high confidence associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation (IPCC, 2007a). Particularly, it is expected that the added stresses to freshwater ecosystems will affect species in terms of numbers and genetic diversity within freshwater populations in the short term, particularly for fish that require cold or cool water, such as salmon (U.S EPA, 2010a).

There have been some attempts with regard to lessening the effects of climate change on ecosystems and biodiversity. In May 1989, in order to meet the needs for an international convention on bio-diversity, the UNEP convened the Ad Hoc Working Group of Experts on Biological Diversity. Soon after, it established the Ad Hoc Working Group of Technical and Legal Experts to prepare an international legal instrument for the conservation and sustainable use of biological diversity. In this respect, the most important international frame The Convention on Bio-diversity (CBD) entered into force in 1993. The convention has three main objectives:

1. The conservation of biological diversity
2. The sustainable use of the components of biological diversity
3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources. (“Article 1. Objectives”, n.d., para. 1).

With sustainable policies, the risks on existing species and habitats can be prevented. National and international protocols gain much more importance in this context to make the nations aware of their responsibilities (Demir, 2009).

2.2.4. Human Health

Another consequence of climate change is observed on human health. The reports and studies on the effects of climate change on human health show that the rate of deaths has increased due to the malnutrition; injuries and diseases increased due to the extreme weather events; and cardio-respiratory diseases have increased because of higher concentrations of ground-level ozone in urban areas (IPCC, 2007a; see Figure 2.6). Beside these direct effects, there are some indirect effects. In the 2nd IPCC (1995) report, it is stated that potential transmission of vector-borne infectious diseases such as malaria, dengue, yellow fever and some forms of viral encephalitis will increase; furthermore, freshwater shortage, air pollution, and limitations on nutritious food will cause diseases. However, populations’ vulnerability to health problems related to climate change is dependent on their natural, technical and social resources.

Another document on the impacts of climate change on human health is an atlas published by the World Health Organization (WHO) and World Meteorological Organization (WMO, 2012) in which it is claimed that climate change will affect human health in three ways. The first aspect is related to climate effects on the geographical and temporal distribution of large burdens of disease threating health security. Second, people may be vulnerable to psychologic and behavioral changes, and also their environmental and socio-economic conditions will be affected by climatic changes. Finally third aspect is on climate information used in affluent and

developing countries in order to protect health through risk reduction, preparedness and response over various spatial and temporal scales.

Besides physical health impacts, changes in climate have impacts on psychology. Research studies highlight the reciprocal and structural relationships between human health and integrity of the natural environment (Clayton & Myers, 2009; Gifford, 2008; Roszak, Gomes, & Kanner, 1995). It is revealed that nature has a positive effect on physical and mental health (De Vries, Verheij, Groenevegen, & Spreeuwenberg, 2003; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006). Besides human security and safety, that human health is also in danger due to the global climate change; thus, necessary measures about the mitigation of infectious diseases and refugee relief should be taken (Komiyama, & Takeuchi. 2006).

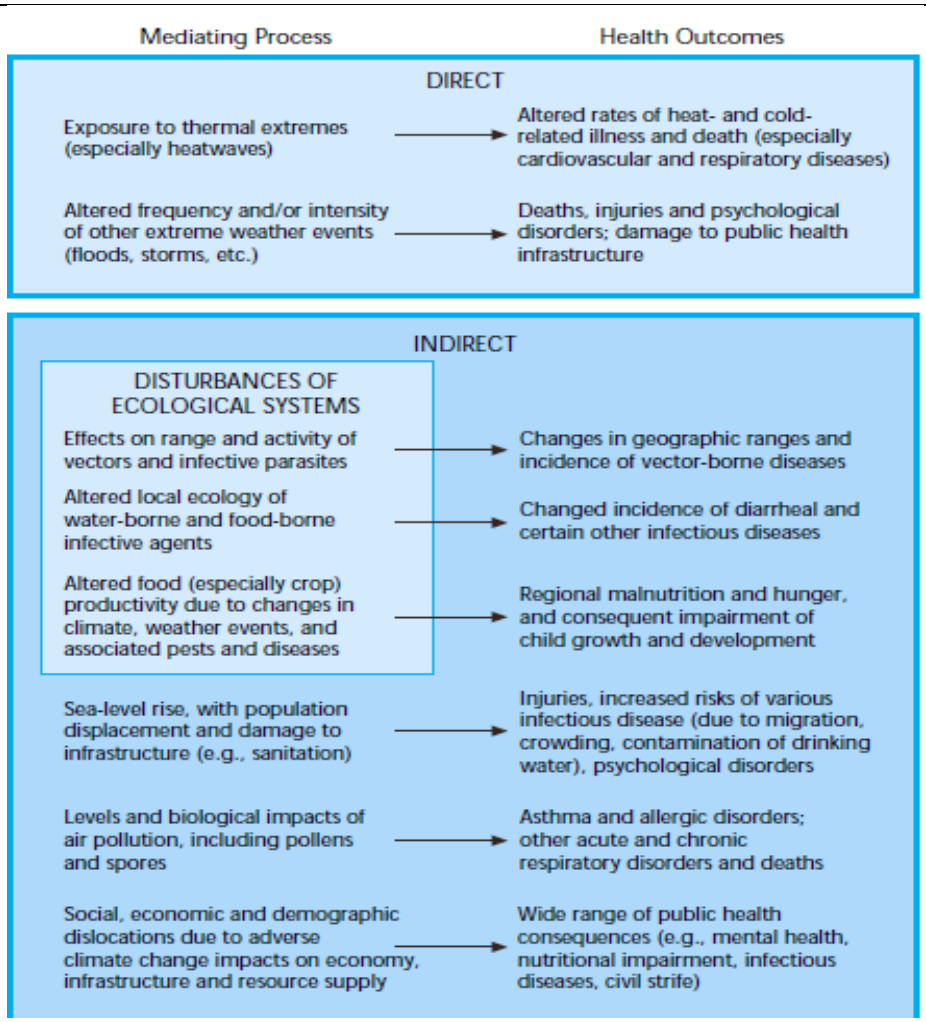

Figure 2.6 Ways in which climate change can affect human health. From "IPCC Second Assessment – Climate Change 1995", p. 35.

2.2.5. Socio-economic Impacts

The last impact of climate change examined in this study is on socio-economic sectors. Climate change directly or indirectly affects societies, including water resources, food production, energy use, transportation and commerce, recreation, and even national security (US/EPA, 2010b). The US/EPA (2010b) also revealed that although some may argue that some of the changes will be beneficial in the short-term, many of the impacts will be costly, damaging to local communities and societies as a whole in the long term. A changing climate, changing precipitation patterns, and extreme weather events will affect farming, ranching, and fishing. To

illustrate, the growing season will be shorter in cooler regions due to the higher temperatures and this will be an advantage for farmers allowing them to diversify crops or to have multiple harvests from the same plot. On the contrary, in warmer regions, high temperatures might prevent certain crops from growing. In addition, more livestock illnesses and deaths are expected due to the high temperatures and extreme weather, and fishing is another sector probably affected by climatic changes, especially those fish that needs cold or cool water, such as salmon.

In addition, climate change is likely to affect the amount of energy to heat buildings in the winter, as well as the amount of energy used to cool them in the summer. Some types of sporting and outdoor activities, including hunting, fishing, skiing, camping, and tourism are also likely to be affected by climate change due to heat waves, decreased snowfall, and changing wildlife habitats. Extreme weather events, such as excessive precipitation, intense snowfall, floods, and storms roads, railways, airports, power grids, water supply systems, and sewers, resulting in the need for extra economic resources. Forests are other socio-economic sources to be affected by climate change, particularly for those countries and regions whose economy and social welfare are highly dependent on them (IPCC, 1992).

Climate change will affect all nations; however, their vulnerability will depend on their resources and level of development. More specifically, developing countries with fewer resources will face more damages from extreme weather events, food shortages, and water shortages, resulting in social disruption, instability, and conflict. In areas, where climate change leads to increased extreme weather events, like heat or storms, some people —including the poor, the elderly, and the disabled—could be disproportionately affected (US EPA, 2010).

Although there are some certain kinds of sectors likely to be affected by climate change have been determined, there are still uncertainties and gaps in the knowledge base of what all possible impacts of climate change on the environment and socio-economic resources are. In order to identify them, international organizations such as UNEP, WMO and the Intergovernmental Oceanographic Commission (IOC) of United Nations Educational, Scientific, and Cultural

Organization (UNESCO) are implementing monitoring programs. These can provide a more accurate analysis of climate change (IPCC, 1992).

To summarize what climate change is and the impacts of it, as the reports and research studies mentioned above claim, human induced climate change is a scientific fact and it directly or indirectly affects nature and socio-economic structures of societies. Therefore, making societies aware of this scientific fact and encourage them to be active citizens in adaptation and mitigation processes are so important. In this respect, in the following parts, what is the role of education and why it is import to educate people about climate change, climate change adaptation and mitigation will be discussed.

2.3. Theoritical Background of the Study

Climate change has been discussed for decades and scientific reports reveal that evidence points to human-induced climate change (IPCC, 2001, 2007). If actions are not taken to mitigate climate change, these changes will continue to impact human beings and natural systems much more than before (Schellnhuber et al., 2006). However, there are some barriers identified in the literature about people's behaviors that are *past behavior, knowledge, experiences, feelings, social networks, institutional trust, demographic background on individual attitudes and behavior towards environmental issues* (Blake, 2001; Kollmuss & Agyeman, 2002). There are some models developed to explain these various influences (Ajzen, 1991; Stamm, Clark, and Eblacas, 2000). For example, the Theory of Planned Behavior postulates that beliefs determine intention to act and consequent behavior (Ajzen, 1991):

> …Intentions are assumed to capture the motivational factors that influence a behavior; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior… (p. 181).

The author also claims that there is positive correlation between intention to engage on a behavior and acting its performance. However, he highlights the importance of person's own decisions on performing or not performing the behavior.

As Ajzen defines motivation as a sub-determinant of behaviors, motivation is another point to be considered to explain behaviors. There are also theories explaining motivation, e.g. Self-determination Theory (Deci & Ryan, 2000), Attribution Theory (Anderman & Anderman, 2010), Expectancy-Value Theory (Dörnyei, 2009). To explain for the present study, Self-Determinant Theory opposes two kinds of motivation: intrinsic and extrinsic. As Deci and Ryan (2000) points that learners are intrinsically motivated when they feel that they are autonomous and free to participate in the activities. The authors also claim that in a learning environment in which learners have a sense of belonging through engaging in the activities with their peers, learners are intrinsically motivated. Besides, the learning environment should provide opportunities for learners to show enthusiasm toward the activities.

As a global environmental problem, climate change mitigation and adaptation require collaboration and cooperation. As Kim (2012) argues "*solutions can be produced when the collective behavioral problem is solved by fulfilling the process of collective engagement, namely, community problem solving*" (p.281). However, recent studies show that public is aware of the problem and is concerned about climate change, yet, their actions are limited causing a gap which is called as 'value-action' or 'attitude-behavior' gap (e.g. Blake, 1999; Kollmuss & Agyeman, 2002).

Considering these theories mentioned above and CLIMES Questionnaires along with pre-interviews results, extra-curricular activities were developed by CLIMES Turkish Project Team to be implemented within the scope of a student club at a private school, and the present study aimed to evaluate the role of those extra-curricular activities which provided students an autonomous learning environment in which the students voluntarily participated in a variety of extra-curricular activities and felt free for engaging or not engaging in the activity, and collaborated and co-operated with their friends on developing students' knowledge, attitude and skills in order to fulfill the "attitude-behavior" gap.

2.4. Role of Extra-curricular Activities

Environment is an abstract term; therefore, environmental education should include real examples from the environment itself (Alım, 2006) because the main aim of the environmental education is not just constructing a knowledge-base, but also educating students as citizens who have awareness on and positive attitudes toward their environment (Demirkaya, 2006). Karataş and Aslan (2012) claim that classroom environment is not enough to promote activities on environment and do not provide a leaning environment that students can recognize their environment.

Inadequacies in the formal curricula lead educators apply for other solutions; therefore the literature has some research studies about the importance extra-curricular activities on education, particularly on the environmental education (Erten, 2004; Karatas, 2011). Karataş (2011) examined the role of natural history museums on increasing environmental awareness and how they take place in Turkish education system. The author concluded that to raise environmental awareness, more importance should be given to natural history museums in Turkey as they do in abroad. On the other hand, in his study on environmental education, Erten (2004) claimed that environmental problems cannot be overcome through only making policies and developing technologies; instead, individual behavior changes should be promoted and this can be through environmental education. Also, he states that environmental education is neglected, at least in practice, at schools' formal education.

Moreover, in a study, researchers determined the views' of teachers about the role of informal learning environments on environmental awareness (Çavuş, Topsakal, & Öztuna Kaplan, 2013). The authors used a fenomological approach and collected qualitative data through semi-structure interviews and open-ended question forms. Findings revealed that teachers mostly prefer preparing posters for school's noticeboards and organize trips. Besides these, writing diaries and making researches are other extra-curricular activities students involve in. Teachers stated that these activities help students increase awareness, make them behave more consciously and help develop skills on environment. Similarly, Finn (2002) conducted a survey study

and claimed that engagement in extra-curricular activities helps students build one's self-worth and become lifelong learners. Moreover, he revealed that girls were more likely to participate in some form of extracurricular activities than were boys that boys tend to participate in athletics, whereas girls are more likely to be involved in drama and other nonsport activities.

Extra-curricular activies encourage students' academic achievement (Davalos, Chavez, & Guardiola, 1999; Feldman & Matjasko, 2007; Guest & Schneider, 2003; Stearns & Glennie, 2010). On the other hand, extracurricular activities are not only associated with academic skills, but also they help students develop non-academic skills such a higher social and academic self-concept, self-worth, social self-concept and general self-worth compared to non-participation (Blomfield & Barber, 2009; Broh, 2002; Mahoney, 2000; Stearns & Glennie, 2010).

Mahoney, Cairns, and Farmer (2003) conducted a study to investigate whether extra-curricular activities promote interpersonal competence and educational success. They interviewed 695 boys and girls in the US annually to the end of thigh school, and re-interviewd when they are 20 years old. Findings of the study showed that participation in extracurricular activities help students develop interpersonal skills, set challenging life goals, and promote educational success. In this respect, Keser, Akar, and Yildirim (2011) evaluated the role of extra-curricular activities on educating elementary students as active citizens through a case study. The findings of the study revelaed effectiveness of extra-curricular activities in developing students' *active citizenship perceptions, social accountability, intercultural awareness, awareness of democracy and human rights, thinking and research skills, and interaction and interpersonal skills*. Likewise, Duncan (2000) proposed that students who engage in extra-curricular activities are more likely to become leaders; to complete different tasks autonomously; to develop better life skills; to value education, environment, and to prioritize others' needs. However, in Turkey, there are still some deficiencies in school-based extra-curricular activities that participation in them is quite low and they are not well organized (Sarı, 2012).

In Turkey, extra-curricular activities are being implemented mostly within the scope of student clubs. Onay and Gelen (2013) investigated the effectiveness of social clubs at primary school level based on managers' and teachers' views. The authors determined some deficiencies in the implementation of social club activities. Differences between the ages of the students, crowded classes, physical and social drawbacks at schools, limited time and budget, and lack of emphasis on club activities are some of those deficiencies. Moreover, it was found that teachers think that activities do not reach their aims because of inadequate allocated time for the activities, and inadequacy of in-class activities at attracting students' interests.

In line with the research studies mentioned above, when the literature is searched how climate change takes place within the scope of extra-curricular activities, there are some projects about climate change implemented in different countries. For example, Twenty First Century Science (C21), a new national curriculum for science was introduced for students aged 14-16 in England and Wales in September 2006. In this context, General Certificate of Secondary Education (GCSE) courses were developed by the Project Team with the partnership of many teachers, scientists, schools and authors who have contributed to the development of the course specifications and materials. The project aims to develop a curriculum model for science that offers flexibility and genuine choice to meet the needs of students' different interests and aspirations through supporting materials and trainings for teachers. Moreover, it aims to construct a science perception that all students can engage in and experience in their everyday life, in this respect, it offers courses including a wide variety of topics from bio-diversity to environment ("Welcome to Twenty First Century Science", 2013).

Similarly, in Turkey there have been some attempts to educate students and public about climate change. For example, the General Directorate of State Meteorology (GDoSM) translated the report "We Care for our Climate," prepared by the World Meteorological Organization (WMO), to Turkish in 2005 and sent copies of this report to all elementary schools. Turkish Foundation for Combating Erosion, Reforestation and the Protection of Natural Habitats (TEMA) and Turkish Marine

Environment Protection Association (TURMEPA) “Do not let our future melt” carried out a project on global climate of in 2008. They traveled around some seashore by a ship which had three wind turbines meeting most of the energy need of the ship. Within the scope of this project, 37.544 people were reached and informed about climate change. Other project organized by Turkish Education Association for High-Performing Needy Children (TOCEV) and The Ministry of National Education (MoNE) was “The Footprints of Tomorrow.” This project aimed to raise awareness among second and third grade primary school students. In the project students were informed about global climate change through movies, theatre plays and special books prepared for the project.

However, in Turkey, as mentioned above, projects on climate change mostly aim to raise awareness among people, yet less try to develop attitudes and skills. “Green Pack” is one of those limited projects in which the Regional Environmental Center for Central and Eastern Europe (REC), REC Turkey and Turkish Bird Research Society and Nature Society, along with the MoNE, the Ministry of Environment and Forestry, Non-Governmental Organizations (NGOs), and lots of other institutions, foundations and individuals collaborated. The Green Pack is a multi-media environmental education curriculum kit primarily intended for primary school teachers and their students. It emphasizes changing behaviors of the primary school students and provides active participation of them in the activities with teacher guide, yet when we consider the intensity of the curricula, implementation of those activities within the class hours may cause problems. In this respect, when the literature is examined, there are a limited number of studies about how the deficiencies in the formal curricula can be overcome.

Briefly, extra-curricular activities can be helpful to fulfill the shortcomings of the formal curricula. Therefore, within the scope of the present study, a case study was conducted in a private school in order to determine the role of extra-curricular activities in students’ developing knowledge, attitudes, and skills with regards to climate change, climate change adaptation and mitigation.

2.5. The Importance of Climate Change Education

When the history of climate change and its impacts are analyzed, the conclusion can be drawn as today we face human- induced climate change and it affects a variety of sectors (eco-systems, forests, agriculture, power generation, and also human health). In order to cope with the problems and mitigate and adapt to climate change, policy makers should consider possible straegies and actions, and make the public aware of them. "The prudent response to climate change, therefore, is to adopt a portfolio of actions aimed at controlling emissions, adapting to impacts, and encouraging scientific, technological, and socio-economic research" (UNEP & UNFCCC, 2002, p.5).

This does not mean that all countries should agree on a single policy to be applied globally in order to maintain it for the next 100 years; on the contrary, each country should develop strategies and adjust them over time in the lights of new information and changing circumstances. Furthermore, in order to adapt to climate change, to reduce emissions, and to improve the knowledge base, national policies should be constructed that can reduce the risks of rapid climate change while promoting sustainable development (IPCC, 1995).

The fact is that changes in climate are now observable: there is an increase in the average global air and ocean temperature, melting of ice has become wide-spread, and the average sea level has raised worldwide (IPCC, 2007a). Also, most of the observed global warming over the past fifty years has evidently derived from human activities (UNEP/UNFCCC, 2002). According to the IPCC (2007a), as human activities continue to add greenhouse gases – carbon dioxide, methane, and nitrous oxides – to the Earth's atmosphere, global temperatures are expected to rise, causing the Earth's climates to change. These climate changes may affect precipitation patterns, severe and extreme weather events, and, over time, environmental systems. Furthermore, human health and agriculture may be sensitive to climate change. Hence, being educated is important to know and gain necessary skills in order to cope with the threats of climate change. The U.S Global Change Research Program/ Climate Change Science Program (2009) defined climate science literacy as:

"understanding your influence on climate and climate's influence on you and society" (p.3). They included recognition of sources of greenhouse gases and perception of basic weather and climate science and determined the requirements of being a ***climate-literate person***:

- understands the essential principles of Earth's climate system,
- knows how to assess scientifically credible information about climate,
- communicates about climate and climate change in a meaningful way, and
- is able to make informed and responsible decisions with regard to actions that may affect climate (p.3).

Educating citizens as climate-literate people will contribute societies' long-term ability to adapt to climate change (International Council on Human Rights Policy, 2008). Therefore, climate change issues have been included in the formal and non-formal curricula, and educational materials have been developed for teachers and those interested in climate change education. The literature has many studies about how climate change takes place at schools (Erdogan, Kostava, & Marcinkowski, 2009; Gökçe & Kaya, 2009). However, the literature does not reveal promising findings related to the studies conducted so far, in other words, it can be summarized as available studies point out deficiencies in the issue of climate change education in schools.

2.5.1. Climate Change Education in Formal and Non-formal Curricula

When the studies and reports on climate change are interpreted, it can be concluded that as modern democratic societies' citizens, we should take responsibilities to participate actively in the climate change debate and to be able to make logical, well-reasoned decisions (Pettenger, 2007). The role of formal and non-formal education from primary through to tertiary and adult education to address climate change is incontrovertible in this respect (see Figure 2.7). As figure 2.7 indicates, education has an important role in the adaptation and mitigation processes. Short term impacts of education mostly include adaptation strategies which include increasing knowledge and preparedness to disaster. In the medium term, reforms in

the curriculum and teacher education can be considered. Through developing mitigation strategies in the long term, sustainability gains importance.

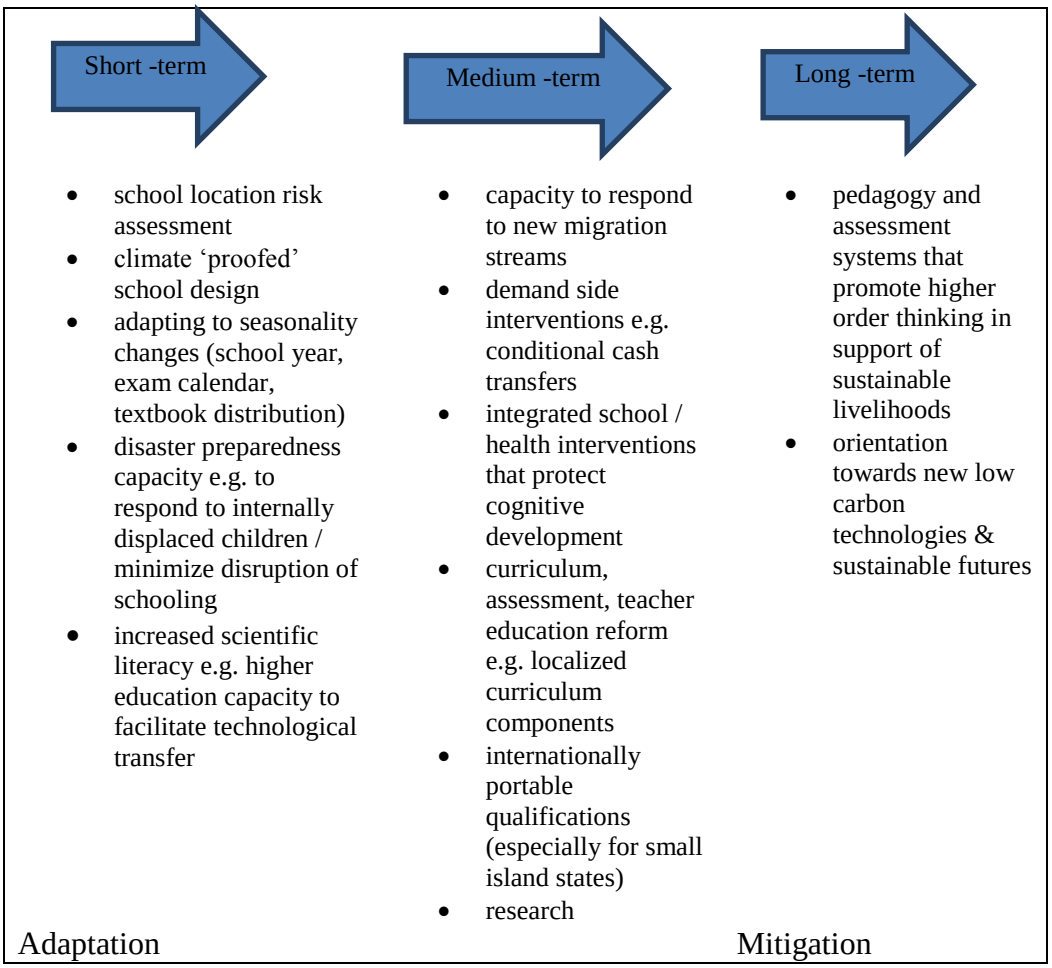

Figure 2.7 Educational responses to climate change a generalized sequential view. From "Education responses to climate change and quality: Two parts of the same agenda?" by C. Bangay and N. Blum, 2010, *International Journal of Educational Development,* 30, p. 365.

