AN INVESTIGATION ON THE TURKISH SCIENCE TEACHERS' VIEWS RELATED TO EDUCATION FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

AN INVESTIGATION ON THE TURKISH SCIENCE TEACHERS' VIEWS RELATED TO EDUCATION FOR SUSTAINABLE DEVELOPMENT

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The main purpose of this study is to explore Turkish science teachers' views on the meaning of SD and the ESD content of Turkish Science Curriculum in terms of the program content and the implementations. The study was conducted 27 middle school science teachers working in Mamak district of Ankara in March 2016. The data was gathered through semi-structured interviews with middle school science teachers. The study comprised of teachers' views on SD and ESD, and teachers' suggestions and practices about ESD in science lessons. The result of the present study showed that science teachers have a view on the content of the concept of SD. However, the study showed that science teachers need to be supported by in-service training on SD and ESD. It has been stated that it should also pay attention to university education of science teachers for an effective ESD. In addition, the teachers' views on the inclusion of ESD in the science curriculum were generally positive. Due to the intense content of the science course, teachers stated that there should be an additional elective course for ESD or that it should be integrated with other courses as an interdisciplinary subject. In conclusion, this study aims to make contributions to development of ESD in science education for a sustainable future.

Keywords: Sustainable Developments, Teachers' View, Education for Sustainable Development

ÖZ

FEN BİLİMLERİ ÖĞRETMENLERİNİN SÜRDÜRÜLEBİLİR KALKINMA İÇİN EĞİTİM İLE İLGİLİ GÖRÜŞLERİNE İLİŞKİN BİR İNCELEME

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Bu çalışmanın temel amacı, fen bilimleri öğretmenlerinin SD anlamı ile ilgili ve Türk Fen Bilimleri Ders Programı'nın ESD içeriği ve uygulamaları ile ilgili görüşlerini incelemektir. Çalışma, Mart 2016'da Ankara'nın Mamak ilçesinde çalışan 27 ilköğretim fen bilgisi öğretmeni ile yürütülmüştür. Veriler, fen bilimleri öğretmenleri ile yarı yapılandırılmış görüşmeler yoluyla toplanmıştır. Çalışma, öğretmenlerin SD ve ESD hakkındaki görüşlerini ve öğretmenlerin ESD ile ilgili öneri ve fen derslerindeki uygulamalarını içermektedir. Bu çalışmanın sonucu, fen bilimleri öğretmenlerinin SD kavramının içeriği hakkında bir görüşe sahip olduğunu göstermiştir. Ancak, çalışma fen bilimleri öğretmenlerinin SD ve ESD hakkında hizmet içi eğitimlerle desteklenmeleri gerektiğini göstermiştir. Etkili bir ESD için fen bilimleri öğretmenlerinin üniversite eğitimine de önem verilmesi gerektiği belirtilmiştir. Ayrıca, araştırmadaki öğretmenlerin, ESD'nin fen bilgisi müfredatında yer alması konusundaki görüşleri genel olarak olumludur. Bununla birlikte, öğretmenler fen bilimleri dersinin yoğun içeriği nedeniyle, ESD için ek bir seçmeli ders olması gerektiğini ya da disiplinlerarası bir konu olarak diğer derslerle bütünleştirilmesi gerektiğini belirmişlerdir. Sonuç olarak, bu çalışma sürdürülebilir bir gelecek için fen eğitiminde ESD'nin gelişimine katkı sağlamayı amaçlamaktadır.

Anahtar Kelimeler: Sürdürülebilir Kalkınma, Öğretmen Görüşleri, Sürdürülebilir Kalkınma için Eğitim

To My Family

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LIST OF ABBREVIATIONS

ESD	Education for Sustainable Development
ESE	Elementary Science Education
ESME	Elementary Science and Math Education ELE Elementary Education
IUCN	International Union for Conservation of Nature
METU	Middle East Technical University
SD	Sustainable Development
UNESCO	United Nations Educational Scientific and Cultural Organization
OECD	Organization for Economic Corporation and Development
PESD	Panel for Education for Sustainable Development
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDSD	United Nations Division of Sustainable Development
UNEP	United Nations Environment Programme.
WWF	World Wide Fund For Nature

CHAPTER 1

INTRODUCTION

Since sustainable development concept has been launched by Brundtland Report in 1987, education has become one of the major areas of interest especially among educators and decision makers. It was also reported in Brundtland Report (Our Common Future, the Report of the World Commission on Environment and Development, 1987) that "the world's teachers … have a crucial role to play" in helping to bring about "the extensive social changes" needed along the pathway towards a sustainable future (p. xiv).