Being aware of the role of education on raising awareness among people and making them take actions, many countries have been developing projects and ducational materials. In the following part a brief summary of them will be given.

Projects on climate change education: In lights of the role of education in promoting a climate-friendly citizenship, some governments have developed projects on climate change. In the Canadian province of Newfoundland and Labrador, an

action plan on climate change emphasizing local effects of it has been adopted since 2005 (Nazir, Pedretti, Wallace, Montemurro, & Inwood, 2009). In line with this action plan, formal curricula have been revised. For example, elementary and high school curricula include living organisms and human effects on their survivals, energy conversation, cultural preservation and sustainability. The issue of climate change is generally given within the scope of sustainability; however, 10th and 11th graders' science curricula include specific units climate change (Shaw & Trand, 2012). In addition, a specific course called Environmental Science Course has been developed to deal with environmental problems, particularly climate change ("Newfoundland and Labrador, Department of Education", 2013).

Australia is an excellent example of ESD that they have a project called National Solar School Program which have been providing over 217$ million to 5,310 schools (almost 60% Australian schools) to install renewable energy systems, rainwater tanks and a range energy efficiency measures. Also, the funding educated students about renewable energy and energy efficiency, and the actions they can take to reduce carbon emissions ("Australian Government, Department of Resources, Energy, and Tourism", n.d.).

Similarly, Storm Peak Laboratory (SPL) is an example to them that the scientists and the staff have developed a hands-on program which is Curriculum in High Altitude Environments for Teaching Global Climate Change Education (CHANGE), a three-day program for fifth and sixth grade students. CHANGE started in 2006 and approximately 250 grade students annually join in it. The program helps students to gain an understanding of the methodology of science and teaches the relationship between climate and weather, and concepts that are important for understanding climate change (Storm Peak Laboratory, n.d.).

Another project is "Climate Change Before the Court" that aims learning of science itself, and also using science teaching to attain general educational objectives (Feierabend & Eilks, 2011). Lesson plans for chemistry classes including different domains of science teaching developed also considering how learning can provide an understanding of behaving responsibly in society. In line with these lessons plans,

units were also developed for physics, biology and politics classes. This was Participatory Action Research project by a group of teachers in a western German city implemented in 10th and 11th grade classes (age range 16-17) in different grammar schools, and lasted for 3 years (2008-2011). Lesson plans were developed for chemistry, physics, biology, and politics classes. The unit lasts a total of about 7-10 hours (45 min. classroom periods). The findings revealed that according to the teachers, students showed high levels of interest and motivation. The students also evaluated the lessons as effective and the approach as good or interesting. Both independent work and group learning were quite often given positive feedback; however, students were confused to place the content in chemistry which shows the complexity and inter-disciplinary approach of the issue.

Considering the curricular resources mentioned above, there are also many other written sources on CCE such as "A Teacher's Guide to *How We Know What We Know About Our Changing Climate:* Lessons, Resources, and Guidelines about Global Warming" (Malnor, C.I., 2008), "Hands-on Materials for Teaching about Global Climate Change for pre-service teachers" (Rule, A.C., Hallagan, J.E., & Shaffer, B., 2008) "Climate Change Information Kit" (UNEP & UNFCC, 2001), "Teachers' Guide on Climate Change and Energy" (World Wildlife Fund [WWF] & Tetra Park, n.d.) and "PowerDown: Teacher's Booklet for Secondary Schools" ("PowerDown", nd) a climate change toolkit for high schools developed as a part of EC funded Global Actions Schools project.

Teaching approaches and materials: Climate change is a complex term that requires specific competence development. For this reason, literature has some studies suggesting some teaching approaches and materials for climate change education. To illustrate, for sustainable development a framework with a number of requirements that are important for coping with climate change was determined (Burandt & Barth, 2010). The competences were classified into four categories including *analyzing, acting proactively*, "*using, shaping, handling and sharing different sets of information and knowledge*" and *proactive thinking*. For acquisition of such competences three distinctive principles were suggested. Firstly, "Self-

directed learning" for the acquisitions of competences that seek for autonomous and constructive learning processes which can help students construct their own knowledge base in a self-direct manner is suggested. Secondly, they suggested using "Collaborative learning" for the acquisition of competences that include both individual and group activities which deal with both cognitive and social-affective development. Finally, for action-relevant procedural knowledge and skills "Problem-oriented learning" is favored.

Similarly, in their study, Devine-Wright, Devine-Wright and Fleming (2004) conducted an empirical research with 198 UK children and adults to explore the impacts of a cooperative learning environment on children's beliefs about global warming and energy. Positive and meaningful effect of collaborative learning for creating a learning environment which considers individual differences and perceptions of the students about global warming was favored in the study.

Computer assisted education was also claimed to have positive effects on understanding of environmental problems (Aivazidis, Lazaridou, & Hellden, 2006). Similarly, Boyes and Stanisstreet (2001) indicated that computer assisted education would be effective in coping with students' misconceptions.

When the issue of which kind of materials should be used in climate change education is discussed, literature says that visual materials seem to have positive effects on students when teaching about climate change. Taber and Taylor (2009) claim that using visual education resources / instruments helped increase students' level of knowledge about global warming and climate change. Similarly, in another study, cartoons and animations were found effective in increasing students' interests (Oluk & Özalp, 2007). Likewise, Feirabend and Eilks' (2010) study emphasizes the importance of climate change education, and the authors recommend developing units/lesson plans using the socio-critical, problem-oriented approach and also beginning with a film about climate change to each lesson.

These projects and research studies mentioned above provide good examples for climate change education because the research studies show that both the students

and the teachers mostly learn the information about environmental problems via visual and print media, especially television (Andersson & Wallin, 2000; Boyes & Stanisstreet, 2001; Groves & Pugh, 1999; Kılınç, Stainstreet, & Boyes, 2008; Öztaş & Kalıpçı, 2009; Spellman, Field, & Sinclair, 2003; Yılmaz, Boone, & Anderson, 2004); however, those often include just basic concepts and sometimes inaccurate information about climate change (Fortner 2001; Schuster, Filippelli, & Thomas, 2008).

Climate change in formal curricula: The studies about the place of climate change education in the current formal elementary and high school curricula help educators compare what they have about climate change in the formal curricula and how it should be. In their study, McCaffrey and Buhr (2008) claimed that it is essential to raise public awareness on climate change by educating students and even teachers with accurate and engaging information; however, climate change is often absent or poorly addressed in state and national education standards.

In this respect, Çeken (2010) conducted a comparative research, Turkey vs United States. The authors examined the place of Hydrological cycle which is considered asa part of environmental education, particularly CCE, in the 4 through 8 grade elementary science curriculum. The findings can be summarized as both nations' curricula were based on a spiral model design. In Turkey, skills were found to be determined in too much detail which was regarded as a drawback for implementing the curriculum in different regions with different socio-economic and environmental backgrounds. In the USA, randomly selected ten states' science curricula were examined. The author got that water cycle and related topics environmental pollution and sustainability included into the science curricula at 4^{th} grade level and continue until higher education.

Similarly, another comparative study on components of environmental literacy in elementary science curricula in Turkey and Bulgaria was carried out by Erdogan, Kostava, and Marcinkowski (2009). The authors analyzed textbook related to environmental education (n=4 for Bulgaria, n=1 for Turkey). The results of the study highlight that in both countries, curricula included well-established core

knowledge. In Turkey, although less attention was given to skills, they were well integrated into the curriculum; however, affective and behavioral dimensions were almost neglected. On the other hand, compared to Turkish context, in Bulgaria, cognitive and affective skills were well integrated but, as in Turkey, behavior development was paid less attention.

The studies mentioned above can be summarized as there is a lack of emphasis on climate change, climate change adaptation and mitigation in the formal curricula of the countries. In 20-40 years, todays' children will be taking responsibilities for global regulations in their communities (Shepardson, Niyogi, , Choi, & Charusombat, 2009); therefore, it is important to educate all of today's school children about the causes and impacts of climate change to develop required knowledge and competences (Mower, 2012).

2.5.2. Climate Change in Turkish Curricula

United Nations Development Programme (UNDP), climate change is not happening only due to natural effects but also due to the human activities which ruin compound of global atmosphere (United Nations International Strategy for Disaster Reduction [UN/ISDR], 2004). Also as the reports and research studies mentioned above reveal that there is an increasing interest in the topics on environmental pedagogy and climate change around the world since the first assessment report of IPCC was completed in 1990. After that, many of the field workers, including policy makers and educators, have been studying issues related to education.

However, in our country, the first comprehensive meeting about climate change was held in Ankara, in 2004. In this respect, since 1999, the MoEF and the MoNE signed a protocol to raise awareness among students on environment, to help them to acquire affirmative consumption habits, and to make them aware of the importance of afforestation and recycling. Also, the General Directorate of State Meteorology (GDoSM) has been annually organizing seminars on the 23rd of March,

the day of World Meteorology, collaboration with the MoNE, at the elementary and high school levels, more than 20,000 students, coming from Ankara and the cities around it, have participated in these seminars. Also, the GDoSM translated the report "We Care for our Climate", prepared by the World Meteorological Organization (WMO), to Turkish in 2005 and sent copies of this report to all elementary schools.

Despite these attempts, the current Turkish curricula narrow down the climate change issues into units as a subtopic. Also, there aren't sufficient objectives in the curricula on education for sustainability. Therefore, in the light of current situation and future possibilities on environment, curricula should be revised or redeveloped also with considering timing and learning environment for implementing activities (Ünal, 2011). In an observation study, researchers found that despite the environmental knowledge students have, they cannot develop ideas on taking action to protect their environment (Çakci & Oğuz, 2010). Similarly, Erdoğan, Koskova, and Marcinkowski (2009) also claimed a lack of emphasis on attitude and behavioral dimensions of environmental education. In this respect, in Turkey, aims of environmental education is determined as creating cognitive, affective and behavioral awareness among students and supporting them to be well educated citizens about environment (State Planning Organization, 1994). Table 2.1 summarizes in which courses and topics climate change is taught.

Table 2.1

Courses in which climate change issues are taught

Courses	9th grade	10th grade	11th grade	12th grade
Biology	Unit 2: Taxonomy and Bio-Diversity Unit3: Conscious Individual - Livable Environment	Unit 3: Eco-system Ecology	Unit1:Plant Biology	Unit 2: Start of Life and Evolution

Table 2.1 (cont.)

Courses	9th grade	10th grade	11th grade	12th grade
Chemistry	Unit 5: Chemistry in Our Lives	-	Unit 4: Electrochemistry	Unit 1: Chemistry of Elements Unit 4: Organic Compounds
Geography	Natural Systems A Spatial Synthesis: Turkey Environment and Society	NaturalSsystems Environment and Society	Natural Systems A Spatial Synthesis: Turkey Environment and Society	Natural Systems Environment and Society
Physics	Unit 2: Energy (FTTÇ-3. b-e,h-k; BİB-1.a-d, 2.a; TD-!.f,I,k,2.h; TD-2.c,d,g).	Unit1: Matter and Its Properties	Unit6: YIldızlardan Yıldızsızlara (FTTÇ-1.h;BİB-4.b,c,d).	Unit1: Matter and Its Properties (BİB-1.a-e 2.a-c 3.a-c)

2.5.3. Misconceptions on Climate Change

There has been an understanding of environmental education, particularly CCE that it is essential if future citizens are to assume responsible for the management and policy-making decisions (Brown 1992; Bybee 1993). Also, to increase the public's climate science literacy, it is vital to provide students and teachers accurate information about climate change (Hallar, McCubbin, & Wright, 2011). Therefore, as science education aims to support a citizenry that has knowledge about global warming and climate change issues, students' conceptions about global warming and climate change issues should be determined (Osborne & Freyberg 1985) to plan a curriculum constructed over students' concepts (Driver, Squires, Rushworth, & Wood-Robinson, 1994) because their misconceptions or alternative conceptions cause challenge for content understanding (Andersson & Wallin, 2000; Lester, Ma, Lee, & Lambert, 2006). In their study, Boyes and Stanisstreet (2001) administered a questionnaire to 1485 students in 30 teaching

groups in British National Curriculum Years 7 (age 11/12 years), 8 (12/13years), 9 (13/14 years), 10 (14/15 years), and 11 (15/16 years) and findings supported the idea of importance of education for coping with students' misconceptions on climate change, and the the important role of the school in overcoming students' misconceptions.

In the literature, there are many studies examining public perceptions on climate change (Kollmuss & Agyeman, 2002; Lorenzi et. al., 2006; Nisbet & Myers, 2007). The studies reveal that public concern about climate change is still low and there is a gap between people's knowledge/attitude and behaviors. Some other studies determined misconceptions of public on climate change. For example, Kempton (1997) reported confusions of global warming with ozone depletion and of air pollution among public. Similarly, a number of misconceptions were discovered among public, despite their high level of awareness (Stamm, Clark, & Eblacas, 2000). Their study revealed that public is aware of a range of causes of global warming; however, their understanding of key human activities, such as fossil fuel use, is limited. Similarly, Nisbet and Myers (2007) notes the most part of the American public still largely do not engage in solutions for climate change.

Moreover, another cross-national comparison was done specifically on global warming and climate change by Lorenzoni, Leiserowitz, Doria, Poorting, and Pidgeon (2006). Lorenzi et. al. surveyed what affective images underlying public risk perceptions of climate change are in the USA and Great Britain. Findings revealed that terms such as ''global warming'' and ''climate change'', and their associated images recall negative affective responses according to the participants. Also, causes, impacts, and solutions to climate change, are rarely stated in both nations.

Many research studies have been conducted to determine and eliminate the misconceptions of students. Leea et al. (2007) and Österlind (2005) highlighted the lack of sufficient scientific knowledge about the complexities of climate change and its impacts among kindergarten (K)–12 students. For instance, Gowda, Fox, and Magelky (1997) conducted a research with N=99 high school students. They

administered a questionnaire including open-ended and T/F questions. The results showed that there are some common misconceptions among students such as confusion of weather and climate, and ozone layer depletion causes climate change.

In addition, there are some other researches showing the confusion between weather and climate as the most common misconception among students (Gowda, Fox, Magelky, 1997; Pruneau, Gravel, Courque, & Langis, 2003). Other common misconception is about greenhouse gases. Additionally, literature shows that some students are unaware that CO_2 is a greenhouse gas (Boyes & Stanisstreet, 1997) and many more do not know that water vapour also is a natural greenhouse gas (Fisher, 1998).

Considering the literature that reveals misconceptionsexist among studnets, Choi, Niyogi, Shepardson, and Charusombat (2010) tried to determine the reasons behind students' misconceptions about greenhouse effect and global warming. They reviewed 17 studies on middle and high school students' misconceptions about climate change, and the findings revealed that students have some common misconceptions about weather and climate, and also have difficulties in defining greenhouse gases. The authors reached that mainly lack of core knowledge causes misconceptions.

Further, in their study, Sheppardson, Niyogii Choi, and Charusombat (2010) reviewed 15 international studies published between 1993 and 2008 that investigated secondary students' knowledge about the greenhouse effect, global warming, and climate change. The analysis results of their study revealed that students believed that air pollution causes global warming and climate change. Also, another commonly accepted conception among students was that global warming and climate change happen because of ozone hole (Andersson & Wallin 2000; Boyes et al. 1999; Boyes & Stanisstreet 1994; Österlind 2005; Pruneau et al. 2003). In addition, most of the students do not consider carbon dioxide as a greenhouse gas (Boyes & Stanisstreet 1993, 1997; Pruneau et al,. 2001). Moreover, students also have misunderstandings about the greenhouse effect that some students do not know what

the greenhouse effect is (Andersson & Wallin 2000; Pruneau et al., 2001) or they confuse the greenhouse effect and global warming (Andersson & Wallin, 2000).

Lastly, there are also some studies that emphasize the importance of teachers' own core knowledge on climate change to cope with the complexity of climate change terms (Groves & Pugh 1999; Papadimitriou, 2004).

The literature on misconceptions about climate change can be summarized as climate change education is the prudent way of dealing with climate change adaptation and mitigation processes because to solve a problem even a simple one, one should primarily understand the concept and context of it.

2.6. Student and Teacher Perceptions on Climate Change

There are many studies in the literature reporting students' and teachers' perceptions and concepts they developed about climate change and related issues. Some of them examined the ideas of elementary school students (Francis, Boyes, Qualter, & Stanisstreet, 1993, Shepardson, Niyogi, Choi, & Charusombat, 2009) and some of them investigated high science school students' perceptions (Boyes & Stanisstreet, 1993; Boyes, Stanisstreet, & Yongling, 2008). In this section elementary and high school students' perceptions on climate change are given. Next, pre-service and in-service teacher perceptions are stated.

2.6.1. Elementary School Students' Perceptions on Climate Change

Research on elementary school students' perceptions on climate change is rich in the literaturewhich can be summarized as students do not have core knowledge and they have misconceptions about global warming (Andersson & Wallin, 2000; Boyes & Stanisstreet, 1993; Gambro & Switzky, 1996; Rye, Rubba, & Wiesenmayer, 1997).

In a descriptive study investigating seventh grade students' conceptions on global warming and climate change, the authors gathered data from 91 7th grade students in the USA (Shepardson, Niyogi, Choi, & Charusombat, 2009). The findings revealed that the students don't have a rich conceptualization of the issue; especially they cannot explain the greenhouse effect and its connection to global warming. The authors concluded that there is a need for a curriculum which will cover the topics of "Carbon cycle and the greenhouse effect", "Global warming and climate change", and "Climate change impacts".

Similarly, an observation study held with fifty students including from 2nd graders to 8th graders in a low economic district of Ankara (Çakcı & Oğuz, 2010). An interactive seminar about environmental problems was organized in the study. Findings revealed that students are aware of these problems; however, most of them do not know the possible actions they can take regarding these problems. Industrial activities and traffic is claimed as the major causes for all kinds of environmental pollution. Renewable energy is little known and the students say that they learn this issue mostly via mass media. The students are aware of the importance of the recycling; however, teachers declared that recycling bins are not being used efficiently. Students have lack of knowledge about terms such as "sustainability", "renewable energy", "emission" and "carbon footprint".

Moreover, literature has also some other studies examining the impact of gender, age, socio-economic background on developing attitudes and skills with regard to environment problems, particularly climate change. In order to determine the elementary students' attitudes towards the environmental issues, a study was conducted with 789 8th grade students who enroll in 18 different elementary schools in Eskişehir (Gökçe, Kaya, Aktay, & Özden, 2007). A questionnaire, "Environment Attitude Questionnaire for Elementary School students" was administered to collect data and the results revealed that the participants have high attitudes related to the environmental issues. Also, there is a significant difference between genders in favor of females, their academic success levels; whereas, educational and economic backgrounds of the parents do not have any significant effect on the attitudes of the

students towards environmental issues. Similar findings were reached in Erol and Gezer's (2006) study that girls have more positive attitude towards environmental problems than boys. Moreover, it was claimed that the older students than younger ones, the students who have working mothers than the ones whose mothers are housewives, the students who don't have any brothers or sisters with regard than the ones who have brothers / sisters show more positive attitude. Other studies also supported these findings that female students are more sensitive than boys (Yılmaz, Boone, & Anderson, 2004; Şama 1997).

To summarize, the studies on elementary students' perceptions on climate change reveal that students have some common misconceptions or lack rich conceptualization of the problem. Shepardson, Niyogi, , Choi, and Charusombat's (2009) findings demonstrate that young people's scientific understanding of the causes of anthropogenic climate change largely depends on their formal education and they inform people around them about the information they gain at schools. Therefore, not only for students themselves, but also in order to reach most part of public, it is vital educating students with comprehensive and accurate information about climate change at schools (Bardsley & Bardsley, 2007).

2.6.2. High School Students' Perceptions on Climate Change

When the literature is reviewed how the situation is like in high school level, literature has some studies conducted to determine the perceptions of high school students' on climate change. Aydin's study (2010a) can be an example that the author conducted a research with about 166 high school students in Istanbul to determine their perceptions on global warming through a half-structured open-ended questionnaire form. The findings showed that students are unable to make an exact definition of global warming term; in fact their definitions are so general.

A similar study was conducted in Greece. It aimed to figure out what Greek high school students believe about global warming and climate change (Liarakou, Athanasiadis, & Gavrilakis, 2010). 626 students (8^{th} to 11^{th} grade levels) were

administered a closed-form questionnaire examining students' views on what the causes, impacts and solutions are for this global environmental issue considering their grade levels, gender, and previous participation in Environmental Education extracurricular programs. Despite the fact that some common misconceptions determined for all graders like the cause-effect relationship between the green-house effect and ozone layer depletion, 11^{th} graders are better informed on the issue than 8^{th} graders. Also, although students are aware of the impacts, they are confused about solutions and especially causes. Further, participation in an Environmental Education program seemed to be playing a significant role in affecting students' perceptions in a positive manner.

Likewise, in another study, high school students' opinions on participating in authentic science projects, which are part of an international EU project on climate change research was examined (Dijkstra & Goedhart, 2011). In order to determine organization; enjoyment; difficulty; and impact of the projects, questionnaires were used to gather data from 1370 students from 60 high schools across Europe. The findings indicated that both female and male students enjoyed authentic science education and the positive impact of the projects on the students' perceptions on climate change, especially for females. The results also showed the effectiveness of activities in which students had an active role, like hands-on experiments or presentation of results.

The literature on high school students' perceptions on climate change can be summarized as like elementary school students, they have some common misconceptions as well. This suggests a need for more emphasis at schools on teaching cause and effect relation between people, CO_2 emissions, and climate change (Mower, 2012).

2.6.3. Pre-service and In-service Teachers' Perceptions

As the literature explained above indicates, schools have an important role on educating students and eliminating their misconceptions about climate change. As

Lorenzoni, Nicholson-Cole, and Whitmarsh (2007) suggest that institutional encouragement is important to make changes in behaviors of people for climate change mitigation, and school are claimed to be a primary source of information on climate change by young people (Dupigny-Giroux, 2010). That is why the role of schools and teachers is vital to educating students about climate change.

As the schools and the teachers have a big deal of responsibility to raise awareness among students, literature on CCE also include some studies about in-service and pre-service teachers' perceptions on climate change issues. In a study, chemistry teachers' views on teaching climate change were examined in a case study through interviews (Feierabend, Jokmin, & Eilks, 2010**).** Teachers were asked about where this topic should be placed within the curriculum, how much time should be dedicated for this topic, and the content of lessons related to climate change within chemistry education. Findings showed that, almost all of the teachers said that climate change is part of their current curriculum and it should be within the formal education. However, there was not any consensus about allocation of the topic and the required time dedicated for this topic.

In another study, Oluk and Oluk (2007) analyzed the perceptions of 24 prospective teachers on greenhouse effect, global warming and climate change. The authors used semi-structured interviews to collect data and the findings revealed that 50% of the participants have misconceptions about climate issues. Also, they don't have enough information to explain the relations between the terms of climate change issues. Additionaly, in the study it is claimed that students should have enough knowledge to describe near future and be aware of the consequences of environmental problems to their life styles. Similarly, a study's findings showed that many of the college students have no idea about greenhouse effect and ozone layer or they have misconceptions (Bahar, 2000).

Another study conducted by Aydin (2010b) aimed to determine geography teacher candidates' views about environmental problems and environmental education. 122 teacher candidates at Geography Teaching Department, at Gazi University participated in the study. Participants were asked to list the environmental

problems and “wasting and unconscious use of natural sources” were listed as the most important environmental problems. Also, teacher canditates claimed that in order to solve the problems, the importance of environmental education was highlighted. “TV and radio” were emphasized as the most effective means that can be used in the environmental education, and as educational tools, “discussing titles as books, scripts, tv and radio programs related to environmental themes” were suggested.

Furthermore, Senel and Güngor (2008) conducted a research with 220 prospective teachers (Science Teaching [n=70], Biology Teaching [n=37], Turkish Teaching [n=29], Classroom Teaching [n=32], Social Science Teaching [n=52]). Findings were in congruence with the literature that although the participants are aware of the global warming, climate change, and precautions to be taken, they do not take even individually actions for this. The interesting finding of the study was that there were no significant differences between the participants who had these issues in their formal curricula and who did not have. This was concluded by the researchers as an evidence of importance of mass media for raising awareness.

As seen, the studies conducted with both prospective teachers and in-service teachers point out that even teachers lack some concepts and have conceptual misconceptions related to the biological diversity, carbon cycle, the thinning of ozone layer, and global warming (Summers, Kruger, Childs, & Mant, 2000, 2001). Moreover, although they are aware of the importance of the issue and emphasize the need for a climate change curriculum, they have limited knowledge on the issue and how to integrate it into to curriculum.

Finally, to sum up, the literature reveals that CCE has been considered all over the world including Turkey by many scholars, government, and NGOs; however, there are some deficiencies faced during the process such as lack of adequate time and theoretical background, inadequate physical facilities of school, and intensive curricula; thus, educators face with challenges while teaching about climate change that it requires a variety of knowledge and skills. Furthermore, as Sean (2007) claimed, educators say they face challenges also in finding accurate and

student-friendly classroom activities and lessons on the topic. Additionally, intensive curricula cause additional challenges; for this purpose, “the level of education and the local and national contexts, as well as global impacts, should be considered” (Shaw & Tran, 2012, p.287). Further, the literature on climate change in formal curricula can be summarizied as formal curricula lack emphasis on attitudes and behaviors. Therefore, the literature also suggests that extra-curricular activities can be helpful for overcoming deficiencies in the formal curricula.

CHAPTER III

METHOD

This chapter presents the method used in this research study. It includes design of the study, context of the case, participants of the study, data collection instruments, data collection procedures, trustworthiness, data analysis procedures, and the limitations of the study respectively.

3.1. Design of the Study

This study was designed as an intrinsic case study complemented with little quantitative research within a mixed-methods research design in which the latter, qualitative research was emphasized that offer an in-depth insight into the context of the study (Yin, 2009). The study was conducted at a private school in Ankara to assess the role of extra-curricular activities on developing students' knowledge, attitudes, and skills with regard to climate change, climate change adaptation and mitigation.

As utilized in this study, a case study design provides opportunities to gather in-depth information of a critical incident, a single subject, or a single depository of documents (Bogdan and Biklen 1998, Patton, 2002). A case can include just one individual, classroom, school, or program (Fraenkel, Wallen, & Hyun, 2012). Another definition of case study is given in Creswell's (1998) book that it explores a case or multiple cases over time through multiple data collection instruments rich in content. Three types of case studies were identified by Stake (1997): intrinsic case study, instrumental case study, and multiple-case study. In an intrinsic case study, as

utilized in the present study, the researcher primarily intends to understand a specific individual or situation, and describes the case in detail to determine what is going on. On the other hand, an instrumental case study helps the researcher reach a more general conclusion beyond a particular case. Lastly, multiple-case studies enable the researcher study on multiple cases at the same time.

Through case study, researcher can get findings about multi-factors interacted to each other and these factors constitute the uniqueness of the entity. To collect data in a case study, Yin (2009) suggests using six types of sources which are documentation, archival records, interviews, direct observations, and physical artifacts. In this study, semi-structured pre, reflective and final interview forms, and semi-structured observation form were used to collect qualitative data.More specifically, main reason for why this study was designed as an intrinsic case study is that the aim of this study is to carry out an in-depth inquiry in order to get empirical evidence about a phenomenon within its real-life context (Yin 2009).

Then, CLIMES Student Questionnaire was administered to diagnose students' knowledge, attitudes, and skills to entire school population within the scope of project CLIMES. However, in line with the study, Green Team Student Club members' (n=18) responses were singled out to analyze.

Quantitative data collected through a ready student questionnaire, CLIMES, helped to diagnose students' pre-knowledge, attitude, and skills with regard to climate change, climate change adaptation and mitigation. Descriptive analyses of the questionnaire results are reported based on means of frequencies and percentages. To get deeper understanding to complementing to the student questionnaire, pre-interviews were made with the Green Team Student Club teachers (n=2) and students (n=3). Qualitative data were obtained through reflective interviews during the process of the case and final interviews at the end of the case, and through in-depth field notes during observations. Observations were made for 20 weeks and they were supplemented with student and teacher refledtive interviews. In this respect, 48 reflective student interviews were conducted and two teachers (n=2) were

interviewed after each club session during 20 weeks, comprising to total 40 reflective interviews with teachers.

The aim of the study was investigating how a school club deasl with climate change, climate change adaptation and mitigation through extra-curricular activities. The student club was founded in line with the requirements of an EU project which the school was a partner of it: Climate Friendly School Management in European Schools. In collaboration with the Turkish project team from METU, Department of Educational Sciences, a set of extra-curricular activities on climate change were implemented within the scope of the student club. The extra-curricular activities aimed to build knowledge, attitude, and skills on climate change, climate change adaptation and mitigation among students. For this purpose, 18 volunteer Green Team members calculated the school's carbon footprint, and two biology teachers guided them in the club sessions. The flow of the study is given in Figure 3.1.

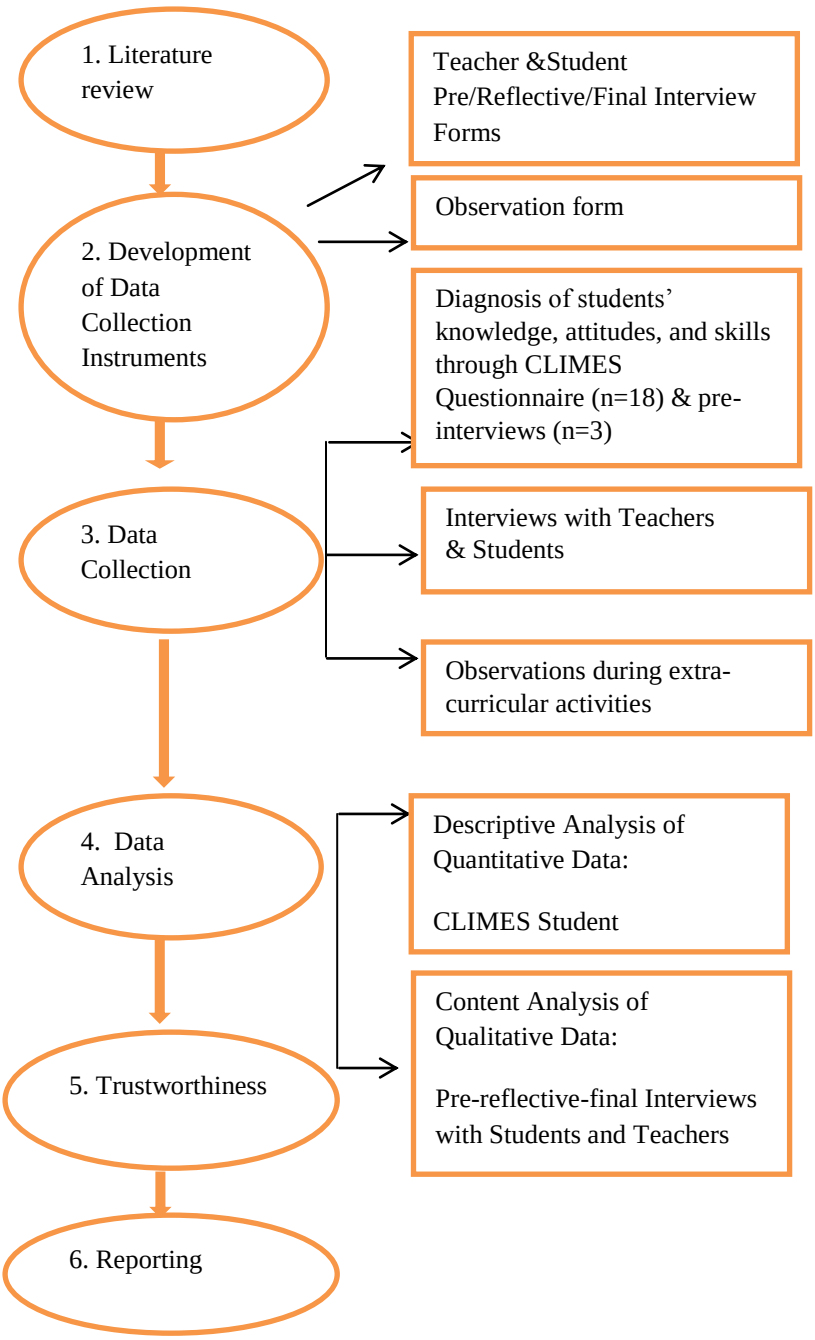

Figure 3.1. Flow of the Study

The steps given in Figure 3.1 were followed in this study. Initially, what students' pre-knowledge, attitudes, and skills on climate change, climate change adaptation and mitigation, how climate change takes place within the formal curricula, and the role of extra-curricular activities in education were reviewed in the literature. Next, data collection instruments which were teacher and student pre/reflective/final interview forms and observation form were developed (see Appendix B). Two curriculum and instruction experts were consulted on the content and face validity of the instruments. Based on their feedbacks on the content and face validity of the instruments, some revisions on the wording of the instruments were made.

Afterwards, the role of extra-curricular activities on students with regard to developing knowledge, attitude, and skills on climate change, climate change adaptation and mitigation was observed, and in-depth field-notes were taken during the observations, and those were complemented with reflective and final interviews made by the researcher with both student and teacher participants. Then, before reporting the research, quantitative data got from CLIMES Student Questionnaire, and qualitative data emerged from interviews and in-depth field notes were analyzed.

This study lasted for 20 weeks, one and a half hour per week during two school semesters. The first semester was mostly about building a knowledge base on climate change, climate change adaptation and mitigation through extra-curricular activities that included seminars by experts, site visits, or knowledge-building dissemination activities such as preparing posters for bulletin boards. The second semester included activities in which students were expected to collect data for calculating the school's carbon footprint through student- centered activities that required student autonomy and self-regulation. Furtheremore, students had to develop strategies for climate change adaptation and mitigation, and to enforce the school stakeholders to implement those strategies and so that results were evaluated during those club hours. Finally, post-interviews with purposefully selected student participants and teachers were conducted to understand the overall impact of the role of the extra-curricular activities on student learning, attitudes, and skills with regard

to climate change, climate change adaptation, and mitigation. Table 3.1 reveals the timeline for the case study conducted.

Table 3.1

Time line of the study

Months	Jan	Feb	Mar	Apr	May	Oct	Now	Dec	Jan	Feb	Mar	Apr
Literature review & development of the data collection instruments: pre/reflective/final interview and observation forms	*	*										
Content & face validity of the instruments		*										
Diagnosis of student and teacher pre-knowledge, attitude, and skills through CLIMES Questionnaires and pre-interviews		*										
Observations of the extra-curricular activity of the sessions			*	*	*	*	*					
Student and teacher reflective interviews about extra-curricular activity of the sessions			*	*	*	*	*					
Student and teacher final interviews								*	*			
Data analysis			*	*	*	*	*	*	*			
Reporting									*	*	*	*

Note: The time line starts on January, 2012, and ends on April, 2013.

3.2. Context of the Case

This study was conducted at the METU-DFHS which aims to promote students who demonstrate Atatürk's principles and who are equipped with the knowledge, skills and insights vital in the 21st century by providing those learning environments and opportunities to ensure that students achieve the fullest possible realization of their individual potential. In line with its aims, educating the students as citizens who are aware of the problems, including environmental problems and climate change, the school has been involved in many projects which cover contemporary issues of today's world and conducted extra-curricular activities within the scope of student club studies. Specifically, the school desires to raise awareness about environmental problems among the students and become role models for other schools as being a pioneer in the field of environmental education through learning projects that implements a climate friendly management system in the school (for more detail visit the school's website http://www.odtugvo.k12.tr/).

The METU-DFHS is a private school, and since Turkey has a centralized education system, the school has to follow the formal curricula; however, the school has also flexibility in the implementation of them that it also provides students with a rich variety of extra-curricular activities within the scope of student clubs. In 2005, the MoNE determined the aims of student clubs' as "In line with general aims and principles of Turkish National Education, they encourage students to be educated as citizens live up to Atatürk's principles and reforms, and to develop their skills that they require" (MoNE, 2005). There exist 27 student clubs in the METU_DFHS, including clubs such asbasketball, dance, photography, philosophy, etc. The student club sessions are on Thursdays, and last for one and a half hour.

Being aware of the role of extra-curricular activities on education, the school is interested in implementing projects on environment so there have been international projects (e.g. Young Reporters for the Environment [YRE], and [NAIS] National Association of Independent Schools Challenge 20/20) being implemented at the school. The program for the extra-curricular activities implemented in the Green Team club was considered as the case to be evaluated. In other words, the present

case was a Comenius project Climate Friendly School Management at European Schools (CLIMES Project). The project started to be implemented within the scope of Green Team Student Club on January, 2012. It aimed to encourage all schools, teachers, parents, pupils, students and other important stakeholders to move forward, working together in order to face the climate change to foster learning on climate change and to reduce climate change impacts at schools under the guiding principles of mutual responsibility. Additionally, the project argues that increased effort and collaboration are required in order to achieve these targets, and there is a definite need to work cooperatively with different stakeholders to reduce climate change impacts at European schools (for more detail visit http://www.climes.eu/, http://www.eds.metu.edu.tr/climes.html).

The ultimate goal of CLIMES project was developing an action plan to reduce carbon footprint of the school. Therefore, during the study the students collected data on energy, water, waste, and transportation in order to calculate their school's carbon footprint on each domain. In addition to the requirements, extra-curricular activities and factsheets on climate change, climate change adaptation and mitigation were designed by curriculum and instruction field experts from METU to firstly construct a theoretical background, and then increase attitudes, and finally help students develop lifelong learning skills during the measurement of the school's carbon calculation process. To illustrate, seminars were put in the extra-curricular activities plan of the Green Team Student Club to help students increase knowledge and awareness; videos and site visits to energy laboratories to make students have a visual understanding of the phenomenon; preparing posters and writing articles for the school journal to help students not only increase knowledge, but also to develop skills. Ultimately, the current case study attempted to evaluate those extra-curricular activities so as to understand their role on developing students' knowledge, skills, and attitudes toward climate change, climate change adaptation and mitigation. The extra-curricular activities implemented during the study are given in Table 3.2.

Table 3.2

Extra-curricular activities implemented in the Green Team Student Club

Extra-curricular activities	Content of the activity	Aim of the activity
Seminars	Students participated in the seminars on: • Global Climate Change and Its Impact : Turkish Case; from an expert from UNDP • Earth Climate History; from two experts at METU, Department of Earth System Science • Solar Decathlon; from METU partners of the project • Solar Energy from three experts at METU, Physics Department	help students : • build a knowledge base and conceptual understanding of climate change • overcome their misconceptions • develop attitudes through raising their awareness
Preparing posters	Students prepared posters in groups for the school bulletin boards on climate change, climate change adaptation and mitigation. The posters included a diversity of topics such as; • transportation • data analysis results of carbon footprint of the school • waste • the effects of consumption habits on climate change • climatic facts	help students : • build a knowledge base and conceptual understanding of climate change for themselves • building a knowledge base for school population • overcome their misconceptions • develop attitudes through raising awareness among their peers • disseminate their works • develop skills such as; ➢ communication ➢ collaboration ➢ discussion ➢ information-manegement ➢ leadership ➢ research
Watching video	Students watched a video on Hydroelectric centrals and their effects on the environment, and a documentary about facts on climate change.	help students : • build a knowledge base and conceptual understanding of energy sources and their impacts on the environment & what climate change and the impacts of it are • develop attitudes through raising their awareness • develop visual understanding about climate change and its impacts & the harms of Hydroelectric centrals

Table 3.2 (cont.)

Extra-curricular activities	Content of the activity	Aim of the activity
Writing article	Students worked in groups to write an article about carbon footprint for the school journal.	help students : • build a knowledge base and conceptual understanding of climate change mitigation • develop attitudes through raising awareness among their peers • disseminate their works • develop skills such as; ➢ communication ➢ collaboration ➢ discussion ➢ information-management ➢ research
Site Visits	Students visited to an energy park in Ankara, and Solar Laboratory at METU, Physics Departments. Students touched the materials and participated in demonstration experiments.	help students: • build knowledge about energy sources and materials, history of energy produce, renewable energy sources • develop visual understanding about energy sources/materials/renewable energy sources • have the opportunity to learn through experience
Participating in meetings of the project	Selected students participated in the meetings of the project with their European partners. Two meetings were held; one in Hungary, and one in Stockholm. In the meetings, the students shared their works and action plans. They worked in groups with their peers from partner schools.	help students: • build knowledge on potential actions to be taken for climate change adaptation and mitigation, and what other countries do and also what their sources are for climate change adaptation and mitigation • develop skills such as; ➢ communication ➢ collaboration ➢ discussion ➢ negotiation ➢ critical thinking
Carbon footprint Calculation	Students calculated the school's carbon footprint on five topics; "journal to school, energy use in the school, energy use in the class, water, and food".	help students: • build knowledge on what carbon footprint is and how to reduce it. • increase awareness on climate change

Table 3.2 (cont.)

Extra-curricular activities	Content of the activity	Aim of the activity
	Students worked in groups to collect and analyze data. Students developed strategies to reduce their carbon footprint. Students also informed others at school about their findings and tried to encourage them take action in order to reduce the school's carbon footprint. Students collected data again to asses whether their strategies worked or not.	• develop positive attitudes toward environmental problems, particularly climate change • develop skills such as; ➢ communication ➢ collaboration ➢ discussion ➢ negotiation ➢ critical thinking ➢ problem solving

3.3. Participants of the Study

This case study included 18 students and their two biology teachers who were members of a strudent club in a private school. The student cub was Green Team Student Club and the members were volunteers to work on a Comenius Project CLIMES. They also voluntarily accepted to participate in the present study. Therefore, these students and the teachers constituted the subjects of this study.

Among the 18 students, only 3 were male, and the rest (*n*=15) were female. Most of the students were between 16 year old (*n*=9, %50) and 17 year old (n=7, %38.9) (see Table3.3). Almost all of the members of the Green Team Club were from 11^{th} grade (n=15, %83.3), and the rest (n=3, %16.7) were 10^{th} graders (see Table 3.3).

Table 3.3

Demographic information of students

Students	Gender	Age	Grade Level
$S1_2$	Male	15	10
$S2_2$	Female	17	11
$S3_2$	Female	16	11
$S4_2$	Female	17	11
$S5_2$	Female	17	11
$S6_2$	Female	18	11
$S7_2$	Female	17	11
$S8_2$	Male	16	10
$S9_2$	Female	17	11
$S10_2$	Female	16	11
$S11_2$	Male	16	10
$S12_2$	Female	16	11
$S13_2$	Female	17	11
$S14_2$	Female	16	11
$S15_2$	Female	16	11
$S16_2$	Female	16	10
$S17_2$	Female	16	11
$S18_2$	Female	17	11

Two biology teachers of the METU-DFHS were responsible for guiding the Green Team Student Club. Both of the teachers were female and had master degree. They both had run a student club dealing with environmental problems. In those clubs, they implemented extra-curricular activities in line with the projects they participated in. T1 had worked for the project NAIS Challenge 20/20, while T2

participated in the project Young Reporters. She also had participated in an in-service training COMENIUS program about plant diversity and health.

Table 3.4

Demographic information of teachers

Teachers	Gender	Teaching Area	Graduate Degree	Experience Year	Club Experience	Joint Project
T1	female	Biology	Master	7	Yes	NAIS Challenge 20/20
T2	female	Biology	Master	8	Yes	Young Reporters & COMENIUS LLP In-service Training for Plant Diversity and Health

In this study, the teachers were the implementers of the extra-curricular activities. However, their role role as a teacher was more like a guide that a student-centered approach was utilized in the implementation of the extra-curricular activities. Therefore, students were active and autonomous during the process.

3.4. Data Collection Instruments

In this study, both qualitative and quantitative data collection instruments were used. At the beginning of the study, quantitative data were collected through CLIMES Student Questionnaire. Next, pre-interviews were made with the Green Team members and teachers of the student club in order to diagnose students' pre-knowledge, attitudes, and actions with regards to climate change, climate change adaptation and mitigation. On the other hand, qualitative data were collected through

semi-structured interviews (pre, reflective, and final) and semi-structured in-depth observation form.

CLIMES Student Questionnaire: Initial data was gathered through CLIMES Student Questionnaire developed by CLIMES project team. The questionnaire was administered to entire school population (*n*=478) including students from science and social science classes from 9th to 12th graders at METU-DFHS in order to determine students' pre-knowledge, attitudes, and behaviors on climate change, climate change adaptation and mitigation as a part of the project CLIMES. In this current study, surveys of the students who attended the Green Team club were singled out to understand the knowledge, skills and attitudes of the participants of who attended the current case. This provided the researcher a broader perspective of student perceptions on climate change, and guided developing interview and observation forms (see Figure 3.2).

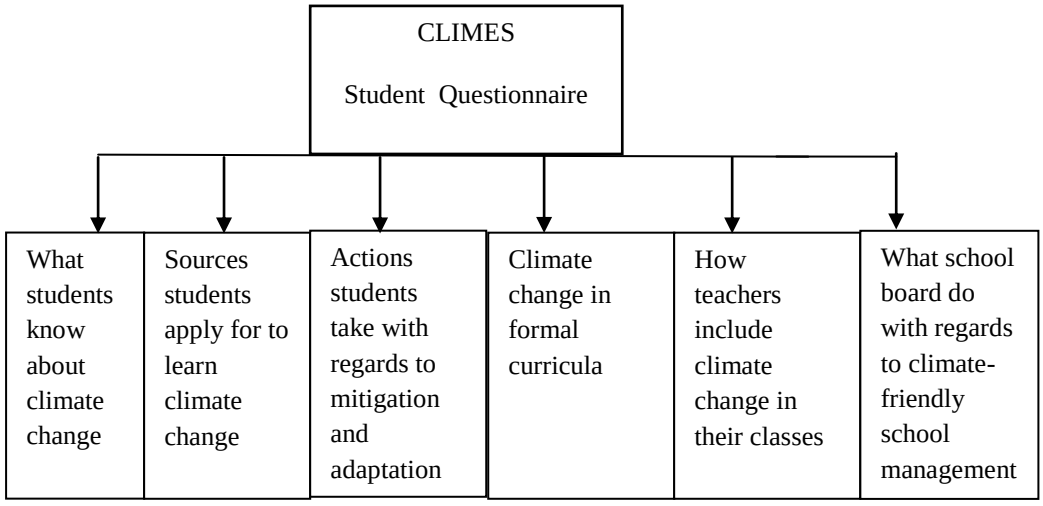

Figure 3.2 Content of the CLIMES Questionnaire.

The CLIMES questionnaire, as mentioned above, was an adopted survey and questionnaire included two parts. The first part intended to determine the students' demographic information (gender, age, grade level, student club that they

were a member of). The second part included six open-ended questions and they intended to determine the students' climate change definition, the factors causing climate change, the actions to be taken for climate change, why they felt responsible for learning climate change, their suggestions for the school to struggle with climate change and protect the environment, and finally their further suggestions and opinions that were not mentioned in the questionnaire.

In the questionnaire, there were also two multi-response items: one was about the topics students had learned about climate change at their school, and the other was the actions they took within and outside of the school for climate change adaptation and mitigation. Students were expected to mark a list of choices.

Students also wanted to mark one of the responses among Yes-Partially-No to respond whether they feel responsible for learning climate change.

One of the items in the questionnaire including 14 sub-items intended to determine the students' perception on the degree of danger of climate change impacts. Students were expected to respond whether the given impact was Dangerous, Little Dangerous, Very Little Dangerous, and Danger Free.

Lastly, a four point frequency scale item including nine sub-items tried to determine how often students apply for sources given as sub-items (e.g. school, family, school, etc.) to learn about climate change.

Interview Forms and Observation Form: These forms were mainly developed to collect in-depth data about role of extra-curricular activities on developing studnets' knowledge, attitudes, and skills with regard to climate change adaptation, and mitigation (Appenix B). The forms were developed on the basis of literature about climate change education and extra-curricular activities. The three dimensions knowledge, attitude, and skills were determined based on Hungerford and Volk's (1990) study that explains behaviors on environment through environmental sensitivity, knowledge, attitude, and action. Similarly, Hwang, Kim and Jeng (2000) revealed the factors affecting people's behavior regarding environment as affective,

cognitive, and situational. The potential skills to be assessed through observations and interviews such as communication, collaboration, and leadership through engaging extra-curricular activities were determined based on the literature review results (e.g. Karatas, 2011; Keser, Akar,& Yıldırım, 2011; Stocklmayer & Gilbert, 2003).

Consequently, based on the literature review and research questions of the present study, the interview and observation forms were given last form. Instead of asking Yes/No questions, the forms included semi-structured open-ended items that helped the researcher understand the context in a broader manner through asking the participants Who?/How?/What? Questions (Krueger, 1998; Krueger & Casey, 2000).