As teachers play this role effectively, they require a commitment to the principles of both sustainable development and education for sustainable development. That is why Education for Sustainable Development has been integrated into education systems of many countries so far.

As the first and basic definition of sustainable development implies, world's resources shall meet the needs without threatening the future demand. However, as reported by Raven and Berg (2006) and as we experience all, world's resources may seem unlimited, but one day they will not be able to meet people's needs. Individuals need to be educated from an early age in order to be aware of the sustainable use of resources around the world before they encounter disasters. Therefore, the term sustainable development is a possible starting point of an education policy that balances competition between people and the environment (Cross, 1998). In addition, in a educational panel report about sustainable development, ESD describes as *"enables people to develop the knowledge, values and skills to participate in decisions about the way we do things individually and collectively, both locally and globally, that will*

improve the quality of life now without damaging the planet for the future." (Sustainable Development Education Panel Report, 1998, p. 30)

Sustainable development, on the other hand, has three components as economic, social and environmental. So, view the concept requires to be considered together these three main components and the complex relationships between these components. Apparently, these relationships can only be understood by gaining a holistic view of individuals and critical appraisal. We cannot achieve sustainable development only by producing technological solutions, by making political arrangements or by using financial instruments. According to UNESCO, however, if we change our thinking and behavior, we can achieve and achieve sustainable development.

When the concept of sustainable development was debated, it is come to light that education is a key to sustainable development. According to UNESCO for example, ESD is holistic and transformational learning that is pointed out the content and results with the pedagogy and the learning environment. It reaches its goal by transforming society. The basis for legitimizing the form of sustainable social change can be made possible by the education provided in schools. So, going back to Brundtland Report related to teachers' role in bringing about changes, they are the main focus in ESD research. Teachers have the responsibility to help students develop the knowledge and skills to clarify the concept of SD and help to understand the challenges about sustainability that facing by society (Hungerford, 2010).

What teachers know and think about SD and ESD are of significant concern among researchers since 1990s. As Cross reported in 1998 for example, teachers from Scotland and USA are actually worried about the interaction of people with the planet and they are also willing to contribute to the regulation of public opinion. However, they generally took the issue as superficially and did not know much about the theoretical problems about sustainable development. Moreover, they either do not have a clear view of how to contribute nor do not find the curriculum appropriate for ESD. As Chatzifotiou (2006) reported however, English elementary school teachers' knowledge is not enough to discuss either environmental issues nor sustainability concept although those are included in the UK national curriculum since 1995.

Moreover, science teachers have been investigated through their views related to SD and ESD in 2000s, since science education has been thought to provide students environmental literacy. Gayford (2002) made an investigation about environmental literacy of 17 science teachers in England. As a result of the author reported four main views of teachers: First of all, although they thought education for sustainable development was necessary, they stated that the science curriculum was intense in order to address this issue. They stated that the important aspects of education for sustainable development can be taught in an appropriate way with the science curriculum. However, the subject remained outside the area of expertise of teachers. They stated that sustainable development is considered as the whole school's approach to the environment in formal or informal form and it should have more precise and clear boundaries in order to understand the subject. Teachers did not want to be involved in the process of inculcating to students on the subject. They said that the issue was controversial and they had to remind the students. According to Summers and Childs (2007) on the other hand, 72 % of the science teachers in the UK perceive SD through environmental, 53% economic and 31% through social components, whereas 15% of them mentioned all three components.

In Turkey, on the other hand, although science curriculum has been revised in 2013 and 2018 as to contain SD concept, there has been no attempt in developing teachers' view on implementing the concept or on ESD. Environmental issues are contained in the Turkish science curriculum as scattered within the subjects. Besides, studies about ESD in Turkey have been carried out to reveal pre-service teachers' view. In 2010 for example, environmental literacy level of pre-service science teachers was found as insufficient by Teksöz et all. Similarly, Çobanoğlu & Türer reported in 2015 that, pre-service science teachers' knowledge on SD is inadequate and the reason was that SD and/or ESD is not contained in teacher education programs in Turkey. However, as Aydın & Kılınç reported in 2013, although they do not have a strong background, pre-service science teachers defined SD in terms of environment, technology, society, economy, politics, energy and education. Existing ideas to raise awareness of the diversity of SD concepts and ESD programs in teacher education should be made more adequate (Aydın & Kılınc, 2013).

When we look at the studies in the literature from past to present, most of the studies (Cross, 1998; Gayford, 2002; Summers & Childs, 2007; Evans et all., 2012; Anyola et all., 2018) conducted with teachers' SD/ESD perceptions are qualitative studies. In these studies, in general, teachers' self-assessment, views on SD/ESD, practices in their lessons and needs for ESD were discussed. The self-assessment described as *"The evaluation or judgment of 'the worth' of one's performance and the identification of one's strengths and weaknesses with a view to improving one's learning outcomes."* (Klenowski, 1995, p. 145)

Cross (1998) stated that teachers 'views are sensitive to social impacts and that these effects will affect teachers' lives and thus their teaching. Therefore, Cross, in his study, decided to examine teachers 'views on sustainable development, considering that teachers' view of sustainable development was influenced by informal learning. Moreover, teachers' views about ESD are of great importance in teaching students the future and preparing them for the future (Anyolo et all., 2018). For these reasons, it is important to investigate the views of teachers, to reveal their ideas and to shed light on the future about ESD.

Tilbury (2011) reported that learning for ESD is often interpreted as the acquisition of knowledge and skills related to sustainable development, but ESD learning also referred to:

- learning to ask critical questions;
- learning to clarify one's own values;
- learning to envision more positive and sustainable futures;
- learning to think systemically;
- learning to respond through applied learning; and,
- learning to explore the dialectic between tradition and innovation.

(Tilbury, 2011)

Learnings that Tilbury (2011) has mentioned concerns teachers' practices while dealing with ESD in their classes. Therefore, it is important for the future of ESD to reveal teachers' practices and suggestions regarding ESD.

Determining a sustainable lifestyle and developing new priorities in accordance with this lifestyle is one of the most important needs of today. According to UNESCO

(1992), education is critical to encourage people for sustainable development and to enhance their capacity to address the concepts of environment and development. When we consider the definition of the concept of sustainable development with education, we can say that education for sustainable development is an inevitable need to meet our needs today and in the future.

1.1 Purpose

The aim of ESD is to educate students through social learning to make sustainable decisions in the future (Wals, 2011). Teachers should provide students with the necessary knowledge and skills to help them understand and develop sustainable development issues (Hungerford, 2010). If we want to create an effective ESD within the scope of science course, first of all it is necessary to determine the science teachers' views of SD and ESD. Developments in the light of the views of science teachers may provide more solid ideas about ESD in the science curriculum. In line with the above mentioned, the purpose of this study is to explore Turkish science teachers' views on the meaning of SD and the ESD, and to explore their suggestions and practices on ESD.

Accordingly, the research questions of the study are set as follows:

RQ1: What are the science teachers' views on Sustainable Development?

RQ2: What are the science teachers' views of Education for Sustainable Development?

RQ2a: What are the science teachers' suggestions for a more useful implementation of Education for Sustainable Development?

RQ2b: How science teachers implement Education for Sustainable Development context of the 2013 Turkish Middle School Science Curriculum?