Student Pre-interview Form: Student pre-interviews aimed to have deeper idea about the Green Team members' pre-knowledge, attitude, and actions on climate change, climate change adaptation and mitigation. There were eight open-ended questions in the interviews.

In the pre-interviews, firstly, the drive(s)/motivation behind the reason they decided to join in the Green Team Student Club was asked. Then, students were expected to make a definition of climate change, list the factors causing climate change and the impacts of climate change. Next, the sources they learned climate change was identified. In addition, whether they feel responsible for taking action on climate change, actions they had taken on climate change, climate change adaptation and mitigation were asked. Moreover, what they had learned about climate change within the scope of formal curricula was investigated.

Frankel, Wallen, and Hyun (2012) claims that validity as the most important issue to consider in design or selection of data collection instruments, and it is defined as "the appropriateness, meaningfulness, and usefulness of the specific inferences researchers make based on the data they collect" (p. 147). Content validity refers to comprehensiveness and representativeness of an instrument (Kerlinger, 1986). For content validity, as Burns and Grove (1993) suggests, firstly the aim of the interview form was determined and related literature was reviewed. Next, two

experts from METU, Department of Educational Sciences were consulted to check the content and face validity of the instrument. They gave feedback on the items whether they were relevant to the aim of the study and the instrument. According to their feedbacks some changes were done in the wording of the questions. For example, a question in the pre-interview form was:

> Yeşil Takım Klubüne neden katıldınız?
> Translated version: Why did you joined to the Green Team Club?

After the feedbacks of the two experts mentioned above, the question was revised as:

> Yeşil Takım Klubüne katılmaya nasıl karar verdiniz?
> Translated version: How did you decide to join the Green Team Club?

This change helped the researcher collect more comprehensive responses while focusing on the interviewee's decision-making process.

Teacher Pre-interview Form: Teacher pre-interviews aimed to have deeper idea about the Green Team teachers' pre-experiences on teaching climate change. Therefore, literature about how teachers perceive climate change and how they integrate it into their instructions were reviewed. The interview form included two parts. The first part included two questions: one about how they decided to take part in the Green Team Student Club and the other about how they perceived the drive/motivation that encourage students to join in the club. The second part was about the place of climate change in their clasess. Four open-ended questions included in this part.

Firstly, the motivation/drive behind their reason to be the Green Team Student Club's teachers, and how they select students to the club among volunteers were asked. Next, what they have taught about climate change issues in the formal curricula, which teaching methods and educational materials they used in their classes to teach climate change issues, and whether formal curricula is adequate to develop students' skills and attitudes toward climate change, climate change adaptation and mitigation were asked. The interviews were made by the researcher with two of the teachers of the club, and the interviews lasted for about 45 minutes.

To establish content validity of the instrument, the procedures mentioned above in the Student Pre-interview Form were followed. Content and face validity of the form was checked by the two curriculum and instruction experts from METU, Department of Educational Sciences. Some changes in wording of the questions based on the experts' feedback were done. For example, a question in the pre-interview form was:

> Sizce, iklim degişikliği, iklim değişikliğine adaptasyon ve iklim değişikliği etkilierinin azaltımı konularında bilgi, beceri ve tutum geliştirmek için program dışı etkinliklere ihtiyaç var mıdır?
>
> Translated version: Do you think that there is a need for extra-curricular activities to develop knowledge, skills, and attitudes with regards to climate change, climate change adaptation and mitigation?

It was revised on the grounds that it was insufficient to get a deeper response of the interviewee and was directing the interviewee.

The revised version of it was:

> Sizce resmi program size iklim degişikliği, iklim değişikliğine adaptasyon ve iklim değişikliği etkilerinin azaltımı konularında bilgi, beceri ve tutum kazandırmada yeterli mi? Değilse, ne tür etkinliklerin yapılmasını istersiniz?
>
> Translated version: Do you think that formal curriculum provides adequate facilities to develop knowledge, attitude, and skills with regards to climate change, climate change adaptation and mitigation? If not, which kind of activities do you want to be implemented?

This revision helped the researcher have a deeper idea about the place of climate change in the formal curricula and deficiencies in the formal curricula.

Student Reflective Interview Form: Mainly, reflective interview form was developed to be used after each club session in order to evaluate how extra-curricular activity/activities of the session helped the students to develop knowledge, attitude and/or skills with regard to climate change/climate change adaptation/ mitigation. This form included 10 short open-ended questions. After club sessions, reflective interviews were made with the selected students by the researcher, and took about 20 minutes. The students were interviewed alone without the club teachers in order not to bias their responses.

The items in the reflective interview form were developed based on the research questions. Firstly, the aim of the activity was asked to students. In line with the first question, whether the activity reached its aim or not was asked. Next, what students liked about the activity and whether there were deficiencies were asked. In order to provide an understanding for developing more effective extra-curricular activities, students' perception for the activity and their own roles in the activity were asked. To determine knowledge base that students developed, the concepts they learned through extra-curricular activity were investigated. Students were asked whether the activity helped them raise awareness and develop skill. Finally, students were expected to make an overall evaluation of the activity.

Content and face validity of the form were checked by the two curriculum and instruction experts from METU, Department of Educational Sciences. To construct content validity, the steps explained above in the student pre-interview form were utilized. A question was added based on the feedbacks of the experts:

> Bugün uygulanan program-dışı etkinlik(ler) hakkındaki genel yorumunuz nedir?
> Translated version: What is your overall idea about today's activity/activities?

Teacher Reflective Interview Form: Teacher reflective interview form was developed to be used after each club session in order to determine how extra-curricular activity/activities of the session helped the students to develop knowledge, attitude and/or skills with regard to climate change, climate change adaptation and mitigation in perspectives of the teachers in line with the research questions. In addition, in order to evaluate the impact of extra-curricular activities on teachers, the teachers were asked whether implementing the extra-curricular activity helped them develop professional skills, if so what they were.

The same procedures were followed in establishing content and face validity as in the student pre-interview form. Content and face validity of the form was checked by the two curriculum and instruction experts from METU, Department of Educational Sciences. Two questions were added based on the feedbacks of the experts:

Bugünkü program-dışı etkinliğin amacı neydi?
Sizce etkinlik amacına ulaştı mı?

Translated versions: What was the aim of today's session?
Has the activity reached its aim?

Final Student Interview Form: Final student interview form was developed to evaluate the effectiveness of extra-curricular activities on developing students' knowledge, attitude and/or skills with regard to climate change/climate change adaptation/mitigation.

The form consisted of mainly two parts; the first was including students' demographic information, and the second was part was in line with pre-interview form in order to evaluate whether there had been a change in students' knowledge, attitude, and skills with regard to climate change after participating in the extra-curricular activities. For this purpose, students were asked to define climate change, climate change adaptation and mitigation, and the concepts they learned through extra-curricular activities. Also, they were asked to make a self-evaluation of their knowledge, attitudes, and skills on climate change, climate change adaptation and mitigation after participating in the extra-curricular activities.

The two curriculum and instruction experts gave feedbacks for the content and face validity of the instrument. Based on their feedbacks, a question was added in order to determine whether students apply the knowledge and skills they developed through participating in the extra-curricular activities:

İklim değişikliği ile ilgili program-dışı etkinliklerde yer alarak kazandığınız bilgi ve becerileri günlük yaşantınızda kullanıyor musunuz?

Translated version: Do you use the knowledge and skills you have developed through participating in the extra-curricular activities on climate change in your daily life?

This item helped the researcher conclude whether the extra-curricular activities also help students take action on climate change adaptation and mitigation.

Final Teacher Interview Form: Final teacher interview form was developed to evaluate the effectiveness of extra-curricular activities on developing students' knowledge, attitude and/or skills with regard to climate change, climate change adaptation and mitigation in the perspectives of teachers. Additionally, the interview questions aimed to investigate whether participating in the implementation of extra-curricular activities helped their professional development. Moreover, through the questions, it was aimed to be investigated the teachers' experience throughout implementing extra-curricular activities: the elements motivated them, the drawbacks they met, etc.

The same procedures as followed in establishing content validity of the student pre-interview form were applied to establish content validity. The two curriculum and instruction experts gave feedbacks for the content and face validity of the instrument. Based on their feedbacks, some changes in the wording of the questions were made. For example, one of the questions in the instrument was:

> Program-dışı etkinliklerin uygulanması sırasında zorluklarla karşılaştınız mı?
>
> Translated version: Have you met difficulties while implementing extra-curricular activities?

The question was re-written based on the experts' opinion as:

> Program-dışı etkinliklerin uygulanması sırasında ne tür zorluklarla karşılaştınız?
>
> Translated version: What kind of difficulties have you met while implementing extra-curricular activities?

Observation Form: A semi-structured form for field –notes were developed to observe the club sessions by the researcher. It included description of learning environment, student and teacher roles, students' knowledge, students' skills, student attitudes toward the extra-curricular activity of the club session. Also, guiding codes for observed skills (communication, decision-making, leadership, and information management, etc.) were stated in the form for in-depth field notes (see Appendix B).

These codes were determined in line with the literature on extra-curricular activities and their impacts on students (e.g. Cain, 2004; Keser, Akar, & Yıldırım, 2011)

Observations were made during club sessions on Thursdays for 20 weeks, 1.5 hours each week. They provided a wealth of non-verbal behaviour, offering considerable insight into the students' learning.

Content validity of the observation for was checked by two curriculum and instruction experts through following the steps mentioned above. The experts suggested using guiding codes for field notes, and guiding codes were determined based on related literature and the experts' feedbacks.

3.5. Data Collection Procedures

The aim of the present study was to evaluate the role of extra-curricular activities on developing students' knowledge, attitudes, and skills with regard to climate change, climate change adaptation, and mitigation. For this purpose, initially, quantitative data were collected CLIMES Student Questionnaire, and this was complemented with pre-interviews with three of the Green Team members ($S5_2$, $S11_2$, $S14_{2)}$ and the two teachers of the club (T1 and T2).

After diagnosis of students' pre-knowledge, attitudes, and skills with regard to climate change, climate change adaptation and mitigation, reflective interviews, both with the teachers and the students, and observations were made by the researcher during each week of the study in order to evaluate whether the extra-curricular activities' helped the students develop knowledge, attitude, and/or skills with regard to climate change, climate change adaption and mitigation (see Table 3.5).

Ultimately, final interviews with both of the Green Team Club teachers (T1 and T2) and purposively selected four students ($S1_2$, $S2_2$, $S3_2$, and $S4_2$) were done in order to evaluate how extra-curricular activities helped the students develop knowledge, attitude, and skills with regard to climate change, climate change adaptation and

mitigation. The reason for selecting those four students was based on observations and reflective interviews. Two of them (both female) ($S2_2$ and $S3_2$) were selected because they relatively worked much more than other club members and were as leaders in group works. Also, three of the students ($S1_2$, $S2_2$, and $S3_2$) participated in the final meeting of the project CLIMES held in Stockholm that might help her develop different skills on and attitudes toward climate change adaptation and mitigation. The third girl ($S4_2$) was selected because she did not take any initiatives; rather, she did only what was expected from her and in the group activities, she was relatively less active compared to others. The fourth student ($S1_2$) was male. He was selected to gather data on the role of extra-curricular activities with regard to climate change, climate change adaptation, and mitigation on male students. Figure 3.3 summarizes the data collection process of three phases of the study.

Phases of the Study	Pre-phase	Process phase	Post phase
Students	CLIMES Questionnaire (*n*=18) Pre-interviews (*n*=3)	Reflective interviews (*n*=48) Observations (*n*=20)	Final interviews (*n*=4)
Teachers	Pre-interviews (*n*=2)	Reflective interviews (*n*=2, 20 times) Observations (*n*=20)	Final interviews (*n*=2)

Figure 3.3 Data Collection Process

As indicated in the Figure 3.3, 48 reflective interviews were made after each club session during 20 weeks and Table 3.5 shows which students were interviewed after each extra-curricular activity. The students were selected considering different types of extra-curricular activities and also observations. $S1_2$, $S2_2$, and $S3_2$ were interviewed more than other students because those students were more active that

they worked in almost each activity, even as a non-partcipant member in group works. Also they mostly behaved as initiators.

Table 3.5.

Extra-curricular activities and interviewed students

Extra-curricular activitiy	Reflective interviews with students
Visit to Energy Park	$S3_2$, $S10_2$, $S15_2$
Seminar on climate change adaptation and mitigation	$S11_2$, $S13_2$
Preparing posters for the school bulletin boards	$S5_2$, $S6_2$
Writing article about fcarbon footprint for the school journal	$S1_2$, $S2_2$, $S3_2$, $S4_2$
Seminar on climate history	$S7_2$, $S8_2$, $S9_2$, $S10_2$
Data collection for calculating the school's carbon footprint	$S3_2$, $S11_2$,$S12_2$, $S13_2$
Data anlaysis of school's carbon footprint	$S4_2$, $S14_2$, $S15_2$, $S16_2$,
Prepartion for Hungary meeting	$S7_2$, $S17_2$, $S18_2$,
Saharing Hungary meeting experiences	$S17_2$, $S18_2$
Visiting solar energy laboratory	$S2_2$, $S7_2$, $S8_2$,
Watching video about local environmental problems	$S1_2$, $S6_2$, $S13_2$,
Watching a documentary about global climate change	$S5_2$, $S6_2$
Seminar on solar panels	$S8_2$, $S12_2$, $S14_2$
Seminar on a climate-friendly project	$S5_2$, $S9_2$, $S11_2$
Preparation for Stokholm meeting	$S1_2$, $S2_2$, $S3_2$,
Sharing Stockholm meeting experience	$S1_2$, $S2_2$, $S3_2$

3.6.Trustworthiness

Due to the fact that a qualitative research is somehow affected by the researcher itself in both collection and interpretation of the data, an important consideration is researcher bias. To overcome this problem using a variety of instruments to collect data, checking for the consistency between the responses of the informant's to the same thing, member checking, external audit, a well description of the context, and interviewing participants and observing the context more than once should be considered (Fraenkel, Wallen, & Hyun, 2012).

Lincoln and Guba (1985) claimed that prolonged engagement, triangulation, peer debriefing, member checks are some of the strategies that can be used for achieving credibility (internal validity) in qualitative research.

Prolonged Engagement: After spending adequate time in the context being studied, the researcher learns the culture of the setting, builds trust with the participants, and reduces the distortions. In the present study, the researcher worked on the case for 20 weeks 1.5 hours per week which can be considered as adequate time for determination and evaluation of the case.

Triangulation: Combination of multiple observers, theories and data sources help researcher to change the way of looking at the phenomenon. In this case, multiple data collection tools were used to gather data. Also, the case was observed three times by a non-participant researcher with educational science background. She described the participants' behavior and the context. Her field notes and the researcher's notes were compared, and similar findings were obtained. To illustrate, she attended in an activity in which students prepared a poster for the school bulletin board. The field notes of the non-participant observer were comprared with that of the researcher.

Peer-debriefing: The peer asks probing questions to the researcher and provides feedback and this helps to prevent researcher's bias on the data analysis, especially interpretations of the data process. Throughout data analysis procedure, the researcher was always in contact with a curriculum and instruction expert at METU, and themes and codes were determined based on the negotiations. Also, an expert

and a researcher from the Department of Educational Science at METU checked the categories and the themes emerged from the oral and written data. Two of them also negotiated on the themes till consensus was reached. To illustrate, three of the inter-coders determined the skills for group work activities mainly as collaboration, discussion, communication, and task management. Through negotiations among the researcher and field experts, decision making and leadership skills were also added to the categories.

Transferability: For transferability which is the degree to which in a qualitative research, the findings of an inquiry can be applied or transferred beyond the bounds of a study, Lincoln and Guba (1985) suggest using thick description, purposive sampling, and reflexive journal which is a type of diary where a researcher makes regular entries during the research process. In this study, thick descriptions of the case and purposive sampling of participants for interviews were used to achieve transferability of the study.

Dependability: For dependability, which is an assessment of the quality of the integrated process of data collection, data analysis, and theory generation, Lincoln and Guba (1985) point two main considerations that are: and reflexive journal. The first includes keeping records and raw data during study. Also, an independent auditor checks for the process of study. Hoepfl (1997) claims that dependability audit can be used to examine the process or the product of the research for consistency. In the present study, a researcher working on education, particularly science and environment education at METU checked the process of the study for dependable results. To illustrate, she joined in the classroom observations three times during club hours. She checked whether there was a change in the setting of the case and found no changes in the settings. Also, the themes and categories emerged from qualitative data of this study were checked by two curriculum and instruction experts, and a M.Sc. researcher who studies education.

Validity of the instruments: Frankel, Wallen, and Hyun (2012) claims that validity as the most important issue to consider in design or selection of data collection instruments, and it is defined as “the appropriateness, meaningfulness, and usefulness

of the specific inferences researchers make based on the data they collect" (p. 147). The appropriateness, meaningfulness, and usefulness of the present study were controlled thgrouh being in close contact with an expert in curriculum and instruction throughout the study. Also another curriculum and instruction expert and a researcher were consulted during data analysis. Beside, a non-participant researcher participated in the observations for three times.

For content and face validity of the interview and observation forms, the two experts in curriculum and instruction were asked for their feedbacks, and necessary revisions were made according to their feedback which were mentioned thoroughly in the data collection instruments section.

3.7. Data Analysis

Fraenkel, Walle, and Hyun (2012) state that "Data analysis in qualitative research is an iterative and continuously comparative process that involves reducing and retrieving large amounts of written (and sometimes pictorial) information." (p. 436). In this study, qualitative data were collected through observations and interviews. While analyzing qualitative data, content analysis, "a technique that enables the researchers to study human behaviors indirectly through an analysis of their communications", was used (Fraenkel, Wallen, & Hyun, 2012, p. 478).

Field notes, transcriptions and computer files are used to store the data gathered from a qualitative study (Creswell, 1998). Some steps to be followed are advocated by two qualitative books (Bogdan & Biklen, 1992; Huberman & Miles, 1994) which are:

1. A general review of all information often gathered through jotting down notes on the observational field notes, interview transcriptions, etc.
2. The researcher might get feedback on the initial summaries from informants. Also, the researcher carefully examines the words used by informants for data reduction. Diagrams, tables or graphs can be used to visualize the information.

3. The researcher develops codes and categories.

Creswell (1998) claims that qualitative data analysis has a spiral structure that researcher do not use a fixed linear approach. Organization of the data by examining conceptualizing and searching for patterns allows research findings to emerge from common, dominant or significance themes. While collecting data, analysis is also done that data analysis goes concurrently with data collection.

The steps followed in the data analysis of this study were summarized in the Figure 3.4.

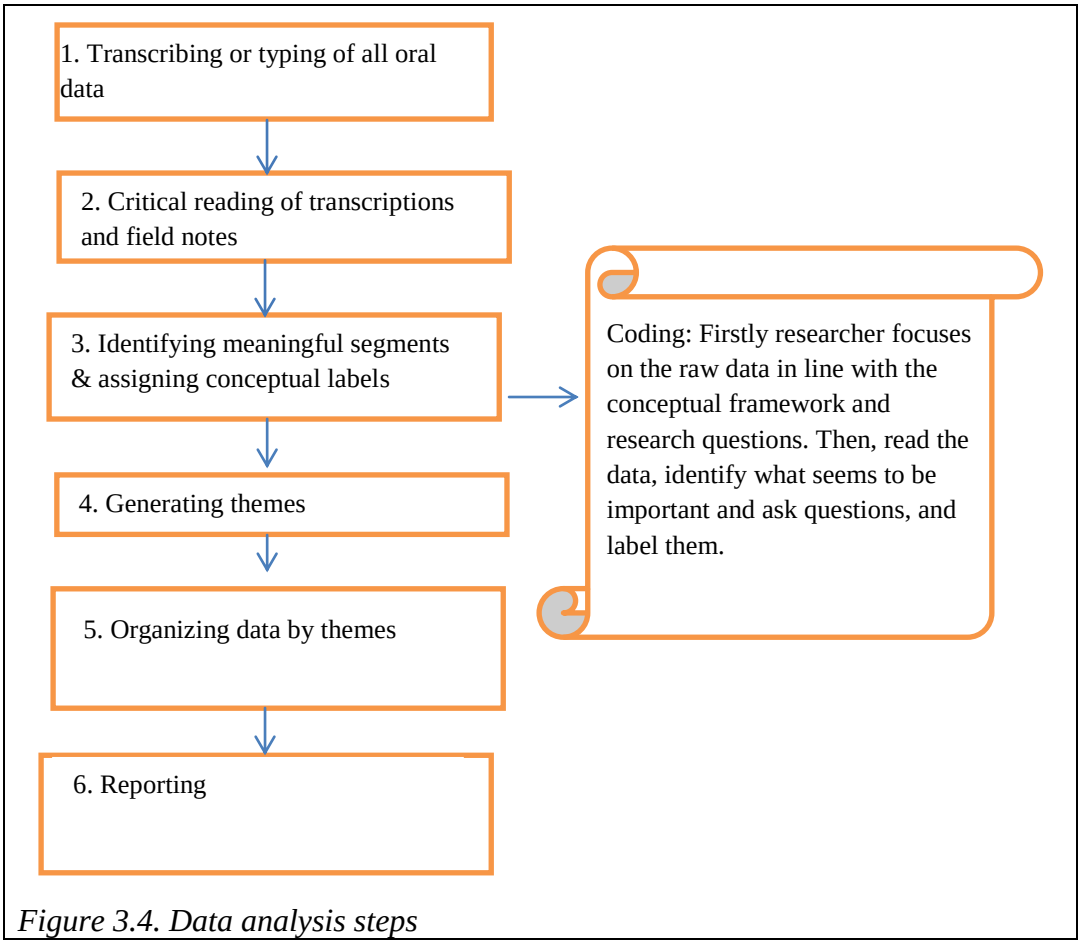

Figure 3.4. Data analysis steps

Figure 3.4 shows the steps followed to analyze the qualitative data collected through interviews and observations. Content analysis was used to analyze

qualitative data. Content analysis requires a deep analysis of the collected, and helps the researcher to determine themes and categories emerged from the data (Yıldırım & Şimşek, 2008). Before starting analyzing the data, for the participants' confidential, the students were labeled as S1, S2,..., S18, and the teachers as T1, T2 (Note: Students were labeled two times. Firstly, in the questionnaire, since their names or student numbers were not asked, their questionnaires were labeled as $S1_1$, $S2_1$,..., $S18_1$. Secondly, after the study started, they were labeled again as $S1_2$, $S2_2$, …,$S18_2$ not to create confusion while analyzing and reporting the data). For content analysis of the data collected in the present study, all the oral data were transcribed, and all the written data were critically analyzed in line with the research questions, then converted to the text in computer, and then raw data was grouped based on the research questions that initial labels were including three dimensions of the students' cognitive, affective, and behavioral development. After identification of these three dimensions, initial categories of the data was determined (see Table 3.6). Content analysis was done based on three dimensions. Finally, while reporting the study, direct quotations from the participants' responses were used to increase trustworthiness.

Table 3.6

An example of initial categories emerged from the data

Dimension	Initial categories
Knowledge	describes identifies clarifies exemplifies develop strategies
Attitude	* volunteer & motivated to take part in the extra-curricular activity * interested in the extra-curricular activity * willing to raise awareness among others * feels responsible to take action for climate change adaptation and mitigation

Table 3.6 (cont.)

Dimension	Initial categories
Skill	* work in groups * economic use of energy, water, paper * do research * collect data *analyze data

These categories given above in the Table 3.6 guided the researcher while interpreting the data deeply to determine final versions of the themes and categories of the present study (see Table 3.7).

Table 3.7

Final themes and codes *emerged from the data*

Themes	Codes
knowledge	define, describes, exemplify, identify, clarify
attitude	willing to take action, motivated, interested, feel responsible, enjoyed, fun, sense of self-development, student autonomy, creativity, student-centered, voluntariness
skill	do research, collect data, analyze data, organize data, interpret data, report data, team work, communicate, collaborate, creativeness, make decisions, lead peers, negotiation

Table 3.7 (cont.)

Themes	Codes
adjectives to describe extra-curricular activities	enjoyable, interested, creative, autonomous, guiding, effective, useful

3.8. Limitations of the Study

There are some limitations determined for the present study. Firstly, the present study was conducted at a private school in Ankara. The school has been participating in national and international projects, not only about environment, but also in physics, literature, etc. Also, the school offers a variety of extra-curricular activities within the scope of student clubs. Therefore, the school is familiar with these kinds of studies and may not reflect the situation in other contexts or public schools.