1.2 Significance of the Study

The concept of sustainable development was approved for the first time in 1987 at the United Nations General Assembly, and immediately after that, a concept of education parallel to the sustainable development was started to be explored to support SD. The concept of sustainable development developed until Agenda 21 was written from 1987 to 1992. In 1992, the UN Conference on Environment and Development (UNCED), called Earth Summit, in Rio de Janeiro, Brazil was an international event in which the concept of sustainable development was discussed. The common feature of *the Rio Declaration*, *Agenda 21* and *the Commission on Sustainable Development*, as key outputs of the conference, is that they are interested in sustainable development. Thus, the concept of sustainable development reaches the international stage (Bac, 2008). Moreover, Agenda 21 emphasizes the importance of training programs for raising awareness, implementing and promoting on sustainable development (UNDSD, 1992). As the concept of sustainable development was discussed and formulated in international committees, it became apparent that education is key to sustainability. Education has the potential to reinforce every priority for a sustainable world (Calder&Clugston, 2003). However, applying globally defined ESD concepts to school curricula will be a long and challenging process. The need for well-equipped teachers to create and implement ESD curricula is inevitable. In order to build the ESD curricula to be built on the solid ground, teachers' views on SD and ESD are important. It is assumed that teachers as informed citizens are sensitive to some of the public problems (Cross, 1998). The fact that the present study was conducted with science teachers is that teachers could make it easier for SD subjects to be conveyed to students. It is important how teachers convey SD issues to students. What makes this study significance is that it is included that science teachers' self-evaluations of SD; teachers' views on SD and ESD; and teachers' ESD related practices and suggestions. Besides, giving place to teachers' practice will facilitate the determination of the current situation in Turkey related to ESD. Moreover, giving

place to teacher's suggestions on ESD can provide ideas about the development of ESD and shed light on future studies.

While this study was conducting, 2013 Middle School Science Curriculum was used and 2018 Middle School Science Curriculum was about to be used. When the objectives of the science course related to sustainable development and aims of the middle school science curriculum were examined, there was no sharp difference between the two curricula. Therefore, 2013 Middle School Science Curriculum was taken into consideration in the interviews with teachers.

This qualitative study is thought to fill the gap in the literature with the views, practices and suggestions of in-service science teachers about SD and ESD. The information obtained in the present study is expected to shed light on the development of ESD in Turkey. In this way, a good education for sustainable development will educate students as individuals who think about present and future generations, who are sensitive to the environment and nature and who adopt a sustainable lifestyle.

CHAPTER 2

REVIEW OF THE LITERATURE

This chapter of this thesis presents a review of the literature on Education for Sustainable Development and teachers' views, understanding on both SD and ESD concepts. Accordingly, the chapter is designed as comprised of six headings as: SD/ ESD and Science Education, Science teachers' role in ESD, Science teachers' views related to ESD, ESD content of Turkish Middle School Science Curriculum and Turkish practice on ESD.

2.1 Sustainable Development, Education for Sustainable Development and Science Education

This part of the introduction presents a review of Sustainable Development, Education for Sustainable development and science education.

2.1.1 Sustainable Development

Sustainable development was defines as

> One of the most important aspects and methods used to conserve natural resources. As a principle, it recognizes that growth must be both inclusive and environmentally sound to reduce poverty and also build prosperity for the present population in addition to meeting the needs of future generations.
>
> (Muralkrishna and Manickam, 2017, p.5)

The concept of sustainable development was first seen in Our Common Future report, also known as the Brundtland Report, and then began to become widely accepted in the late 1980s. In the Brundtland Report, it is emphasized that sustainable development is a process of change that takes future into account: “A process where the exploitation of resources, the orientation of technological development and institutional change, are made consistent with future as well as present needs.” (Brundtland Commission Report, 1987, p. 9)

Accordingly, sustainable development was defined as *"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* (World Commission on Environment and Development, 1987, p.43). There are two main concepts in this definition: the concept of "needs" which should be given priority, the idea of limiting technology and social uses to meet the needs of the environment in our present and future (Bac, 2008). The report prepared by the United Nations (UN) stated that we should review life styles and its management as soon as possible in order to proposing a "global agenda for change" in the concept of development (OECD, 2008). In 1992, the UN Conference on Environment and Development (UNCED), called Earth Summit, in Rio de Janeiro, Brazil was an international event in which the concept of sustainable development was discussed. The common feature of *the Rio Declaration*, *Agenda 21* and *the Commission on Sustainable Development*, as key outputs of the conference, is that they are interested in sustainable development. Thus, the concept of sustainable development reaches the international stage (Bac, 2008).