Another limitation is about allocated time for the study. Although the study lasted for relatively long time (for 20 weeks, 1.5 hours each week), the club hours were limited to one and a half hour each week. This limited the study in terms of data collection process. At some weeks, due to the limited time, the students could not finish that day's extra-curricular activity; thus, those students could not be interviewed after the club session. Data were collected from a limited number of participants that might have decreased the dependability of the study for that session.

Similarly, mortality of the students was another limitation. During the exam weeks, a few of the students did not attend in club sessions. Also, the ones who attended the class were unmotivated to work on the extra-curricular activities; instead they wanted to study for their exams. Hence, at examination weeks, data were collected from a limited number of participants that might have decreased the dependability of the study for that session.

Finally, the student questionnaire which was administered at the beginning of the study was a ready-made instrument. The researcher did not use another test for the diagnosis of knowledge, attitude, and skills of the students as this would be

subject to instrumentation internal validty threat. Therefore, during the implementation of the extra-curricular activities, the role of extra-curricular activities on developing students' knowledge, attitudes, and skills data were collected through qualitative data collection instruments: interviews and observations. Although triangulation of the qualitative data was done, using qualitative data for conclusions can be considered as a limitation due to researcher-bias on the data.

CHAPTER IV

RESULTS

Students' descriptive data analysis with regard to their knowledge, attitude, and skills they developed through extra-curricular activities on climate change, climate change adaptation and mitigation is given in this chapter. The results are given in three main domains: knowledge, attitude, and skills of the students. Along with the student data analysis, the impact of the case on teachers, and student and teacher roles are also described. Initially, CLIMES Questionnaire analysis of the Green team members, and pre-interviews with both the teachers and the students are given. Next, results belonged to reflective interviews, observations, and final interviews are given in this section.

4.1. Pre-knowledge, Attitudes, and Skills of the Students

In this section, the CLIMES Questionnaire results of the Green Team members are given. Complementary to the questionnaire results, teacher and student pre-interviews are given. The questionnaire results and pre-interviews helped the researcher diagnose context of the case deeply. Also, this diagnosis helped the Turkish project team while developing extra-curricular activities on climate change to build knowledge, attitudes, and skills on students. The results also gave an understanding of how climate issues included at the METU-DFHS' school management and in the formal curricula, what students know about, which sources they apply for to learn climate change issues, the place of climate change issues, and the teachers' instructional choices with regard to climate change. In order to have a

deep idea of the case, three Green Team members and two of the club teachers were interviewed.

4.1.1. Results of Green Team Members' CLIMES Questionnaire and Pre-interviews

Data for CLIMES Questionnaire included all 18 participants in the Green Team Student Club. Among them three were male, and the rest were female. Most of the students were among 16 year old (*n*=9, 50%) and 17 year old (n=7, 38.9%). There were only one 15 years old student and one 18 years old. Almost all of the members of the Green Team Club were from 11th graders (n=15, 83.3%), and the rest (n=3, 16.7%) were 10th graders.

In the questionnaire, firstly, the students were asked to make a definition of climate change with an open-ended question and Table 4.1 reveals their responses.

In the Table 4.1, the Green Team Club members' (*n*=18) responses to what climate change are figured out. More than half of them (*n*=10, 55.56%) defined climate change as "climate shift" and about 38% (*n*=7) of the students' definition was about changes in weather conditions. Rest of the students defined climate change as long term changes in temperatures (*n*=5, 27.78%) and global warming (*n*=1, 5.56%).

Table 4.1

Green Team members' definitions of climate change

Key terms	f	%
climate shift	10	55.56
changes in weather conditions	7	38.00
long term changes in temperatures	5	27.78
global warming	1	5.56

Secondly, students were asked to list the causes of climate change and the findings are given in Table 4.2.

Table 4.2

Factors causing climate change by Green Team members

Factors	f	%
harmful gases	16	90.00
global warming	10	55.56
environment and air pollution	6	33.33
deforestation	5	27.78
reduction in water resources	5	27.78
increase in energy consumption	5	27.78
ozone layer depletion	4	22.22
chemicals and waste	2	11.11
natural disasters	1	5.56

As indicated in the Table 4.2, among 18 Green Team members' responses, the most repeated responses were: harmful gases, almost 90%, (*n*=16), global warming (*n*=10, 55.56%), and environment and air pollution (*n*=6, 33.33%). Deforestation and reduction of water resources (*n*=5, 27.78%), energy consumption (*n*=5, 27.78%), ozone layer depletion (*n*=4, 22.22%), chemicals and atomic nuclear waste (*n*=2, 11.11%), and natural disasters (*n*=1, 5.6%) were other responses of the students.

Ways of mitigating impacts of climate change were also asked to the Green Team Club members (*n*=18). Table 4.3 shows their responses.

Table 4.3

Green Team members' suggestions to mitigate climate change impacts

Actions	f	%
informing people/ raising awareness	14	77.78
decreasing the amount of CO_2 emission	6	33.33
energy saving	6	33.33
using renewable energy	6	33.33
recycling	6	33.33
ozone layer depletion	4	22.22
encouraging use of public transportation	2	11.11
founding a ministry	1	5.56

Table 4.3 figures out actions to be taken with regard to climate change mitigation. Almost 80% of the Green Team Student Club members (*n*=14, 77.78%) highlighted the importance of informing people and raising awareness. Decreasing the amount of CO_2 emission (*n*=6, 33.33%), energy saving and using renewable energy source (*n*=6, %33.33), and recycling (*n*=6, 33.33%) were other mostly listed suggestions. Students also suggested increasing the number of public transportation vehicles (*n*=2, 11.11%), and founding a ministry specifically work on climate change problems (*n*=1, 5.6%).

Since the aim of this study evaluating the role of extra-curricular activities on developing students' knowledge, attitude, and skills on climate change, the topics that students learned about climate change in the formal curricula were also asked to the students. Table 4.4 gives a descriptive analysis of student answers.

Table 4.4

Climate change in the formal curricula

Topics	f	%
Melting of icebergs	16	88.89
Erosion	15	83.33
The rise of sea-level	14	77.78
Poor precipitation causing drought/desertification	13	72.27
Deforestation	11	61.11
Unpredictable meteorological changes (whirlwind, tornado, storm, ect.)	10	55.56
Over precipitation causing floods	10	55.56
Difficulties faced in agriculture	8	44.44
Famine (water and food problems	7	38.89
Epidemic illnesses	6	33.33
Melting of permafrost	5	27.78
Difficulties faced in animal breeding	5	27.78

Table 4.4 shows the topics in the formal curricula that students learn about climate change. This was a multi-response question and each student marked the topic he/she learned within the scope of their formal curricula. '*melting of iceberg'* was at the top among their responses (*n*=16, 88.89%). *Erosion* was other mostly marked topic (*n*=15, 83.33%). The rise of sea level (*n*=14, 77.78%), poor precipitation causing drought/desertification (*n*=13, 72.27%), deforestation (*n*=11, 61.11%), unpredictable meteorological changes (whirlwind, tornado, storm, etc.) (*n*=10, 55.56%), and over precipitation causing floods (*n*=10, 55.56%) were some of other topics claimed to be taught in the formal curricula. Moreover, 44.44% of the students (*n*=8) claimed that they learned about difficulties faced in agriculture and 38.89% of them (*n*=7) noted that famine was another issue they learned in the formal

curricula. Epidemic illnesses (*n*=6, %33.33), melting of permafrost (*n*=5, 27.78%), and difficulties faced in animal breeding (*n*=5, 27.78%) were other topics that students claimed to be taught within the scope of formal curricula.

The results mentioned above belong to students' pre-knowledge on climate change. In the questionnaire, students were also asked whether they feel responsible for learning about climate change. Almost all of them claimed that they feel responsible (*n*=15, 83.33%).

Following question intended to clarify their reasons for why they feel responsible or irresponsible. Half of them (*n*=9, 50%) claimed that they feel responsible because human beings cause climate change. For example, one of the students wrote that:

> $S14_1$: Human beings are also responsible for climate change and for a livable environment we must do something. To overcome the problems climate change causes, we should learn what really climate change and its impacts are, and what can be done in this respect.

There were other responses highlighting the importance of *raising awareness* (*n*=5, 27.78%). In addition, four of the students (22.22%). claimed that they feel responsible to be able to take precautions One student said that he felt partially responsible and mentioned the importance of *team work* beside individual attempts. He wrote that:

> $S3_1$: Taking individual actions are not sufficient to struggle with climate change. People should work together for it. At schools, there can be more lessons on climate change issues to teach us what we can do as a team. We can't handle the problem by just switching of the lights or being conscious on water and energy consumption. We should also make others take actions in this respect.

Actions the students take with regard to climate change were determined through a multi-response question. Students were asked to select a list of actions that they take at school or at home. Table 4.5 shows students' responses.

Table 4.5

Actions students take at their school or at their home

Actions	f	%
Switching off the lights/computers if they are not being used	18	100.00
Using recycled paper	12	66.67
Separating recycled waste (e.g : paper, glass, metal)	12	66.67
Poor precipitation causing drought/desertification	13	72.27
Avoiding using sprays which contains CO_2	11	61.11
Using environmental friendly gas/combustible	10	55.56
Recycling used batteries	9	50.00
Avoiding using plastic	5	27.78
Using recyclable tap water (e.g : for gardens/flowers/ cleaning	3	16.11

In the Table 4.5, students' individual actions on dealing with climate change are summarized. All of the students (*n*=18) marked switching off the lights/computers if they are not being used. It seems that they also paid attention to recycling (*n*=12, 66.67%) and using recycled papers (*n*=12, 66.67%).

Complementary to the questionnaire, at the beginning of the study, since the students' responses to open-ended questions were including short explanations, in order to have deeper idea of the students' knowledge, attitude, and skills, semi-structured interviews were made with three randomly selected Green Team Student Club members by the researcher: two females, one male.

Firstly, students were asked to make a definition of climate change, and all the definitions (*n*=3) included greenhouse gases and global warming. For example, one of the definitions of the students was:

> $S14_{2:}$ Climate change is long term changes in the weather conditions. The Earth is getting warm and human actions also affect this process that we have caused an increase in the amount of greenhouse gases in the atmosphere and this causes global warming.

This indicates that students' climate change perceptions were limited to greenhouse effect; although, they can distinguish climate and weather, and aware that human actions affects changes in the climate.

Next, the factors causing climate change and the impacts of climate change were asked to the interviewees. Their responses on the factors causing climate change were including harmful gases (*n*=3), global warming (*n*=1), deforestation and reduction of water resources (*n*=1), and ozone layer depletion (*n*=1). The students listed the impacts of climate change on health (*n*=3), global warming (*n*=2), melting of ice (*n*=2), air pollution (*n*=1), and water (*n*=1).

The actions they take with regard to climate change issues were another question in the pre-interviews. They almost gave the same answers that they switch of the lights, pay attention to water and energy consumption, and recycling. These show that students take very basic actions; they were not aware of the complexity of the problem.

The students were also asked whether climate change issues included in their formal curricula or not. One of the students ($S5_2$) claimed that they learned some topics regarding climate change like global warming, renewable energy, and melting of the ice on the poles. The other two only ($S14_2$ and $S11_2$) talked about the lessons they learn about climate change namely; geography, biology, and physics; however, all of them claimed that climate change was narrowed down in the formal curricula.

Another point investigated through student pre-interviews was how the students decided to join to the Green Team to learn their drive/motivation. Three of the students said that they voluntarily decided to be member of Green Team because they were interested in environmental problems, and they were willing to be a part of solutions of the environmental problems (*n*=1). Also, they highlighted that participating in Green Team to work on climate change would help them to raise

awareness so they would be able to inform other people. Additionally, one of the students ($S5_2$) noted that if she did not do anything, she would feel responsible for not leaving a livable word to next-generation. The responses of the interviewees show a positive attitude toward taking part in the solutions of environmental problems.

4.1.2. Results of Green Team Teachers' Pre-interviews

Addition to Green Team member students, Green Team teachers' (*n*=2) pre-interview results are given in the present study. Table 4.6 summarizes their demographic information.

Table 4.6

Demographic information of teachers

Teachers	Gender	Teaching Area	Graduate Degree	Experience Year	Club Experience	Project Experience
T1	female	Biology	Master	7	yes	NAIS
T2	female	biology	Master	8	yes	Young Reporters

Initially, the teachers were asked to explain the reason for joining in the Green Team Student Club. Both of the teachers mentioned the importance of taking initiatives as teachers to raise awareness. One of the teachers stated that:

> T1: We desire to raise awareness about environmental problems among our students and become role models for other schools as being a pioneer in the field of environmental education. Through learning projects that implements a climate friendly management system in our school; we can reach one of the main goals of our mission, which is raising students equipped with the morals of modern life.

As her statement indicates, the teachers were interested in and were willing to raise awareness related to environmental problems among students.

Secondly, the reason why students joined in the Green Team Student Club based on the perceptions of the teachers was examined. Both of the teachers claimed that the students joined in the club had relatively much awareness on environmental problems and they were interested in taking action for their environment. Nevertheless, as T2 mentioned, some of the students' reasons for joining in the club were their desire to be with their friends or the teachers themselves were motivations to take part in the club.

The topics that the teachers taught in their classes were also asked to the teachers. Both of the teachers said that there was not a specific unit for climate change. While teaching pollution at 9^{th} graders, eco-system at 10^{th} grade, and population at 11^{th} grades they link the unit to climate change. The sources they applied to teach climate change were internet (n=2), documentaries (n=1), and TV broadcasts (n=1).

When the teachers' previous experiences in the projects and extra-curricular activities related to climate change were determined, both of the teachers had experiences. T1 had worked for NAIS Challenge 20/20 which provided an opportunity for schools to develop international partnerships and to work toward real solutions to global problems. That was an internet-based international education program that partners schools in the U.S. with schools in other countries to work on 20 global problems and identify solutions that could be implemented locally and nationally. During the past two years, the students had been working on global warming and climate change topics with their partner school students. Also, she participated in an international workshop given by 'Climate Advocates'. She claimed that the workshop was concluded as there was a need to integrate climate change as a main unit in the formal curricula, and a report was sent to the MoNE.

T2 had worked on Young Reporters for the Environment (YRE) which was a program of the Foundation for Environmental Education designed for educating people for sustainable development. In this project, students defined their own investigation topic about a local environmental issue. There were 6 main investigation topics: agriculture, cities, coastline, energy, waste, water. The goal of

each project was to communicate relevant information to a local public by carrying out journalistic activities about a local environmental issue, with a multidisciplinary approach.

As their responses reveals, both of the teachers were familiar with projects and extra-curricular activities that would help them while guiding Green Team members.

In conclusion, pre-interviews helped determining the students' pre-knowledge, their attitudes and skills with regard to climate change, climate change adaptation and mitigation in perspectives of the teachers. Moreover, how current curricula cover climate change issues, and how the teachers integrate climate change issues into their classes was determined. It was found that the students had basic knowledge about basic concepts of climate change; however, some of them were not aware of how human actions affect climate change and had misconceptions such as "Climate change is global warming" (*n*=1, 5.56%), "Ozone layer depletion causes climate change" (*n*=4, 22.22%). Besides, both of the teachers claimed that formal curricula lack emphasis on climate change, climate change adaptation and mitigation. They also stated that they mostly apply for documentaries and field trips for teaching about climate change.

4.2. Knowledge the Students Developed

In this section, analysis results of the data collected through reflective interviews, and observations are described regarding whether there have been changes in students' knowledge on climate change, climate change adaptation and mitigation.

The present study lasted for 20 weeks, 1.5 hours per week. During the study each club session was observed, and after the session reflective interviews were made. The extra-curricular activities the students worked on were:

- preparing posters on climate change to raise awareness among other students at the school
- holding seminars and watching video on climate change to build a knowledge base related to conceptual facts about climate change, and their roles as citizens to adapt and to mitigate climate change impacts
- writing an article about climate change issues for a journal to construct a knowledge base about carbon footprint
- calculation of school's carbon footprints, participating in an international meeting within the scope of the project CLIMES
- visiting a solar energy laboratory at Middle East Technical University (METU) Physics Department, and Energy Park in Ankara

The results revealed that the students increased knowledge throughout working on the extra-curricular activities. Mainly, they learned new concepts such as

- greenhouse gases,
- how much CO_2 is released when a variety of electronic devices, washing machine, dish machine, vacuum cleaner, blow-dryer etc., are used,
- how we can save energy and water,
- which type of transportation car is more environment friendly; diesel cars, public transportation, cars with petrol engine, etc.,
- what carbon footprint is
- human effects on climate change

In the following sections details about the knowledge students' developed with regard to climate change, climate change adaptation, and mitigation are described on the basis of reflective interviews and observations.

4.2.1. Reflective Interviews and Observations

In this section, how extra-curricular activities helped the students develop knowledge on climate change, climate change adaptation and mitigation is given. The club sessions were observed during 20 weeks, 1.5 hours each week and the students' and the teachers' were interviewed after each club session and each reflective interview lasted about 20 minutes. Both the observations and interviews were made by the researcher. Additionally, interviews were made in isolation from the class so that the students would not to feel affected by their teachers or their peers.

Normally, club sessions were held in physics class setting except for field trips and some seminars which were held in the library of the school. The class size was large enough to let students work in groups or individually. Also, the facilities of the class let the teachers and the students work on three boards and a smart board, and also use projection machine for presentations and watching videos/documentaries. The library of the school also had all the facilities for conducting presentations; a smart board, a board, a projection machine, a laptop, a desk for presenters, and seats for audience were set.

As mentioned before, students participated in different kind of extra-curricular activities each aimed to help students develop knowledge on different concepts. To explain, seminars specifically aimed to construct a basic theoretical understanding of climate change. In this respect four seminars were held (see Table 4.7).

Table 4.7

Seminars and interviewees

	Seminar-1: Climate Change and Its Impact on Turkey	Seminar-2: Earth Climate System	Seminar-3: Solar Decathlon	Seminar-4: Solar Panels
interviewed students	$S11_2$, $S13_2$	$S7_2$, $S8_2$, $S9_2$, $S10_2$	$S5_2$, $S11_2$, $S9_2$	$S8_2$, $S14_2$, $S12_2$
total partcipants	18	18	12	18

Reflective interview results revealed that seminars helped them learn new concepts about climate change, such as climate change mitigation and adaptation (*n*=4; $S5_2$, $S9_2$, $S11_2$, $S13_2$), impacts of climate change (*n*=6; $S11_2$, $S13_2$, $S7_2$, $S8_2$, $S9_2$, $S10_2$), what solar panels are and how they are constructed (*n*=3; $S8_2$, $S14_2$, $S12_2$), and greenhouse gases (*n*=6; $S7_2$, $S8_2$, $S9_2$, $S10_2$, $S11_2$, $S13_2$).

The students not only learned new concepts, but also they learned how to link those concepts and cases to their project CLIMES. In this respect, after seminar on solar panels, one of the students said that:

> $S8_2$: Actually, as Green Team members we try to calculate carbon footprint of the school and to develop an action plan to reduce the amount of CO_2 emission we release. This seminar made us think of using solar panels to meet the energy need of the school. We will talk to school board to make a feasibility study.

Another student ($S5_2$) joined in the Solar Decathlon seminar claimed that:

> $S5_2$: This project (mentioning Solar Decathlon) gave us an understanding of constructing a climate-friendly building. We know that when we change some of our consumption habits we can make a difference but what about buildings? We should also consider this while developing our action plan.

As $S8_2$ and $S5_2$ stated, the students became able to use the information they learned in their cases that they could make connections with the project they were working on.

In some of the activities such as preparing posters for the school bulletin boards (*n*=2; $S5_2$, $S6_2$) and writing article for the school journal (*n*=4; $S1_2$, $S2_2$, $S3_2$, $S4_2$), students searched the web to find information and used computers to organize their works. During these activities, it was observed that the students knew basic concepts about climate change such as global warming, some of the observed changes in the climate such as melting of ice and rise in the sea level, and greenhouse gases; however, they needed for more information to explain the cause-effect relation between climate change and global warming and greenhouse effect. They asked their teachers how they could make those connections and the teacher suggested them some web sources to search and some articles to read. They (*n*=6) claimed that while working on these activities they mostly searched for scientific facts that would appeal to other people at the school. As $S1_2$, $S3_2$, and $S6_2$ highlighted in the reflective interviews, these activities not only helped them learn new concepts, but also helped students how to apply information in a new building, to make plans based on the information, to critically examine information, and to make judgments.

Further, students were watched a Turkish-made video about a local issue in Black Sea Region, and a well-known documentary about scientific observed changes on climate. The videos were watched in the physics class. All the group members

watched the documentary and two of them ($S5_2$, $S6_2$) were interviewed. On the other hand, in the club session that the video about a local issue in Black Sea Region was watched, there were 15 students in the class and two of them ($S1_2$, $S16_2$, and $S13_2$) were interviewed.

Considering these two extra-curricular activities on documentary videos, findings revealed that students were interested in the documentaries. During the video on hydro electric centrals and climate change facts, students did not talk to each other, and some of the students took notes. The first video was about scientific facts on climate change. After the video, one of the students ($S9_2$) asked their teachers from where she could reach that video and added that she wanted her family to watch it. This indicates that she showed an attitude toward informing others. Then, the teachers told the source of the video. During reflective interviews $S5_2$ noted that:

> $S5_2$:...Before watching the video I did not know that 1^0C increase in the temperatures can cause such consequences. For example, mosquitos start to occur earlier and that threatens other animals and also people…

Her response indicates that students construct a conceptual understanding of climate change when they learn the facts through real-life scientific examples.

The second video was about local people's rebellion to construction of hydroelectric centrals. It was including information about how hydroelectric centrals are constructed, why they are harmful for the environment, and so on. The students watched the video carefully, and they were quite attracted that when the video finished, they applauded, and one of the students talked to the class:

> $S16_2$: …The people in the video are just local people, most probably they are not well-educated; however, we watched how they are aware of the environmental problems, and the importance of protecting their environment. This should be a case for us that not only we will be active seekers of the environment protection, but also we should inform our friends, families, or other people around us…

Her ($S16_2$) speech reveals that the video motivated her and raised awareness. The video also helped her develop attitudes to inform others and take action. Also, with

giving this short speech, it can be claimed that she was willing to take initiatives as a leader among her friends.

The extra-curricular activities also aimed to help the students to build a visual conceptualization of climate change. In this respect, the students visited Energy Park in Ankara (*n*=18) and solar panel laboratory of METU Physics Department (*n*=18). Three of the students ($S3_2$, $S10_2$, and $S15_2$) were interviewed after visiting Energy Park, and three of them after were interviewed after visiting solar panel laboratory ($S2_2$, $S7_2$, $S8_2$). Students were especially quite interested in the solar laboratory. They asked questions to coordinators of the laboratory about which materials they use to construct solar panels, how much energy they produce, etc.

In the site visit, the students were also allowed to touch the materials on display. Two of the students ($S2_2$, $S8_2$) stated that they did not know theoretical information about solar panels such as they were made of silisium, consist of small packaged, connected assembly of photovoltaic cells, and how expensive construction of them is. Addition to their responses, other interviewee ($S7_2$) mentioned that they could use solar panels to reduce the school carbon emission caused by energy consumption. Their responses reveal that through engaging in such extra-curricular activities, while learning about climate change, climate change adaptation and mitigation, the students also learn how to apply information in their cases and daily-lives.

In addition, within the scope of the project CLIMES, students attended to two international meetings with partner schools. One was held in Hungary, and two members of Green Team Student Club ($S17_2$, $S18_2$) and one of the teachers of the club (T1) with two project managers from METU, Department of Educational Sciences participated in. Since the researcher did not participate in Hungary meeting, only reflective interviews were made to collect data. The results showed that both of the students ($S17_2$, $S18_2$) were attracted by the meeting. Both of them stated that they liked and enjoyed the meeting, and had new friends from partner schools. Additionally, both $S17_2$ and $S18_2$ indicated that they were impressed by the context of the school. Especialy, the school was well equipped with renewable energy

sources and a wide range of practice areas including agriculture, stockbreeding, and sports arenas. Their perceptions of the vocational schools in Turkey and the one they say in Hungary changed their conception of vocational education. Beide, both of the students claimed that those school facilities were effective in climate-friendly school management and shed a light to consider implementing similar strategies for their action plans.