As reported by Dernbach (2003) and Stoddar (2011), the key principle of sustainable development is that, it requires to integrate environmental, social, and economic aspects into decision making.

Therefore, sustainable development definition implies that, development must be environmentally sound and to continue to meet the needs of future generations. Therefore, there are three components of sustainable development: economic growth, environmental stewardship, and social inclusion (Figure 2.1.).

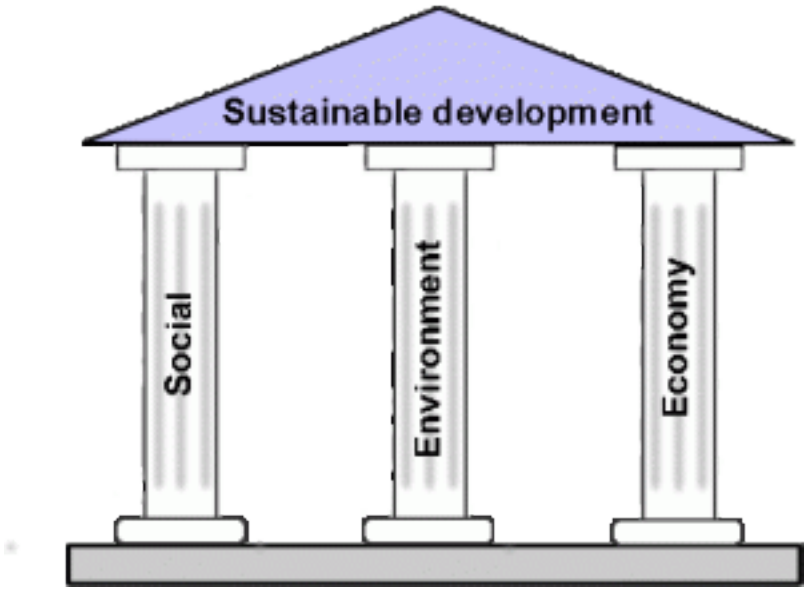

Figure 2.1. Components of sustainable development

Economical component is about giving people what they need ensuring quality of life. Social component is about raising awareness to participate in environmental sustainability and teaching environmental protection. Environmental component is the need for protecting environment. Environmental component is the primary concern of the sustainable future of humanity. By this component, it is defined to protect ecosystems, air quality, integrity, and sustainability as well as to concern future and technology that is key to sustainability (Shah, 2008).

Moreover, Agenda 21 emphasizes the importance of training programs for raising awareness, implementing and promoting on sustainable development (UNDSD, 1992). The term sustainable development is a possible starting point of an education policy that balances competition between people and the environment (Cross, 1998). Thus, it is accepted internationally that, sustainable development cannot be achieved only through technological solutions, political regulations or financial instruments; we must change our way of thinking and acting (UNESCO, 2002). Therefore, when

the concept of sustainable development has been debated, it is come to light that education is a key to a sustainable future.

2.1.2 Education for Sustainable Development and Science Education

The world's resources may seem unlimited, but one day they will not be able to meet people's needs. Individuals need to be educated from an early age in order to be aware of the sustainable use of resources around the world before they encounter disasters (Raven and Berg, 2006). This need is believed to be achieved through environmental education in 1970s. Thus, the foundations of environmental education were first introduced in 1972 with the Stockholm Conference, and environmental education was mentioned for the first time as legal, economic and technological importance as solution of environmental problems. Purpose and scope of environmental education was defined through Tbilisi Declaration (UNESCO, 1977) and in 1977 environmental education was considered as an important means for sustainable development (UNESCO, 1977).

In the document Caring for the Earth (IUCN, UNEP & WWF, 1991), which is a strategy for sustainable living was introduced by IUCN/UNEP/WWF, emphasized the role of education in bringing sustainable changes to lifestyles. This document targeted environmental education and strengthened education for sustainable development (Tilbury, 1995). In 1991, international organizations such as IUCN, UNEP and WWF declared that, it is needed to be sure that training programs reflect the importance of education for sustainable development.