In the second meeting that held in Stockholm, three Green Team Club members ($S1_2$, $S2_2$, and $S3_2$), the teachers of the club (T1, T2) participated at the meeting with project managers who wre two professors at the METU Educational Science, and the researcher of the present study participated. In this meeting, each of European partner schools shared their final action plans to have a climate-friendly school management system and experts presented their studies on climate change issues. Also, the most effective and efficient action plans to reduce carbon footprint of the school were awarded. Data collected through observation notes of partners' presentations, seminars, along with social activities including lunch and dinner hours, city sides, and award ceremony. To complement observation notes, reflective interviews were made with three of the students ($S1_2$, $S2_2$, and $S3_2$), the teachers of the club (T1, T2). Observation notes indicate that since partners from different countries participated in these meetings, they helped the students gain different perspectives on climate change adaptation and mitigation processes. The students learned the action plans for climate-friendly school management of their partners. $S2_2$ said that she enjoyed the meeting and liked it. She had new friends from different countries and cultures and visited a new country. As she states these were social dimension of joining in the meeting that indicates this meeting motivated them to participate in such projects through giving them the opportunity socialize with their peers from other countries and visit new countries.

When she was asked about how the meeting helped her develop knowledge, she told that throughout participating in the extra-curricular activities within the scope of the Green team, she learned many new concepts; yet, those provided her develop a theoretical background of climate change. However, Stockholm meeting

helped her develop a broader perception through analyzing partner schools' action plans on climate-friendly school management. This can be concluded as meaningful learning occurs when students experience the information they learn in a real-life context.

In addition to all activities mentioned above, the most important activity the students involved in was carbon footprint calculation of the school. All the members of the Green Team Student Club participated in this process. Data were collected two times; at the beginning of the study and at the end of the study on five topics; namely, journey to school, school waste, energy use in the class, energy use in the whole school, water use in the school. At the end, the results were compared to see whether the action plans students developed and worked on.

During this process, the students were autonomous and the teachers only guided them. Some of the students took initiatives in data collection, while others were active in data analysis and informing the school about the analysis results. For example, two of the students ($S3_2$ and $S5_2$) took the initiative in data collection for calculating carbon emission caused by journey to school. The students talked to their group members and suggested collecting data on a paper instead of using questionnaires not to waste paper. Then, they shared the tasks collected data from all 9^{th}, 10^{th}, 11^{th}, and 12^{th} graders, all teachers, and school board in groups with two students. They talked to school principle, teachers, other students, janitors, and accountants of the school to learn who comes to school by their own cars, who uses school buses, the distances between their homes and the school to calculate the amount of carbon emission caused by transportation. On the other hand $S7_2$ and $s8_2$ analyzed the data with the help of their teachers. They draw tables and prepared figures in order to prepare a more meaningful analysis report. Next, $S1_2$, $S2_2$ and $S13_2$ prepared a presentation on analysis results in order to inform other stakeholders at the school for a joined climate-friendly school management system.

As reflective interview and observation notes revealed, data collection process was to be claimed as difficult that required energy and time; however, the students enjoyed and voluntarily worked on the process. Four students were

interviewed worked in data collection to calculate the school's carbon footprint. One of the students ($S11_2$) worked in the group collecting data for "energy use in the whole school" stated that he was interested in the process and enjoyed while working with his friends, and added that during club sessions, they visited other classes giving them a good opportunity to make other students and also teachers informed about their project. His response indicates that data collection process provided dissemination of the project at the school which helped the Green Team members have supporters among their peers and teachers.

After collecting data, the teachers and two of the students ($S7_2$ and s82) made analysis of them through software; afterwards, three of the club members ($S1_2$, $S2_2$ and $S13_2$) prepared a presentation about the results. During their work, they were autonomous, the teachers only guided them by asking questions such as "What about preparing figures and tables to give the results?", "Would you add an overall summary?", and so on. In the guidance of the teachers, the students prepared the presentation. They (n=3) all noted that they liked working for preparing the presentation and were excited to sharing the results with their friends. One of them said that:

> $S14_2$: …This activity helped us recognize our impact on climate change. It was exciting to see the results in figures. I mean we knew that yes we also have an impact on climate change; however, seeing the degree of that impact was so exciting. I think we all will be more conscious consumers and warn also other people about saving energy and water…

Her response indicates that activities that help students understand their impact on climate change in real-life context in form of numbers are effective in raising awareness of them and teaching them the degree of their daily activities' impact on climate change. Also, giving results in figures and tables helped students develop a visual understanding of an abstract term, carbon footprint, and discuss the results to develop strategies to reduce the amount of carbon emission.

In summary, during all of the extra-curricular activities, it was observed that a student-centered approach was ruled in the club sessions that the students were completely autonomous and their teachers just guided them. During the activities, when students seemed to need guiding, the teachers asked probing questions such as

“What about considering also natural effects on climate?”, “Do you think that adding climate facts on the poster might be attractive?”, “Have you searched for this website?”, and so on. The students were themselves who contacted with the school board when necessary and took initiatives for informing others at school. Also, they were the decision makers; for example, they made decisions about how to collect data for calculating the school’s carbon footprint and the strategies to be implemented for a climate-friendly school management system. Through decision making processes, the students developed also higher order thinking skills that required analysis and sysnthesis of information. Also, they were as leaders through managing decision-making processes that they decided on the steps to be followed, the organization, and implementation of the decisions. They discussed the issue and negotiated during group works to reach joined decisions. To illustrate, while students were working on preparing a presentation to share the carbon footprint results of the school, $S1_2$ suggested adding also a brief summary of data collection process to calculate carbon footprint of the school and $S2_2$ suggested choosing a member from each group who collected data to present what they did. $S13_2$ argued that it would be time consuming and agreed with $S1_2$. Then, they decided on adding a figure showing work-flow of data collection and analysis process od carbon footprint calculation. Besides, they selected their group leaders appreciating their personal skills and shared group tasks. To illustrate, they decided how to collect data to calculate the school carbon footprint, and developed strategies to be run for reducing carbon footprint of their school.

Their knowledge on climate change, climate change adaptation and mitigation was developed that none of the students mentioned climate change adaptation or mitigation in the questionnaire or pre-interviews. However, in the reflective interviews they also mentioned about climate change adaptation and mitigation, and simple strategies to be developed for climate change adaptation and mitigation. For example, $S11_2$ and $S13_2$ were interviewed after the seminar on climate change adaptation and mitigation. Both of the students mentioned that they basicly knew what climate change is; however, they were not aware of the adaptation and mitigation processes. When they were asked the terms they learned from the seminar, both of them were able to make a definition of climate change adaptation

and mitigation. $S11_2$ also stated some of the mitigation strategies: using renewable sources, saving energy and water, promoting energy efficient, low-carbon transport and urban systems, etc.

Moreover, they were confused about global warming and climate change that more than half the students (*n*=10) claimed that global warming causes climate change. Additionally, only half of the students (*n*=9) were aware that human actions are also causing climate change. After participating in the extra-curricular activities mentioned above, they became able to make a definition of climate change including human effects, and also identifying causes and effects of climate change.

4.2.2. Final Interviews

Final student interviews were conducted at the end of case which was the end of the second semester in order to evaluate whether there has been a change on students' knowledge, attitudes, and skills with regard to climate change. In this section, knowledge dimension is analyzed.

Four students, who were selected based on oservations and reflective interviews, were interviewed in the final interviews. According to analysis results, all of four students learned new concepts related to climate change, climate change adaptation and mitigation. They also highlighted that they raised awareness because they learned their effects on climate change and potential strategies for climate change mitigation that they started to inform other people about climate change and the actions they could take for climate change mitigation. Moreover, they became conscious consumers about energy and water consumption, also food consumtion. To illustrate, while preparing a poster for the school bulletin boards, students ($S5_2$ and $S6_2$) searched for which product comes from which city or country. Then, they calculated avarege carbon emission through using google maps and they realized that using domestic products lessens the amount of carbon emission caused during food transportation.

Two of them ($S1_2$ and $S2_2$) claimed that they had not fully unserstood some concepts such as climate change adaptation and mitigation, carbon footprint, solar energy, etc. prior to attending in the case. Although not very in-depth, they claimed that with participatin in the extra-curricular activities their knowledge increased. They admitted that had misconceptions about greenhouse gases before, and were confused about the causes and effects of climate change in line with the greenhouse effect. For example, one of the students ($S1_2$) said that he did not know that until participating in the seminar that Earth Climate History, greenhouse gases naturally exist in the atmosphere but human actions increase and ruin the natural proportion of them.

All of the students (n=4) noted extra-curricular activities as effective on developing their knowledge, skills, and attitudes toward climate change. Additionally, all of them (n=4) said that especially carbon footprint calculation of the school was so interesting and useful for them that they recognized their own effects on climate change which enabled them develop strategies for reducing carbon emission. To clarify, the Green Team members collected data and calculated carbon footprint on five topics, namely, journey to school, energy use in the class, energy use in the school, water, and food. They discussed their findngs and developed strategies to reduce carbon footprint of their school. To illustrate, they informed other stakeholders at the school about energy and water consumption and they sticked notes in the classes and lavatoriessuch as “Turn off when not in use,” “Switch of when not in use,” “Please use hot tap water as and when required,” etc..

One of the interviewee ($S3_2$) summarized the processes that she was involved in. She claimed that extra-curricular activities were interesting and enjoyable because they had the chance to work on different kinds of activities. Throughout the project, it was observed that the teachers utlizied different kinds of instructional methods considering students’ personal characteristics. The teachers encouraged group works, as well as individual works, for the students who better succeed in a collaborative learning environment. Further, they organized visual materials, field trips, and seminars to ensure that each student with a different learning style could learn about climate change.

$S3_2$ stated that the teacher asked them in which activity they wanted to work and she was volunteer to work on writing article and carbon footprint calculation of the school. She also attended in the seminars with other Green Team members. Throughout participating in the extra-curricular activities during two semesters as a Green Team member, she learned new concepts that she claimed that she had known what climate change was but had not had adequate knowledge about the impacts and consequences of it. Moreover, she did not know what carbon footprint was, the aim of the Kyoto Protocol, details about solar energy, etc. in the Green Team Club. She concluded that if she had not participated in the extra-curricular activities, she would not have learned those concepts; hence, she would not have been aware of the importance of taking action to adapt and mitigate climate change.

Further, two of the participants ($S2_2$, $S4_2$) mentioned about lack of emphasis on climate change, climate change adaptation and mitigation in the formal curriculum. They claimed that through these extra-curricular activities they learned what climate change and impacts of it were, and what caused climate change.

Throughout the project, the students showed interest in applying the procedures that were decided to be carried out by their Green Team Club members and fulfilled the tasks as instructed by each group worked in different kinds of extra-curricular activities in solving problems regarding climate-friendly school management. They became able to classify factors affecting climate change such as energy and water consumption habits, also, actions to be taken to cope with climate change. They developed cognitive skills regarding teamwork by engaging in a coordinated work flow. Moreover, they learned what carbon footprint was, how to calculate it, and also, which measures could be taken to decrease the carbon emission amount.

To sum up, when the analysis of the reflective interviews, observations, and final interviews are interpreted the results on whether there was an increase in students' knowledge that can be concluded that students seem to have increased knowledge and awareness on basic concepts, and also some lifelong learning skills which may help them deal with climate change adaptation and mitigation explained

later in this chapter. New concepts learnt are how the Earth's climate had changed, what climate change mitigation and adaptation were, what carbon footprint was and how it was measured, the Kyoto Protocol and the countries that signed it, solar panels, how human actions have affected climate change, and what actions to be taken to handle climate change problems. Table 4.8 summarizes the concepts the students learned while they were engaged with extra-curricular activities in their Green Team Club hours.

Table 4.8

A summary of concepts students developed during the study

Topics	Concepts
Climate change	History of climate What climate change is Factors affecting climate change • natural factors • human factors
Climate change adaptation	Effects of climate change on: • air • water • human health • bio-diversity • socio-economic conditions Global warming Carbon footprints
Climate change mitigation	Kyoto Protocol Individual actions to be taken Clean energy • Solar panels Climate friendly school & house • CLIMES • Solar Decathlon Enabling activities and capacity building Calculation of carbon footprints of the school

4.3. Skills the Students Developed

In this section, the skills students developed with regard to climate change, climate change adaptation and mitigation will be explained based on the reflective interviews, observations, and final interview results.

The skills that students developed with the help of extra-curricular activities implemented were observed, and also the students were interviewed during 20 weeks, after each club session. Also final interviews were made at the end of the second term.

The extra-curricular activities implemented throughout the present study were including:

- Preparing posters,
- Seminars,
- Watching video,
- Writing articles,
- Visiting solar energy laboratory at Middle East Technical University (Metu) & energy park in Ankara,
- Participating in international meetings within the scope of the project climes
- Presentations in the meetings of the project CLIMES & at the school

The variety and richness of the extra-curricular activities provided the students a learning environment different from formal learning environments. Analysis of the observations and interviews revealed that students voluntarily worked on the extra-curricular activities and they were intrinsicly interested in the topics they dealt with. During the club sessions, a student-centered approach was adopted by the teachers and the teachers only acted as guide. The students were left autonomous; in the decisions they had to take while they were working on the extracurricular activities that included the measurement of the school's carbon footprint. Student mostly prefered to work in groups, shared the tasks among themselves based on voluntary distrubution but also on the skills that found they were best equipped, and they also decided on the strategies and action plans on reducing carbon footprint of their school. Finally, they informed others on climate

change through presentations, posters, and informal meetings with their stakeholders at school. To illustrate they conducted the action plan they developed for reducing the amount of carbon emission caused by water and energy consumption. They warned their peers, teachers, janitors, even school board about saving water and energy through simple daily routines, e.g., using cold tap-water while washing their hands because as they claim most of the students use hot tap-water to get warm in winters. Furthermore, they warned their friends about switching off the lights and not leaving electronic machines in stand-by. One more point to remark, while collecting data to calculate the school carbon footprint caused by transportation, the students did not use questionnaires not to waste paper; instead, they asked their friends and the teachers how they come to school by school bus or by their own car, and where they live. They took notes on a paper, and then organized the data they gathered. All these indicate that students develop ***accountability*** on environmental issues.

Moreover, the students worked in groups while preparing posters for the school notice boards to inform others at school about what climate change is, how it affects people's lives, and which actions people can take for climate change adaptation and mitigation, writing articles for the school journal about climate change, and calculating carbon footprint of the school. The students collaborated on all the activities they conducted. Thus, ***collaboration*** is one of the skills the students developed through working on group activities. During their work, it was observed that group members worked in a harmony and helped each other. To illustrate, the students were observed, and then interviewed while they were writing an article about carbon footprint for the school journal. Three students (three female and a male) worked on the activity. They shared the tasks as the three girls would search for information from the internet, and the boy would read reports about carbon footprint. Then, they would share what they have found and bring them together to organize the article. By working together on the activity and sharing their interpretations of literature in discussions, they motivated and tried to make each other feel comfortable while sharing individual suggestions. They respected their ideas and helped each other. This gave opportunity to shy students work in coherence with their peers.

Collaboration is not the only skill the students developed through group activities. Throughout the group activities, they discussed and shared their ideas, and then tried to reach a consensus. Thus, negitiaton as another skill they practiced. They talked to their friends, teachers, and school managers while collecting data and informing them about their action plans, etc. For example, while writing an article for the school journal, the students shared and discussed their ideas. During their work, it was observed that one of the students ($S1_2$) suggested putting how much energy electronic machines that people use in daily life consume. His friend ($S2_2$) asked him the reason behind his suggestion and $S1_2$ answered:

> If we know how much energy they use, we can also learn the CO_2 emission they cause; thus, we behave more careful in this respect.

$S2_2$ agreed on including $S1_2$'s suggestion on the poster to raise awareness on being conscious consumers. Another student ($S3_2$) suggested putting some basic theory about climate change and they discussed what they could write about it. Other student ($S4_2$) came up with writing definitions of climate change, global warming, and greenhouse effect, and the suggestion was accepted by other group members. It can be concluded that during the activity, the students develop skills on ***discussion, negotiation,*** and ***communication.***

Moreover, in group activities, different perspectives of the group members lead more creative works. They did lots of brain-storming during the group works. In accordance with theories of cooperative learning, every individual's participation contributed to the success of the whole group. Learning occured through group learning and peer-directed learning. Especially, while developing strategies for the action plan of the project, a variety of different perspectives were emerged. To illustrate, some of the students suggested developing an action plan to reduce the energy consumption of the school through controlling electric consumption, while some suggested using solar energy. Another example can be students' work on preparing a presentation on what they have done throughout the project CLIMES for the school. At first, the aim of the project and the carbon calculation processes were included in the presentation. However, one of the students ($S5_2$) involved in the

presentation suggested mentioning about the extra-curricular activities they participated in, especially the international meetings and field visits to attract other students' attention. Also, another group member ($S8_2$) suggested including part in the presentation in which their peers could ask questions about the detail and also they could ask their peers' personal opinions on the project and the action plans they developed. Therefore, the presentation became more interactive and interesting. This process can be claimed to help the students develop skills on ***creativeness*.**

Throughout group works, some of the studnets took more responsibilities in the group activities than their group members. They took the initiatives while task sharing, managing group discussions, and making decisions.***Leadership*** is another skill these students developed. To illustrate, one of the participants (S62) who worked on preparing poster stated that the teacher gave them some topics they should search for; however, at first, they did not know where to start, and then she suggested her friends that each of them could search for one of those topics so that later, they combined them. They agreed with her appreciating her leadership and she distributed the topics to her group members. Afterwards, when all of them finished their own task, they presented their findings and discussed to reach an agreement on what they should have put or not on the poster. She admitted that she led the discussion, yet, as she claimed that it wasn't like a conflict management; it was just leading a discussion.

As her response in the reflective interview reveals, she developed leadership skills. Students' mutuality was an interesting feature of group works that one of the students were taking the responsibility by lessening others' as all students combined their incomplete skills to reach a joint solution. Sometimes this was in the form of affirmation. To illustrate, while students sharing tasks on preparing posters, $S5_2$ asked her firend $S6_2$:

- $S5_2$: I think you're rather confident on that, do you think you could be the leader for task sharing?

Throughout the extra-curricular activities such as preparing posters and writing article for the school journal, the students often applied for doing research. They searched for information about climate change issues, and then organized the information they reached. These helped the students developed ***research*** and ***information management skills.*** To begin with ***research skills,*** students who worked on preparing poster, writing article, and data collection and analysis of the school's carbon footprint found these extra-curricular activities effective in terms of helping them develop the research skill. To illustrate, in order to calculate the school's carbon footprint, the students *collected data and analyzed the data* they gathered. They were the ones who decided on how to collect data. In other words, they did not use questionnaires to collect data on how people commute to school (by bus or car) in order not to waste paper; instead, they interviewed each person in school by visiting classes and taking notes on a paper. They ran and analyzed the data they gathered through a software called Dt.007 within the guidance of their teachers. Additionally, evidence that the students developed research skill was also observed during the extra-curricular activities while preparing posters and writing an article. The group members firstly *determined their purpose* for each work. Then, they *searched some sources* (internet, books, and the reports) to get information in line with their purpose. Since, internet has many sources; the students got help from their teachers *to choose the best, and the most reliable* information to use in their work. Next, they *took notes* about the sources they reached. Finally, they decided together on which points to include in the poster or article.

To continue, students developed also ***information management skills*** throughout the implementation of extra-curricular activities: while they were preparing posters and writing an article for the school journal, and collecting and analyzing data to measure the school's carbon footprint. As mentioned above, the students got ready for their task through doing research. Additionally, they also *analyzed* the strengths and weaknesses of the sources they reached, and *made inferences* from the data they analyzed. Based on the discussions among group members, they decided on how to *organize* and *to report* their work collaboratively in harmony.

During all of the extra-curricular activities, it can be claimed that the students were autonomous; they were only guided by their teachers. To illustrate, the students were the ones deciding on the steps to be followed to gather data for carbon footprint calculation for the school. They sometimes had difficulties while collecting data because they were allowed to collect data only during the club hours not to cause problems in the implementation of the formal curricula. Also, due to the location and administrative culture of the school, the students had difficulties while collecting data on water and energy. For instance, the school has five faculties and other academic buildings and their water and energy consumption are controlled through a shared system. To overcome, these difficulties, they discussed and consulted to their teachers. They also collaborated with the school managers. After analyzing the data they gathered, they developed strategies to be implemented in order to reduce the amount of carbon emission of the school. Examples of those strategies were given below:

- The degree of the tap water is decreased.
- Janitors and students are informed to use water economically.
- Students, teachers, and janitors are informed to turn of the lights, not to leave electronic machines run or stand-by.
- A new climate-friendly building is being constructed, e.g. more windows with new technology will be put to make use of more sunlight and new thermal insulation materials will be used in the building.

It can be concluded that the students worked autonomously, made other people involve appropriately in decisions that may impact them, and quickly responded with a back-up plan when a decision went amiss which helped their ***decision-making skills*** developed.

Addition to these skills mentioned above, the last not the least important skill that the students developed was ***problem solving***. Students faced some drawbacks during data collection to calculate the school's carbon footprint. Students tried to overcome those drawbacks they faced through group discussions. For example, to measure carbon footprint of the school caused by transportation, the students did not use questionnaires not to waste paper; instead, they took notes on a paper talking

each person one by one. They used google maps to calculate avarege distance between people's houses and the school to determine how much oil was required for a certain distance and the amount of CO_2 emission for that. Moreover, the school has five buildings and they use water and energy from a shared system; therefore, the water and electricity bills include those five buildings' usage. However, the students needed the amount of water and electricity consumption for only high school building. For this reason, students visited other buildings and tried to compare those with their building. They calculated class and other rooms' sizes and counted the electronic machines and lightbulbs in classes and through corridors. They found that those buildings had almost similar to theirs so that they could calculate the avarege consumption for their building by dividing total consumption into five. These examples indicate that students discuss and develop strategies to overcome the problems they face. They identified the problem, looked for solutions, made decisions and implemented them leading development of problem solving skills.

In conclusion, at the beginning of the study, the students had been taking basic actions that could be applied to any context such as switching of the electricity when not in use, currently, through participating in a variety of extra-curricular activities, they seem to be developed as they have been equipped with certain basic research, communication, and problem solving skills so that they can handle with the climate-friendly management system, and develop individual actions for the school context. Also, as Cain (2004) proposes that extra-curricular activities help students develop skills on leadership, discipline, and credibility, these activities provided students the opportunity to learn responsibility, teamwork, accept diversity, and how to coorparate. The skills students developed on climate change through engaging in extra-curricular activities are summarized in the Table 4.9.

Table 4.9

The skills students developed through extra-curricular activities

Extra-curricular activities	Skills
Preparing poster Writing article Carbon footprint calculation Presentations in the project meetings & at the school	Communication Collaboration Creativeness Decision making Discussion Information management s Leadership Negotiation Research Problem solving

4.4. Attitude the Students Developed

In this part, how students' attitudes toward climate change, climate change adaptation and mitigation have changed through participatin in the extra-curricular activities are stated. Qualitative data collected through reflective interviews, observations, and final interviews. Observations were made during the Green Team Club sessions for 20 weeks. Also, reflective interviews were made after each club session to get deeper idea about their attitudes, and with final interviews conclusions were made.

The results revealed that the students developed positive attitudes toward learning about and taking actions on climate change, climate change adaptation and mitigation with the help of extra-curricular activities. Students' independency was encouareged in the group activities and they were supported to gain sense of work-flow through the challenge involved. Also, their capacities for autonomous learning were developed that the students directed their own learning.

In other words, one of the extra-curricular activities students participated was preparing a poster for the school's notice boards. Two students were interviewed ($S5_2$ and $S6_2$) and both of them mentioned that they were volunteers for working on that extra-curricular activity because they believed that to cope with climate change making all people take action was essential. One of the students ($S5_2$) said that:

> S5: I wanted to work in this activity because I like preparing posters and drawing. Also, I believe that informing people about a problem should be the initial step. If you do not raise awareness on how the problem is vital, you cannot make people take action on it. Therefore, I thought that if we prepare a poster, we can attract people and encourage them for a joint climate-friendly school management system.

As her response indicates, these kinds of activities help students raise awareness and enjoy in a coordinated work-flow. Besides, they develop attitudes toward taking action on climate change adaptation and mitigation along with raising awareness among other people on the actions that they can take.

Another extra-curricular activitiy students participated in was writing an article for the school journal abut carbon footprint. Four students ($S1_2$, $S2_2$, $S3_2$, and $S4_2$) were interviewed during three weeks after the each club session. Three of them ($S1_2$, $S2_2$, $S3_2$) stated that while working on that activity they learned what carbon footprint was and how people could reduce their carbon footprint, and also some scientific facts such as which electronic machine caused the most amount of carbon emission, why nuclear centrals were dangerous for the environment, etc. All of the participants (n=4) added that these kinds of activities helped them increase knowledge; therefore, their awareness raised and they became more willing to raise awareness also among other people and to encourage people take action to mitigate climate change impacts. In this respect, one of the students ($S3_2$) claimed that the more she knew what climate change and its impacts were, the more she felt responsible for taking action in adaptation and mitigation processes of climate change.