Then, AGENDA 21 of the United Nations Conference on Environment and Development (UNCED, 1992), added a new perspective to environmental education. Therefore, the first thoughts on Education for Sustainable Development (ESD) were covered under Agenda 21 under the heading "Education, Public Awareness and Education Promotion" (McKeown, 2002). The importance of Education for Sustainable Development was reported in the Chapter 36 of Agenda 21 as follows:

> Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. While basic education provides the underpinning for any environmental and developmental education, the latter needs to be incorporated as an essential part of learning. Both formal and non- formal education is indispensable to changing people's attitudes so that they have the capacity to assess and address their sustainable development concerns. It is also critical for achieving environmental and ethical awareness, values and attitudes, skills and behavior consistent with sustainable development and for effective public participation in decision-making. To be effective, environment and development education should deal with the dynamics of both the physical/biological and socio-economic environment, and human (which may include spiritual) development should be integrated in all disciplines and should employ formal and non-formal methods and effective means of communication.
>
> (UNCED, 1992, p.320)

At the end of the Rio Declaration (1992), it was stated that people should be made aware of environmental pollution as well as other global issues such as food and agriculture and biodiversity. Environmental education is the mean to cover complex relationships between the issues (Tilbury,1995).

Developing new priorities and adopting a sustainable lifestyle is one of the most important needs today. UNESCO states that education plays an important role in encouraging people for sustainable development, as well as enhancing and improving people's ability to address environmental and development issues.

In 1998, a report about Education for Sustainable Development (ESD) in the schools is published by Panel for Education for Sustainable Development (PESD) (Council for Environmental Education, 1998). The ESD is defined in the report as:

> Education for sustainable development enables people to develop the knowledge, values and skills to participate in decisions about the way we do things individually and collectively, both globally and locally, that will improve the quality of life now and without damaging the planet for the future.
>
> (PESD, 1998, p.4)

The basis for legitimizing the form of sustainable social change can be made possible by the education provided in schools. Science education is mainly focused on environmental components, such as the causes of global climate change, the behavior of ecosystems, the nature of chemical pollution (Summers & Childs, 2007).

Accordingly, ESD is defined UNESCO as:

> ESD empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society, for present and future generations, while respecting cultural diversity. It is about lifelong learning and is an integral part of quality education. ESD is holistic and transformational education which addresses learning content and outcomes, pedagogy and the learning environment. It achieves its purpose by transforming society.
>
> (UNESCO, 2005)

Moreover, learning content is defined as integrating critical issues into curriculum; like, climate change, biodiversity, sustainable consumption and production. Pedagogy and learning environments, on the other hand defined as comprised of revising teaching and learning in an interactive, learner-centered way. Strengthening students to transform themselves to the 21st century issues and the society they live in however is defined as societal transformation.

2.2 Science Teachers' Role in ESD

The main role of science and technology in sustainable development in modern societies reveals the important role of science education in ESD (Bradley, 2005). The aim of ESD is to educate students to make sustainable decisions in the future (Walls, 2011). This will be achieved by the correct transfer of the correct information by the teachers to the students. Science education, at all levels of education, aims to ensure that young generations become responsible citizens and to promote sustainable development in our world (Eilks, Nielsen & Hofstein, 2014). At this point, teachers' views about ESD are of great importance in teaching students the future and

preparing them for the future (Anyolo, Kärkkäinen & Keinonen, 2018). Moreover, developments in science and technology and decisions about them related to economic, environmental and social influences. Therefore, science education also has great potential in developing students' knowledge and skills related to participatory learning (Eilks et all., 2014). In addition to these, Nikoloski (2017), stated that as one of the three pillars of sustainable development is the environment, science teachers have the most intense role in ESD. Considering the subjects of the science course, there are many points to address sustainable development. Therefore, science teachers' views on this issue are important in order to develop and implement education for sustainable development and to provide students with ESD-related objectives.

2.3 Science Teachers' Views Related to ESD

The research on teachers' views on ESD dates back to late 1990s; just after the Rio Conference held at the beginning of 1992. Cross (1998) for example, made a study with titled "Teachers' view about what to do about Sustainable Development". The purpose of this research was investigating the effect of environmental education on teaching practice. The questions of interview were mainly about the definition of SD, SD with science and technology, effects of SD to our life styles and teachers. The author concluded as a result that, teachers were actually worried about the interaction of people with the planet and they are also willing to contribute to the regulation of public opinion. However, teachers generally took the issue as superficially and did not know much about the theoretical problems about sustainable development. They did not have a clear view of how to contribute. Moreover, the curriculum did not find appropriate for concept of sustainable development by these teachers. Teachers are well-intentioned and willing to adapt the subject to their class. However, teachers did not have a theory-based view of sustainable development. Their efforts are not allowed to clarify the issue and it is foreseen that they may give wrong messages to the students about sustainable development. Similarly, in a research conducted by

Gayford in the England in 2002, teachers stated that the important aspects of education for sustainable development can be taught in an appropriate way with the science curriculum. However, the subject remained outside the area of expertise of teachers. Although they thought education for sustainable development was necessary, they stated that the science curriculum was intense in order to address this issue. They stated that sustainable development is considered as the whole school's approach to the environment in formal or informal form and it should have more precise and clear boundaries in order to understand the subject. Teachers did not want to be involved in the process of inculcating to students on the subject. They said that the issue was controversial, and they had to remind the students. As a result of the ongoing meetings, the teachers concluded that they had an important role in education for sustainable development as a science teacher. Teachers thought that their task was to enable students to evaluate the information they heard from media etc. Gayford (2002) stated that this research provided an insight into the current ideas of science teachers on sustainable development and they have wanted to do more research on the subject. Teachers recognized that science education has an important role in education for sustainable development. It was stated that the complete education was the responsibility of the whole school. In following years, Chatzifotiou (2006) made an investigation about Environmental Education about national curriculum with primary teachers and mentioned the possible effects of this research on education for sustainable development, in England. The research had similar results to the previous one. The researcher stated that, although environmental concepts have been included in the UK national curriculum since 1995, most of the teachers were not knowledgeable enough to discuss these concepts. When it comes to education for sustainable development, it is thought to be in line with environmental education. Education for sustainable development is not a new issue but a new approach (Chatzifotiou, 2006). It is mentioned that education for sustainable development did not enter the curriculum in a more prescriptive or more specific way. The area devoted to both environmental education and education for sustainable development is limited and there are no specific guidelines for their implementation. There are no specific borders for education for sustainable development. So, it creates is a blurred picture in the minds of the teachers that what

education for sustainable development is. It is mentioned that education for sustainable development is explained by environmental education while taking part in the curriculum. It was not explained that these two concepts are how similar or how different. In this case, it is stated that teachers need more information and guidance on integrating education for sustainable development in their classes. As a result, it is stated that teachers do not have enough knowledge about the historical and philosophical principles of environmental education and similar problems can also be encountered in education for sustainable development.

Since teachers felt insufficient about the concept of sustainable development, I also wanted to mention a few researches with pre-service teachers. Summers and Childs (2007), applied a questionnaire about sustainable development concepts to student teachers starting a secondary science teacher-training course. They have developed categories in order to achieve sustainable development features. They examined the individual answers as to whether key concepts about sustainable development were addressed. They examined the answers in light of a framework proposed by the Education Panel for Sustainable Development in the UK. 72% of the responses to sustainable development were based on environmental, 53% economic, 31% social factors. Only 15% of the participants mentioned all three factors. Personal responsibility, protection of diversity, uncertainty in actions are defined as deficiencies in terms of dominating the subject (Summers and Childs, 2007). In the final part of the study, they mentioned that the role of schools should be taken into consideration in teacher education. From this point of view, they come together with the their colleagues who teach geography at the university and talk about the development of pedagogical approaches to sustainable development. They thought that another lesson that represents EDS in compulsory curriculum at schools is geography. As a result of the interviews with geographers, it was stated that the teachers in both branches should develop and deepen their understanding of sustainable development. As a result, they foresee the need for a school-based experience to develop interdisciplinary cooperation with ESD at the university. (Summers and Childs, 2007). Thus, student teachers will be able to better

comprehend the relationship between concepts related to sustainable development (environment, economy, social).