To summarize how the extra-curricular activities helped the students develop positive attitudes towards taking action on climate change, all the Green Team

members worked in different kinds of group works, such as preparing a poster, writing an article, preparing presentations for the school meetings, etc. Besides, they participated in the activities such as watching videos, joining at seminars and field trips. The general consensus among students was, these extra-curricular activities helped them increase knowledge, and also provided a learning environment that they could actively participate even in decision-making process. One of the students claimed that:

> $S1_2$: I liked participating in the extra-curricular activities because I was autonomous. I mean we decided where to search for information, how to organize the posters, the contents of the articles, etc. We worked with our friends and this helped us also develop better friendships. We saw that even when our teachers were as guiding us in the class, we can succeed.

In addition, another student ($S15_2$) mentioned the reason why she evaluated extra-curricular activities as effective that as she admitted the activities helped them increase awareness on climate change problem that after these activities she was motivated to raise awareness among her friends and family members. She explained that:

> ($S15_2$):…When I see a friend of mine or a person, throwing rubbish away, I go and warn him/her not to throw the rubbish away. In addition, I am now more careful about energy and water consumption, and also warn other people when they use energy or water lavishly. For example, I told my father to change the lambs with energy-friendly bulbs at home. Also, now we separate rubbish at home…

As seen, the students liked participating in the activities, and their awareness increased on taking actions and raising awareness among other people. In otherwards, it can be claimed that students became willing to disseminate the information they learned through engaging in extra-curricular activities, and also they linked their experiences to real-life cases. This reveals they were able to turn their knowledge and attitudes into situational behaviors.

One point to highlight in this respect is according to the students the most important activity was carbon footprints calculation of the school. Almost all the Green Team members participated in the carbon calculation process. Some of them

collected data, and some analyzed them. Overall ideas of the students were that they liked working on the activity because it was interesting concreting an abstract concept, which was their impacts on climate change, through measuring carbon footprint of the school. One of the students ($S13_2$) said that she worked the data collection process to calculate the amount of carbon emission caused by energy consumption and calculated how many bulbs and electronic devices are there in the class, and how many hours they work in a day. Then, carbon footprint of the school caused by energy consumption was calculated.

> S132: …The results were surprising. I could not believe that we cause such an amount of carbon emission. Seeing our impact on climate change in numbers was attractive. We all decided to be more careful about energy consumption. After all, we put notes in the classes and the laboratories that warn people switch off the lights and turn of the electronic machines when they are not in use…

The extra-curricular activities did not only help the students increase knowledge and awareness on climate change, and learn individual attempts for climate change adaptation and mitigation, but also they helped the students realize the potential impact of teamwork in achieving their target: creating a climate-friendly school management system. In this respect, one of the students ($S18_2$) claimed that climate change was one of the most important global problems; thus, people should take action at least to mitigate impacts of climate change. She added that one way of handling this problem was raising awareness among people to be active citizens in climate change adaptation and mitigation processes and this could be managed by the means of education.

By working together with others in order to achieve the goals of the project, the students also increased awareness of appreciating different thoughts in order to establish harmony. In this respect, in the reflective interviews, the students stressed the importance of teamwork. They claimed that they enjoyed during the group works and learned how to work with all types of people adding their perspectives to an issue based on their previous experiences on the issue. Another point the students liked about group works was easiness of them. One of the students explained why he found group works easier than individual work as:

> $S1_2$:…When we work in groups, we share the tasks. Each group member works on his own responsibilities, and then we combine them to finish the task. This is less time and energy consuming compared to individual work…

Furthermore, $S11_2$ noted that they enjoyed in the extra-curricular activities because being able to do what was expected from them by themselves helped them develop self-confidence.

The students' ($S1_2$ and $S11_2$) responses can be interpreted as students like group works and help students develop non-academic skills that group works help students socialize with their peers, develop a sense of mission, and self-confidence.

To summarize the students' perceptions on the role of extra-curricular activities on developing climate-friendly attitudes, the students liked the activities and they were interested in them. The activities helped them increase knowledge and developed skills with regard to climate change problem. Accordingly, they became more aware of the problem and motivated to raise awareness among other people. The extra-curricular activities provided opportunities for raising awareness along with knowledge that would help students develop certain lifelong learning skills with regard to climate change. Although students had difficulties in accomplishing some of the activities, particularly in the carbon footprint calculation process of the school, there were some other extra-curricular activities that they succeed easily such as preparing posters. Throughout the activities, each student had their own place and they were autonomus that the responsibility of the teacher was scaffolding.

The general atmosphere in the club sessions was like there was a genuine feel of cooperation between students and teachers. The students displayed good teamwork and helped each other out. They negotiated and reached concensuses. They were the decision-makers that they developed strategies and implemented them in a co-ordinated work-flow with in close contact while they were in close contact with their peers, teachers, and school managers.

Impact of the Case on Teachers: In the present study, it was found that extra-curricular activities not only had an impact on developing students' climate-friendly knowledge, attitudes and skills, but also they provided opportunities to teachers to build concepts and skills on climate change that in-deep involvement in the extra-curricular activities also helped the teachers become more professional in how extra-curricular are developed and implemented within the school context. They learned how to include the students in the process of creating a climate-friendly school management.

As diagnosis results revealed, at the beginning of the study, the teachers knew the importance of teaching climate change; however, they did not know how to create a climate-friendly classroom. In the interviews, they claimed that with the help of extra-curricular activities both students and they ***raised awareness*** on climate change; therefore, they started to behave more conscious about recycling, energy and water consumption. Also, they were motivated to raise awareness among other people and to search for sources to be used in the club sessions. One of the teachers stated that:

> (T1): Before working on the extra-curricular activities with regard to climate change, it was so hard for us to include climate change issues into our classes because as you know, we have to follow the formal curriculum, and it is so intensive. We were trying to teach all the topics during a semester so we did not have enough time for group activities, seminars, etc. Therefore, we could only teach very basic concepts on climate change, and it was not enough to promote climate-friendly attitudes and behaviors.

In addition, the other teacher (T2) also highlighted that teaching about climate change was essential, yet, formal curricula did not provide a conceptual understanding of the problem. Besides, she stated that the students came to school with a developed perception of environmental education that they learned mostly from their families and media, and it was hard to change some biases and misconceptions of them; therefore, schools play an important role on educating students about environmental problems, particularly on climate change.

However, the data emerged from observation notes revealed that at the beginning of the study, the teachers did not have sufficient knowledge about how to implement extra-curricular activities in which students can actively participate. Throughout the present study, the teachers were willing and motivated to implement the extra-curricular activities, and to attract students' attention to those. Also, they became better at ***managing a student-centered class***, and having the ***guide*** role at club sessions. To illustrate, preparing a poster was one of the group activities. The teachers asked the class who wanted to participate in that activity. Five students were volunteers for this job. Then, the teachers gave a brief description of what the students will do, and helped them for task sharing. While the students were working on the activity, they guided them: suggested sources, helped for organization of the poster, and using technology, etc.

The final interview results supported the findings got from observation notes. Both of the teachers claimed that they now feel more comfortable at planning and implementing extra-curricular activities. One of the teachers highlighted the importance of extra-curricular activities:

> (T1):…I did not know that extra-curricular activities can be such effective. The students are willing and working voluntarily. I do not know may be because we will not grade them at the end of the project they work hard and actively participate in the extra-curricular activities. Therefore, I will often apply for such extra-curricular activities. Furthermore, I learned new sources that I can search for activities about climate change, global warming, carbon footprints, etc….

With the help of extra-curricular activities, the teachers took initiatives to help progress of all students leading development of their ***leadership skills***. They ***encouraged*** the students' individual and group activities. Moreover, the teachers claimed that they learned how to search information and organize it according to needs of the class. They ***considered differences between the student characteristics*** while developing and implementing the extra-curricular activities, also while task sharing in the group activities.

One more point to mention about the skills that the teachers developed, at the beginning of the club session, the teachers summed up what that day's activity, and

asked the class whether they had a suggestion for the implementation or even content of the activity. They always prioritized ***the needs and wills of the students*** for a more effective club session.

Table 4.10 gives a summary of the skills the teachers developed throughout the project.

Table 4.10

The skills the teachers developed

Skills	Exercise leadership by taking personal responsibility for the progress of all students
	Encourage students in individual and group activities
	Organize and motivate students to participate actively in the class in which the needs of both the individual student and the class as a whole are considered
	Know when and how to use current educational technology
	Keep the needs of students at the center of professional thoughts and actions

Despite the advantages of implementing extra-curricular activities, the teachers also mentioned about the drawbacks they met during the implementation of the activities. One of those drawbacks was finding activities which encourage students for active participation and help them develop knowledge, attitude, and skills on climate change. Also, as one of the teachers (T1) said that she sometimes had difficulties while encouraging all the students in the activity because sometimes they had exams and wanted to study for the exams. Another drawback the teachers complained about was that even club sessions which takes one and a half hour was not enough for the implementation of some activities. To illustrate, one of the teachers (T2) stated that seminars could last more than one hour. She told that after

seminars, students had questions but sometimes because of the timing they could not ask their questions to the presenters.

Other obstacle was about making whole school participate in the creating a climate-friendly school process. One of the teachers (T1) pointed out that most of the students in the Green Team Student Club were interested in and motivated to taking action in this respect; however, to achieve a climate friendly school management system, working together with all people from students, teachers, and janitors to school board was essential. Therefore, adopting the mission and vision of the Green Team Club required extra effort, time and budget.

To conclude, extra-curricular activities also help the teachers developed knowledge and increase awareness on climate change, climate change adaptation and mitigation. Throughout the study, the teachers developed skills on classroom management, leadership, etc. while implementing extra-curricular activities. Deep involvement in the present study and collaboration with the university staff helped the teachers gain a different perspective on increasing students' knowledge, attitudes, and skills through extra-curricular activities.

Student and Teacher Roles: In this section, student and teacher roles are explained based on the observation notes and reflective interviews.

The students participated in the present study were volunteer Green Team Student Club members (n=18). The club was founded on January, 2012 in line with the project CLIMES and right after the present study started. The students were expected to develop an action plan to achieve a climate-friendly school management through engaging in the extra-curricular within the scope of the student club. They were in close contact with the school administration to have support during implementation of the extra-curricular activities and also for conducting their action plans.

Throughout participating in the extra-curricular activities, students developed knowledge, attitude and skills with regard to climate change, climate change adaptation and mitigation. While working on the extra-curricular activities, they were

autonomous and active. They worked individually or in groups on a variety of extra-curricular activities that they were interested in.

They worked in coherence and collaborated with other group members in the extra-curricular activities. Moreover, they were the decision-makers' and initiators' of the process that they developed action plans and tried to implement those plan at school. For this, they held meetings to inform students, teachers, and janitors of the school about saving energy and water, and recycling to reduce carbon footprint of the school and tried to encourage others at school to use school buses.

The students also worked out of club hours to fulfill their responsibilities that the extra-curricular activities required. They made observations outside. For example, they tried to understand transportation habits of public while making observations in the traffic, and to determine the green areas around them. Additionally, the students also intended to raise awareness among their friends, teachers, and even families. In order to make others at school be aware of climate change, they prepared posters and wrote article on climate change related topics. Beside, at the school, they disseminated the actions they took with regard to climate change adaptation and mitigation through presentations, school journal, and posters. On the other hand, as the students indicated in the reflective interviews, they also raised awareness among their families that they made their parents change the light bulbs at home with energy-efficient bulbs, and separate waste for recycling. They were as a role-model for their peers and other people.

When the teachers' roles were analyzed, it can be claimed that before the study, they were active club teachers at other student clubs. In line with the CLIMES Project, they started to work at Green Team Student Club. Although they had run student clubs, it was the first time they worked in such a club that student autonomous and students' needs were prioritized.

During the implementation of the extra-curricular activities, the teachers were as guides. They provided sources and materials to the students, and helped the students when they need. Also as a facilitator, mentor, and scaffolder, the teachers

ensured that each extra-curricular activity reached its aims. They tried to help students be aware of their responsibilities and their own capabilities to achieve their tasks, and also develop knowledge, attitude, and skills with regard to climate change adaptation and mitigation.

Additionally, they tried to maintain respect and control among students, and also their self-esteem while encouraging them to achieve their tasks while working on the extra-curricular activities.

CHAPTER V

DISCUSSION AND IMPLICATIONS

This chapter presents the conclusions of the study and the implications for further studies.

5.1. Discussion

The purpose of the present study was to evaluate role of extra-curricular activities on developing students' knowledge, attitudes, and skills with regard to climate change, climate change adaptation, and mitigation at a private secondary school in Ankara.

Through a qualitative study complemented with little quantitative research, an in-depth analysis of the case was done. The results revealed that the Green Team members of the METU-DFHS developed knowledge, attitudes, and certain skills on climate change with deep involvement in the extra-curricular activities. These three dimensions are also defined by Hungerford and Volk (1990) that they explained behaviors on environment through environmental sensitivity, knowledge, attitude, and action. Similarly, Hwang, Kim and Jeng (2000) revealed the factors affecting people's behavior regarding environment as affective, cognitive, and situational. Therefore, the present study's results are given in this three category; knowledge, attitude, and skills.

Before strating discussions, it is important to state that education is a vital tool for coping with environmental problems, and extra-curricular activities

supplement the formal curricula. In this respect, Liarakou, Athanasiadis, and Gavrilakis (2010) noted that participating in Environmental Education programs help students to develop positive attitudes. In support of literature, this study aimed to evaluate the role of extra-curricular activities on promoting students' knowledge, attitudes and skills with regard to climate change, climate change adaptation and mitigation. As one of the teachers of the Green Team Student Club (T1) claimed, climate change is a complex, scientific, and interdisciplinary problem that should not be limited to just a unit because raising awareness and making permanent changes in climate-friendly behaviors of the students require time, and organization of learning environment and teaching materials. In his master thesis, Yurtseven (2006) examined 9^{th} graders misconception on climate in geography lessons. The findings showed that the time allocated for the topic climate change is not adequate; therefore, teachers just define the concepts of the unit causing misconceptions among students that the students do not know basic terms and how to relate them to each other.

These findings are in congruence with Ünal's (2011) study. In her study she emphasized the importance of restructuring curricula, reorganizing learning environment and timing. Congruently, Fortner's (2001) study asking *where climate change fits* within the school and *how we are ready* to integrate it into the curriculum also support the idea of a need for restructuring formal curricula. She indicates the importance of the global warming and climate change and in order to prepare students for their responsibilities in the society, as well as a sustainable life, climate change should be included in the curriculum. She suggests developing a curriculum based on students' perceptions that "Educational strategies are best designed when they are based on knowledge of the learners' level of knowledge and preconceptions" (p. 21).

The studies mentioned above indicate that teaching climate change is an interdisciplinary topic and requires time; however, the time allocated for this topic and the scope of it in the formal curricula are limited. Moreover, in order to help students equipped with lifelong learning skills which they might need to deal with climate change adaptation and mitigation, their perceptions and pre-knowledge

should be considered, as well as their needs. Therefore, this study aimed to evaluate how these deficiencies can be overcome through implementing extra-curricular activities within the scope of a school club. The findings of the study revealed that extra-curricular activities helped students develop knowledge, attitude, and skills on climate change adaptation and mitigation. It can be concluded that through extra curricular activities students build environmental consciousness and started to take actions to control and to solve environmental problems as suggested in the literature (Atasoy & Ertürk, 2008; Erten, 2012). Their initial actions were warning the stakeholders for water consumption in their school, secondly, they developed strategies that might have reduced energy and water use, and have changed their transportation habits. The findings of this study is also in line with that of Lakin's study (2006) who proposed that activities implemented in in-formal learning environments contributed to students' cognitive, affective, and psycho-motor skill development.

To begin with ***role of extra-curricular activities on developing students' knowledge*** with regard to climate change , climate change adaptation and mitigation, at the beginning of the study it was found that students had lack of knowledge on climate change, climate change adaptation and mitigation that they did not aware of some concepts such as climate change mitigation and adaptation. They were not able give an exact definition of climate change that most of the definitions were limited to climate shift and changes in weather conditions. Also, they confused climate change with global warming. Moreover, the participants did not list causes and impacts of climate change.

In this respect, these findings match with the literature that indicates students have misconceptions about climate change causes and effects. For example, in a study examining Greek secondary school students' beliefs in climate change through a closed-form questionnaire consisting of statements regarding the causes, impacts and solutions for this global environmental issue, Liarakou, Athanasiadis, and Gavrilakis (2010) investigated that students have clear ideas about the impacts of climate change; although, they are not aware of the solutions and causes. They also

found a consistent result with the literature that students have a common misconception which is they relate the greenhouse effect to the ozone layer depletion. Similarly, Reynolds *et al*. (2010) identified two common misconceptions: belief in the cause-effect relation between ozone hole and climate change, and linking global warming to environmental pollution.

Another point people are confused is about the causes of climate change that they sometimes have difficulties in identifying efficient solutions to decrease the number of changes (Owen, 2005; Patchen, 2006) since they often confuse mitigation and adaptation (Eisenack, Tekken & Kropp, 2007). In terms of solutions, numerous individuals suggested reducing the use of aerosols or collecting waste to lower CO_2 emissions (Lorenzoni & Pidgeon, 2006; Patchen, 2006; Pruneau, et al., 2001). Consistent with these findings, 4 of the students (22.22%) suggested that people should stop using aerosols to prevent ozone layer depletion for climate change mitigation.

Secondly, ***the role of extra-curricular activities on developing students' attitudes*** toward climate change, climate change adaptation and mitigation was determined. Findings of the study revealed that students showed positive attitudes toward extra-curricular activities on climate change that they voluntarily worked on the activities and tried to raise awareness also among their friends by preparing posters and presentations for other student clubs. They claimed that they liked and enjoyed the extra-curricular activities because different kind of activities let them participate in those that they were interested in. The students also added that after participating in the extra-curricular activities they became more willing to take action for climate change adaptation and mitigation in their future lives outside the school context indicating they became able to link the information they learn with real-life situations. This finding is parallel to those Vermaas, van Willigenburg-van Dijl, and van Houdt (2009) revealed in their study "Extra-curricular Activiites at School". The authors claimed that students are much more motivated in participating extra-curricular activities when they are *interested in or want to have fun*, want to *support their future education* or *grades in current course*s.

Furthermore, despite the misconceptions or lack of knowledge on climate change, climate change adaptation and mitigation, the participants were aware that climate change is a global, environmental problem that they should learn about. In this respect, almost all of the members of the Green Team Student Club claimed that they felt responsible to take action for adaptation and mitigation. These findings support some of the studies in the literature showing that most of the population believes climate change is a real phenomenon (Poortinga, Spence, Whitmarsh, Capstick, & Pidgeon, 2011; Whitmarsh, 2011). Similarly, in a recent academic review of public attitudes toward environment in the UK, it is claimed that public is aware of the problem and their concern level is high (Upham *et al*., 2009).

Although most of the students had a high level of concern about climate change as a global problem, there were some students sceptical about whether climate change is a real problem or it is being exaggerated. Concordantly, the literature also has some research studies. To illustrate, Poortinga et al (2011) investigated public opinion about climate change and 15% of people said that they do not believe the world's climate is changing. Similarly, 40% of the UK population was determined to believe in that the consequences of climate change are exaggerated (Eurobarometer, 2009). Whitmarsh (2011) claim that long-held personal beliefs and misconceptions on climate change make them be sceptical about.

Another salient finding of the present study was that the participants were able to turn their attitudes into situational behaviors that they started to use energy efficient light bulbs and to seperate waste in their houses, and to use recycling bins at the school efficiently. They also purveyed dissemination of information they learned through preparing posters and presentations, and writing an article. Moreover, they warned other people, even outside of the school, about energy and water consumption, and promoted using public transportation. However, literature reveals that there is a gap between people' attitudes and behaviors (Ungar, 1994) that even those who claim to be aware of the phenomenon do not change their behaviors (Semenza *et al*., 2008) as it is found out in the present study. Similarly, Çakci and Oğuz (2010) claimed that students have knowledge on environment; however, this

knowledge is not adequate to develop attitudes and behaviors on environment. Lorenzoni, Nicholsan-Cole, and Whitmarsh (2007) highlight the importance of institutional support in encouraging genuine behavioral changes for climate change mitigation. Houghton et al. (2001) suggest emphasizing climate change mitigation and adaptation for individual behavioral changes.

Findings of the study showed that ***extra-curricular activities helped the students equipped with the lifelong learning skills*** with regard to climate change, climate change adaptation and mitigation. Communication was one of the skills the students developed with the help of extra-curricular activities. As Moser (2007) claims that when the ones bearing the message and the ones receiving establish a relationship, communication functions well, the students talked to all the stakeholders at the school and took their opinions to include them to the process of constructing a climate-friendly school management system.

As Pruneau, Khattabi, and Demers (2010) points out that it must be the members who analyze the environmental problems, predict potential impacts of climate change, evaluate their community's vulnerability, and propose strategies for the solutions, throughout the present study, the students were autonomous that they were only guided by the teachers while working on the extra-curricular activities. They were the decision-makers in all the processes from data collection for carbon calculation of the school to developing strategies for the action plan. These helped the students develop skills on leadership, decision making, teamwork, developing strategy, etc.

Moreover, the findings showed that variety and richness of the extra-curricular activities helped the students' development in different dimensions. They were effective in motivating the students to work by themselves individually or in groups. To illustrate, videos and visuals about climate change developed students' visual understanding of climate change and their impacts. Hyerle's (1996) study supports these finding that he suggests using simple representational graphics to illustrate the greenhouse effect. The students also had field trips which helped them be better observers, and interact with the environment while make them realize the

holistic structure of climate change (Pruneau, Chouinard, Arsenault and Breau, 1999).

Social constructivism construct theoretical context of this study emphasizing interaction with a variety of information sources in the learning process (McInerney & McInerney, 2002). The findings revealed that students develop certain skills when they work in coordinated work-flows in groups. They collaborate and cooperate to apply the information into behaviors. Devine-Wright, Devine-Wright, and Fleming (2009) notes that *a certain form of situational influence, that is exposure to cooperative learning environments outside of formal schooling amongst children of similar age and adults with similar values, can have a significant and positive impact upon children* (p.500).

Addition to the role of extra-curricular activities on developing students' knowledge, attitude, and skills, the teachers also benefited from engaging in the extra-curricular activities. At the beginning of the study, they showed enthusiasm to implement extra-curricular activities; however, they had lack of both theoretical knowledge and practice on how to implement extra-curricular activities. This finding coincide with the literature that teachers and pre-service teachers have lack of knowledge about the instructional strategies to be used in the environmental education and therefore needed help (Moseley & Utley, 2008). Throughout the study, with implementing various activities, and collaborating with the university, they developed profession on extra-curricular activities.

The teachers claimed that they now feel more comfortable while teaching about climate change because as they mentioned the extra-curricular activities not only helped the students develop knowledge and positive attitudes toward climate change, they also learned what to teach about climate change issues in their classes. Additionally, they claimed that the more they felt comfortable, the more they became willing to teach climate change also in their classes. Paul and Volk' study is in line with the present study that the authors (2002) highlight the positive effect of workshop studies about teaching environmental problems on teachers. Moreover, research studies in the literature revealed that extra-curricular activities help teacher

increase self-competence in teaching environmental problems (Moseley, Reinke & Bookout, 2002).

5.2 Implications

In this section, implications for further research and practice are proposed.

5.2.1. Implications for Further Research

This study was designed as a case study, and qualitative data were complemented with little quantitative research in order to evaluate the role of extra-curricular activities on developing students' knowledge, attitudes, and skills with regard to climate change, climate change adaptation and mitigation. Quantitative data was collected through a questionnaire to determine students' pre-knowledge, attitude, and skills, while qualitative data collected through pre-reflective-final interviews and observations throughout study. Further research can be conducted with a quantitative approach, particularly in order to evaluate students' knowledge; a standardizied test can be administered to supplement observations and interviews.

Additionally, the present study was conducted at a private school in Çankaya district of Ankara. The school had been participating in national and international project on environmental problems. Therefore, the school and the school facilities were appropriate to conduct the study. However, since 90% of the schools in Turkey are public, how the situation at public schools can be investigated for further research.

5.2.2. Implications for Practice

In this study, it was found that the extra-curricular helped students develop knowledge, attitude and skills. Beside, in the reflective interviews the teachers claimed that they suggest the extra-curricular activities to their colleagues to implement in their own classes. In this respect, geography teachers of the school got

the videos which were watched in the Green Team Club in their classes. Also, fact-sheets about climate change were exhibited through school corridors and teachers took them to demonstrate in their classes. These indicate that these extra-curricular activities can be implemented in class hours within the scope of formal curricula. Although this study aimed to determine the role of extra-curricular activities on developing students' knowledge, attitude, and skills with regard to climate change, climate change adaptation and mitigation, the problem climate change should not be limited to the extra-curricular activities. The problem should be integrated into the formal curricula because developing students' lifelong learning skills also requires a planned and structured formal education. Actually, some countries (e.g. some states of USA [e.g. Newfoundland and Labrador], UK, Australia, etc.) integrated climate change into their formal curricula through designing projects. However, literature on climate change education reveals that climate change education is insufficient in many schools in both the US and the UK that a report that in the US indicates a lack of guidance causing poor quality on climate change education (McCaffrey & Buhr, 2008b). Dupigny-Giroux (2010) also suggests including climate change into the national curricula for a positive way of ensuring at schools, climate change is taught well. Similarly in Turkey, when high school science and geography curricula are examined, although school-based formal environmental education is essential (Pekel, Kaya & Demir, 2007), it can be claimed that formal curricula do not have sufficient amount of objectives on environmental education for sustainability. Therefore, further research can be conducted on how to integrate climate change into the formal curricula.

Moreover, the school offers a variety of student clubs, and within the scope of student clubs, students participate in various extra-curricular activities. The school support students' activities and action plans, yet the place of extra-curricular activities still need to be examined. It would be interesting to see how school clubs function at public schools in terms of developing students' non-acedemic knowledge, attitudes, and skills.

Finally, this study was designed as a case study which primarily emphasized qualitative data and little quantitative data. An experimental study can be designed to determine role of extra-curricular activities on developing students' knowledge, attitudes, and skills which may help promoting implementation of extra-curricular activities.

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APPENDICES

APPENDIX A

CONCENT FORMS

Orta Doğu Teknik Üniversitesi İnsan Araştırmaları Etik Kurulu

Gönüllü Katılım (Bilgilendirilmiş Onay) Formu

Araştırmacının Adı-Soyadı: Özlem Fatma Yıldırım

Araştırmacının Kurumu: Orta Doğu Teknik Üniversitesi

Araştırmanın Amacı: Bu çalışmada, ODTÜ Geliştirme Vakfı Lisesi'nde iklim değişikliği ile ilgili uygulanan program içi ve program dışı etkinliklerin öğretmen ve öğrenci görüşlerini bir eylem araştırması kapsamında değerlendirilmesi amaçlanmaktadır.

Öğretmen ve öğrencilerin program içi ve program dışı iklim değişikliği etkinlikleri ile ilgili görüşlerine eylem çalışması öncesi, program dışı etkinliklerin uygulanması süresinde ve bitiminde mülakat yoluyla başvurulacaktır. Bunun yanı sıra, iklim değişikliği etkinliklerinin uygulanması sırasında sınıf içi derinlemesine gözlem notları tutulacak ve her etkinlikten sonra mülakat yapılacaktır. Ayrıca öğrenci ürünleri de video ve fotoğraf çekimleriyle belgelenecektir. Bu çalışmanın 2011-2012 Eğitim Yılı Bahar Dönemi ve 2012-1013 Sonbahar Döneminde uygulanması öngörülmektedir. Çalışmaya dahil olduktan sonra, çalışmanın sonuna kadar devam edilmemesi durumunda herhangi bir sorun olmayacaktır. Çalışmada, katılımcıdan toplanan kişisel bilgiler 3. şahıslarla kesinlikle paylaşılmayacaktır. Toplanan veriler şahsi bilgileriniz paylaşılmadan, araştırma sonuçlarını yorumlamada ve bu çalışma kapsamında düzenlenecek olan bildirilerde kullanılacaktır. Çalışma boyunca çekilen video ve fotoğraflar da kongre/seminer vb. etkinliklerde öğrenme ortamlarının gösterilmesi amacıyla kullanılacak ve herhangi bir medya aracılığıyla paylaşılmayacaktır.

Araştırmaya yönelik oluşabilecek sorularla ilgili olarak aşağıda iletişim adresleri verilen Özlem Fatma Yıldırım veya Hanife AKAR ile iletişime geçilebilir.

Ar. Gör. Özlem Fatma Yıldırım

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Araştırmanın amacı konusunda bilgilendirildim ve gönüllü olarak katılmayı kabul ediyorum.

Katılılımcının Adı-Soyadı:

İmzası:

Veli Onay Mektubu

Tarih

Sayın Veli,

Orta Doğu Teknik Üniversitesi, Eğitim Bilimleri Bölümünde araştırma görevlisiyim ve yüksek lisans tez çalışmamı yürütmekteyim. Tez çalışmam kapsamında okullardaki iklim değişikliği ile ilgili program dışı etkinlikleri incelenecek ve hedef kitle olarak 14-18 yaş gruplarındaki öğrenciler seçilecektir. Bu formun yollanış amacı sizleri çocuklarınızla çalışacağımıza dair bilgilendirmektir.

Çalışma kapsamında, 2011-2012 eğitim-öğretim yılı bahar dönemi ve 2012-2013 eğitim-öğretim yılı sonbahar dönemi boyunca ön görüşmeler, sınıf içi gözlem, etkinlik sonrası görüşmeler, son görüşmeler uygulanacaktır. Öğrencilerin görüşmeleri, görüşmeyi daha doğru analiz edebilmek adına ses kaydına alınacaktır. Ayrıca, öğrenme ortamlarını temsil etmek için fotoğraf çekimleri ve video kayıtları yapılacaktır. Öğrencilerden toplanan kişisel bilgiler, fotoğraf çekimleri, ses kayıtları ve video gösterimleri 3. şahıslarla paylaşılmayacaktır. Öğrencilerden elde edilen veriler sadece analiz için kullanılacak, tez çalışmasında yer alacaktır. Ayrıca analiz sonuçları tez çalışmasının bir parçası olarak, öğrencilerin kişisel bilgileri paylaşılmadan, bilimsel kongre ve konferanslarda paylaşılabilir.

Bu çalışmaya katılım tamamen gönüllülük esasına dayalı olup öğrenciler çalışma sırasında arzu edildiği taktirde hiçbir yaptırıma maruz kalmadan katılımdan vazgeçme hakkına sahiptir.

Çalışmaya ya da çocuğunuzun katılımına yönelik daha fazla bilgi için:

Ar. Gör. Özlem Fatma Yıldırım

Orta Doğu Teknik Üniversitesi

Eğitim Fakültesi Eğitim Bilimleri Bölümü

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İlginiz için teşekkür ederim.

Arş. Gör. Özlem Fatma YILDIRIM

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Eğitim Bilimleri Bölümü

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Yukarıda açıklamasını okuduğum çalışmaya, oğlum/kızım _____'nin katılımına izin veriyorum. Ebeveynin:

Adı, soyadı: _____ İmzası: _____
Tarih: _____

Çocuğunuzun katılımı ya da haklarının korunmasına yönelik sorularınız varsa ya da çocuğunuz herhangi bir şekilde risk altında olabileceğine, strese maruz kalacağına inanıyorsanız Orta Doğu Teknik Üniversitesi Etik Kuruluna (312) 210-37 29 telefon numarasından ulaşabilirsiniz.

APPENDIX B

INTERVIEW FORMS & OBSERVATION FORM

ÖĞRENCİ ÖN GÖRÜŞME FORMU

Merhaba, ben Özlem Fatma Yıldırım. Orta Doğu Teknik Üniversitesi, Eğitim Fakültesi, Eğitim Bilimleri bölümünde araştırma görevlisiyim. Bu görüşmeyi, okulunuzda yürüteceğimiz "İklim değişikliği ile ilgili müfredat dışı etkinliklerin değerlendirilmesi" başlıklı tez çalışmam hakkında veri toplama için yapacağım. Bu görüşme yardımıyla, sizlerin iklim değişikliği ve ilgili program dışı etkinlikler hakkındaki görüşlerinizi öğrenmeye çalışacağım.

Görüşmemiz yaklaşık olarak 30 dakika sürecektir. Görüşmede betimsel bilgiler ve iklim değişikliğine dair sorular yer alacaktır. Görüşme sırasında verdiğiniz kişisel bilgileriniz 3. Şahıslarla paylaşılmayacaktır. Verilerin yorumlanması kısmında da size ait olan cevaplar isminizle belirtilmeyecektir. Görüşmemizde vereceğiniz yanıtları kaçırmamak ve daha iyi yorumlayabilmek için, izniniz olursa görüşmeyi kaydetmek istiyorum.

Sizin görüşmeye başlamadan önce söylemek istediğiniz bir şey var mı?

Görüşmemize betimsel bilgilerinizi içeren sorularla başlamak istiyorum.

Betimsel Bilgiler:

Cinsiyet:

Yaş:

Sınıf:

Bölüm:

Görevli olduğu öğrenci kulübü:

Öğrenci kulübündeki deneyim:

Esas Bölüm:

1. Biliyorum ki Green Team öğrenci kulübünün bir üyesisin. Bu kulübe katılma sebebin nedir?
   a. Arkadaşlar
   b. Öğretmenler
   c. Hobi
   d. Daha önce yer aldığım kulüplerle bağlantılı olması

e. Diğer

2. Bu kulübe söylediğin sebep/sebeplerden ötürü katıldın. Peki, iklim değişikliği sana göre nedir? İklim değişikliğini nasıl tanımlarsın?
3. İklim değişikliğine neden olduğunu düşündüğün etkenleri sıralar mısın?
4. İklim değişikliğinin etkileri nelerdir?
5. İklim değişikliği ile ilgili bu bilgileri hangi kaynaklardan edindin?
6. İklim değişikliği ile ilgili eyleme geçmek konusunda kendini sorumlu hissediyor musun? Neden?
7. Bu öğrenci kulübünde görev almadan önce, iklim değişikliğine uyum ve iklim değişikliği etkilerini azaltmak adına herhangi bir eylemde bulunuyor muydun?
8. Okulda iklim değişikliği ile ilgili hangi derslerde, hangi konuları öğrendin?

ETKİNLiK SONRASI ÖĞRENCİ GÖRÜŞME FORMU

Merhaba, ben Özlem Fatma Yıldırım. Orta Doğu Teknik Üniversitesi, Eğitim Fakültesi, Eğitim Bilimleri bölümünde araştırma görevlisiyim. Bu görüşmeyi, okulunuzda yürüteceğimiz "İklim değişikliği ile ilgili müfredat dışı etkinliklerin değerlendirilmesi" başlıklı tez çalışmam hakkında veri toplama için yapacağım. Bu görüşme yardımıyla, sizlerin öğrenci kulüplerinde uygulanan etkinlikler hakkındaki algılarınızı öğrenmeye çalışacağım.

Görüşmemiz yaklaşık olarak 20 dakika sürecektir. Görüşmede betimsel bilgiler ve iklim değişikliğine dair sorular yer alacaktır. Görüşme sırasında verdiğiniz kişisel bilgileriniz 3. Şahıslarla paylaşılmayacaktır. Verilerin yorumlanması kısmında da size ait olan cevaplar isminizle belirtilmeyecektir. Görüşmemizde vereceğiniz yanıtları kaçırmamak ve daha iyi yorumlayabilmek için, izniniz olursa görüşmeyi kaydetmek istiyorum.

Sizin görüşmeye başlamadan önce söylemek istediğiniz bir şey var mı?

Görüşmemize betimsel bilgilerinizi içeren sorularla başlamak istiyorum.

Betimsel Bilgiler:

Cinsiyet:

Yaş:

Mezuniyet:

Mezuniyet derecesi:

Verdiği dersler:

Deneyim:

Görevli olduğu öğrenci kulübü: öğrenci kulübündeki deneyim:

Esas Bölüm:

1. Bugünkü aktivitenin amacı neydi?
2. Sizce, aktivite amacına ulaştı mı? Neden? Lütfen açıklar mısınız?
3. Bu aktivitede en çok neyi sevdiniz?
4. Bu etkinliğin uygulanmasında eksik gördüğünüz bir nokta var mı? Varsa açıklayınız.
5. Bu aktivitede farklı olarak ne yapılabilirdi?
6. Bu aktivitede kendi rolünüzü nasıl algılıyorsunuz?
7. Bu aktivede iklim değişikliği ile ilgili yeni hangi kavramları öğrendiniz?
8. Sizce bu aktive hangi becerilerinizi geliştirmenize yardımcı oldu?
9. Sizce bu aktivite iklim değişikliğiyle ilgili farkındalık yaratmasına yardımcı oldu mu? Neden?
10. Bu aktiviteyle ilgili genel değerlendirmeniz nedir?

ÖĞRENCİ SON GÖRÜŞME FORMU

Merhaba, biz Özlem Fatma Yıldırım ve Arzu Erol. Orta Doğu Teknik Üniversitesi, Eğitim Fakültesi, Eğitim Bilimleri bölümünde araştırma görevlisiyiz. Okulunuzda, kulüp saatlerinde Eu-Camp adlı bir Avrupa Birliği projesi yürütülecektir. Bu görüşmeyi, proje kapsamında uygulanan etkinliklerden sonra oluşan Avrupa Birliği algınızı ölçmek için gerçekleştireceğiz. Görüşmemiz yaklaşık olarak 30 dakika sürecektir.

Görüşmede betimsel bilgilerinize ve Avrupa Birliği algınıza dair sorular yer alacaktır. Görüşme sırasında verdiğiniz kişisel bilgileriniz 3. Şahıslarla paylaşılmayacaktır. Verilerin yorumlanması kısmında da size ait olan cevaplar isminizle belirtilmeyecektir. Görüşmemizde vereceğiniz yanıtları kaçırmamak ve daha iyi yorumlayabilmek için, izniniz olursa görüşmeyi kaydetmek istiyoruz.

Sizin görüşmeye başlamadan önce söylemek istediğiniz bir şey var mı?

Görüşmemize betimsel bilgilerinizi içeren sorularla başlamak istiyoruz.

Betimsel Bilgiler:

Cinsiyet:

Yaş:

Sınıf:

Bölüm:

Görevli olduğu öğrenci kulübü:

Öğrenci kulübündeki deneyim:

Esas Bölüm:

1. Sizce iklim değişikliği nedir? Nasıl tanımlarsınız?
2. Sizce iklim değişikliğine uyum nedir? Nasıl tanımlarsınız?
3. Sizce iklim değişikliği azaltma nedir? Nasıl tanımlarsınız?
4. Kulüp etkinliklerinde, iklim değişikliği, iklim değişikliğine uyum ve iklim değişikliğini azaltma konularında neler öğrendiniz?
5. Bu çalışmaya dahil olduktan sonra, iklim değişikliği ile ilgili konulardaki bilgilerinizde bir değişiklik oldu mu?
6. Bu çalışmaya dahil olduktan sonra, iklim değişikliği ile ilgili konulara tutumunuzda bir değişiklik oldu mu?
7. Bu çalışmaya dahil olduktan sonra, iklim değişikliği ile ilgili konularda davranışlarınızda bir değişiklik oldu mu?
8. İklim değişikliği ile ilgili program-dışı etkinliklerde yer alarak kazandığınız bilgi ve becerileri günlük hayatınızda kullanıyor musunuz?

ÖĞRETMEN ÖN GÖRÜŞME FORMU

Merhaba, ben Özlem Fatma Yıldırım. Orta Doğu Teknik Üniversitesi, Eğitim Fakültesi, Eğitim Bilimleri bölümünde araştırma görevlisiyim. Bu görüşmeyi, okulunuzda yürüteceğimiz "İklim değişikliği ile ilgili müfredat dışı etkinliklerin değerlendirilmesi" başlıklı tez çalışmam hakkında veri toplama için yapacağım. Bu görüşme yardımıyla, sizlerin iklim değişikliği ve ilgili program dışı etkinlikler hakkındaki görüşlerinizi öğrenmeye çalışacağım.

Görüşmemiz yaklaşık olarak 45 dakika sürecektir. Görüşmede betimsel bilgiler ve iklim değişikliğine dair sorular yer alacaktır. Görüşme sırasında verdiğiniz kişisel bilgileriniz 3. Şahıslarla paylaşılmayacaktır. Verilerin yorumlanması kısmında da size ait olan cevaplar isminizle belirtilmeyecektir. Görüşmemizde vereceğiniz yanıtları kaçırmamak ve daha iyi yorumlayabilmek için, izniniz olursa görüşmeyi kaydetmek istiyorum.

Sizin görüşmeye başlamadan önce söylemek istediğiniz bir şey var mı?

Görüşmemize betimsel bilgilerinizi içeren sorularla başlamak istiyorum.

Betimsel Bilgiler:

Cinsiyet:

Yaş:

Mezuniyet:

Mezuniyet derecesi:

Verdiği dersler:

Deneyim:

Görevli olduğu öğrenci kulübü:

Öğrenci kulübündeki deneyim:

Esas Bölüm:

Kulüp ve Etkinlikler

Green Team öğrenci kulübünde görevlisiniz. Şimdi izninizle kulüp etkinlikleri hakkında konuşalım.

1. Bu kulüpte görev almaya nasıl karar verdiniz? Bu süreçte sizi ne/neler motive etti?
2. Öğrencileri bu kulübü seçme konusunda teşvik eden unsurlar neler?

Program

Bu bölümde bir biyoloji öğretmeni olarak, iklim değişikliği ve iklim değişikliği ile ilgili okulunuzda devam etmekte olan çalışmalar hakkındaki görüşlerinize başvuracağım.

1. İklim değişikliği ile ilgili kendi derslerinizde neler öğretiyorsunuz?
2. Iklim değişikliğini öğretirken hangi öğretim yöntemlerini ve materyallerini kullanıyorsunuz?
3. Sizce resmi program size iklim degişikliği, iklim değişikliğine adaptasyon ve iklim değişikliği etkilerinin azaltımı konularında bilgi, beceri ve tutum kazandırmada yeterli mi? Değilse, ne tür etkinliklerin yapılmasını istersiniz?
4. Daha once iklim değişikliği ile ilgili bir projede çalıştınız mı? Çalıştıysanız ne tür program-dışı etkinlikler uyguladınız?

Sorularım bu kadar. Sizin önemli gördüğünüz ve konuşmadığımız bir nokta varsa ve eklemek isterseniz çok memnun olurum.

Teşekkür ederim, benim için oldukça verimli bir görüşmeydi. Görüşmenin doküman halini onaylamak ister misiniz? Aklıma sormam gereken başka bir şey geldiğinde size tekrar ulaşabilir miyim? Teşekkür ederim.

ETKİNLİK SONRASI ÖĞRETMEN GÖRÜŞME FORMU

Merhaba, ben Özlem Fatma Yıldırım. Orta Doğu Teknik Üniversitesi, Eğitim Fakültesi, Eğitim Bilimleri bölümünde araştırma görevlisiyim. Bu görüşmeyi, okulunuzda yürüteceğimiz "İklim değişikliği ile ilgili müfredat dışı etkinliklerin değerlendirilmesi" başlıklı tez çalışmam hakkında veri toplama için yapacağım. Bu görüşme yardımıyla, sizlerin öğrenci kulüplerinde uygulanan etkinlikler hakkındaki algılarınızı öğrenmeye çalışacağım.

Görüşmemiz yaklaşık olarak 20 dakika sürecektir. Görüşmede betimsel bilgiler ve iklim değişikliğine dair sorular yer alacaktır. Görüşme sırasında verdiğiniz kişisel bilgileriniz 3. Şahıslarla paylaşılmayacaktır. Verilerin yorumlanması kısmında da size ait olan cevaplar isminizle belirtilmeyecektir. Görüşmemizde vereceğiniz yanıtları kaçırmamak ve daha iyi yorumlayabilmek için, izniniz olursa görüşmeyi kaydetmek istiyorum.

Sizin görüşmeye başlamadan önce söylemek istediğiniz bir şey var mı?

Görüşmemize betimsel bilgilerinizi içeren sorularla başlamak istiyorum.

Betimsel Bilgiler:

Cinsiyet:

Yaş:

Mezuniyet:

Mezuniyet derecesi:

Verdiği dersler:

Deneyim:

Görevli olduğu öğrenci kulübü: öğrenci kulübündeki deneyim:

Esas Bölüm:

1. Bugünkü aktivitenin amacı neydi?
2. Sizce, aktivite amacına ulaştı mı? Neden? Lütfen açıklar mısınız?
3. Bu aktivite kendi rolünüzü nasıl algılıyorsunuz?
4. Bu aktivite öğrencilerin rolünü nasıl algılıyorsunuz?
5. Bu aktivite öğrencilerin katılımını nasıl buldunuz?
6. Sizce öğrenciler bu aktiveyle hangi becerilerini geliştirdiler?
7. Sizce öğrenciler bu aktiviteye karşı nasıl bir tutum geliştirdiler?
8. Bu etkinlik sizin mesleki gelişiminize katkı sağladı mı? Sağladıysa, ne tür bir katkı sağladı?
9. Bu aktiviteyle ilgili genel değerlendirmeniz nedir?

ÖĞRETMEN SON GÖRÜŞME FORMU

Merhaba, ben Özlem Fatma Yıldırım. Orta Doğu Teknik Üniversitesi, Eğitim Fakültesi, Eğitim Bilimleri bölümünde araştırma görevlisiyim. Bu görüşmeyi, okulunuzda yürüteceğimiz "İklim değişikliği ile ilgili müfredat dışı etkinliklerin değerlendirilmesi" başlıklı tez çalışmam hakkında veri toplama için yapacağım. Bu görüşme yardımıyla, sizlerin iklim değişikliği ve ilgili program dışı etkinliklere katıldıktan sonra, iklim değişikliği ile ilgili konular hakkındaki görüşlerinizi öğrenmeye çalışacağım.

Görüşmemiz yaklaşık olarak 45 dakika sürecektir. Görüşmede betimsel bilgiler ve iklim değişikliğine dair sorular yer alacaktır. Görüşme sırasında verdiğiniz kişisel bilgileriniz 3. Şahıslarla paylaşılmayacaktır. Verilerin yorumlanması kısmında da size ait olan cevaplar isminizle belirtilmeyecektir. Görüşmemizde vereceğiniz yanıtları kaçırmamak ve daha iyi yorumlayabilmek için, izniniz olursa görüşmeyi kaydetmek istiyorum.

Sizin görüşmeye başlamadan önce söylemek istediğiniz bir şey var mı?

Görüşmemize betimsel bilgilerinizi içeren sorularla başlamak istiyorum.

Betimsel Bilgiler:

Cinsiyet:

Yaş:

Sınıf:

Bölüm:

Görevli olduğu öğrenci kulübü:

Öğrenci kulübündeki deneyim:

Esas Bölüm:

İklim Değişikliği:

1. Sınıflarınızda iklim değişikliği ile ilgili konulara nasıl yer veriyorsunuz?
2. Sınıflarınızda iklim değişikliği ile ilgili konularda hangi materyalleri kullanıyorsunuz?
3. Programda yer alan, iklim değişikliği konularını yeterli buluyor musunuz?
4. Öğrenciler iklim değişikliği ile ilgili yeterince bilinçli olmak adına, neler öğrenmeli?

Bu bölümde, uygulanan program dışı etkinlikler sürecine dair sorular yer alacaktır.

1. Araştırma boyunca genel olarak ne tür deneyimler edindiniz?
2. Araştırma boyunca sizi motive eden unsurlar nelerdi?
3. Sahip olduğunuz hangi özellikler bu süreçte size yardımcı oldu?
4. Hangi süreçlerde zorluk çektiniz?

5. Kulüp etkinlikleri olmasaydı, sınıflarınızda iklim değişikliği ile ilgili konulara nasıl yer verirdiniz?

OBSERVATION FORM

The purpose of this observation schedule is to explore students' reactions toward the activities they are subjected, and elicit traces of knowledge, skills, attitudes and reactions toward climate change issues through in-depth field notes.

Aim of Session:	
Duration:	
Objectives:	
Materials:	
✓ **Description of learning environment**	
✓ **Description of student and teacher roles**	
✓ **Description of students' knowledge**	
✓ **Description of students' skills**	
✓ **Description of students' attitudes**	

Guiding Observation Codes for In-Depth Field-Notes

Codes	Field Notes
Attitudes and Skills	
1. Communication	
2. Collaboration	
3. Decision making	
4. Negotiation	
5. Tolerance	
6. Self-expression	
7. Self-respect	
8. Empathy	
9. Information management	
10. Others	

APPENDIX C

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Yıldırım
Adı : Özlem Fatma
Bölümü : Eğitim Bilimleri

TEZİN ADI (İngilizce) : Role of Extra-curricular Activities on Students' Knowledge, Skills, and Attitudes toward Climate Change, Climate Change Adaptation and Mitigation

TEZİN TÜRÜ : Yüksek Lisans ■ **Doktora** ☐

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

Yazarın İmzası: **Tarih:**