In the undergraduate courses of geography, environmental issues are discussed from a humane point of view, including cultural contexts and political perspectives. (Corney & Middleton, 1996). As Summers and Childs mentioned in the above study, Geography is another course representing ESD. For this reason, I wanted to touch upon Corney and Reid's study with geography teacher students who were studying postgraduate education at Oxford University. The purpose of study was investigating the professional knowledge of student teachers about ESD. In terms of learning and teaching, the subject and pedagogy are important for all areas in the school curriculum. But it is especially important for ESD (Corney & Reid, 2007). As a result of the research, it was stated that it would be appropriate for the UK national curriculum to incorporate ESD into teacher training courses and to adopt a phased approach to develop teachers' expertise in this field (Corney & Reid, 2007).

Another research conducted with preservice teachers by Bursjöö (2011) in Sweden aimed to investigate the views of pre-service teachers, who were close to graduation, about ESD in their vocational training. This research was conducted with 20 teachers in different branches. Preservice teachers stated that implementation of ESD depends on both internal and external factors. Colleagues, time and curriculum were identified as three main external factors by teachers. The preservice teachers addressed internal factors such as acquiring knowledge and skills, searching for new options for new actions and integrating new actions in ESD teaching. As a result of the study, it was understood that the preservice teachers were not sure about the need for teachers about ESD beyond a traditional environmental perspective such as recycling. They defined ESD content as focusing on specific issues such as environment, consumption, health, democracy, energy, justice, resources and economy. Another remarkable point in the study was that most of the teachers emphasized the lack of interest of other teachers. It is a common opinion to many teachers in this research that science teachers (chemistry, biology, etc.) have great responsibility in ESD. In a similar study in Austria about how primary and secondary school teacher candidates in Austria understood the concept of ESD similar results

were obtained that most teachers showed a limited understanding of ESD and presented a one-dimensional view of ESD related to ecology and environment (Evans, Whitehouse & Hickey, 2012). At the end of the study, teachers' understanding the concept of ESD was grouped under four categories: education that is continuous; education about ecological systems and environmental issues; education that is active, hands-on, local and relevant; and education for the future (Evans et all., 2012). In all categories, there was a future perspective driven by the element of continuity (Evans et all., 2012). When the answers of the teachers who participated in the study were examined, the pre-service teachers in the last years showed more wide opinions than the pre-service teachers in the first or second grades. From this point of view, it can be said that pre-service teachers who are exposed to ESD can develop a more conscious understanding (Evans et all., 2012). As a result, the redesign of courses at university level and the choice of teaching made by teachers are important for the success of ESD (Evans et all., 2012). In parallel to this, a study conducted in Germany in 2013 also highlighted the lack of education of teachers about EDS at the university. Burmeister and Eilks (2013), on the other hand, focused on the perspectives of student teachers and trainee teachers about ESD in chemistry education. These groups have shown positive attitudes towards the idea of sustainability and sustainable development and its educational context, but their knowledge is not very clear in theoretical sense (Burmeister and Eilks, 2013). As in many studies, it was concluded that the participants mostly touched on the environmental dimension and did not relate the ecology, economy and social dimensions together. It is clear that both student teachers and trainee teachers do not get enough information about the concepts of sustainability in teacher education (Burmeister and Eilks, 2013). They did not mention any pedagogical concepts that would relate ESD to chemistry. Moreover, most of the participants stated that any information they have about sustainable development is usually obtained from mass media and the Internet, not during teacher education. As a result of the study, it was concluded that in-service training related to ESD is a need.

In Sweden, it was stated that teachers should integrate all aspects of SD according to the Swedish curriculum (Borg, Gericke, Höglund & Bergman, 2014). According to

the results of the research, teachers generally do not have a holistic view of SD. While the science teacher deals with the environmental dimension of SD, the social teacher deals with the social dimension of SD. The greatest uncertainty is the economic dimension (Borg et all., 2014). From this point, the need for further education for teachers to integrate the three dimensions of SD is emphasized. The majority of the teachers participating in the research stated that they needed such training. Successful implementation of ESD by pre-service teachers and in-service teachers will make a difference (Borg et all., 2014). Therefore, it was concluded that teachers should be provided with trainings to encourage the view of SD and to implement ESD successfully.

Another study in Sweden, 11 high school teachers from different branches were interviewed about SD opinions, their beliefs and how they teach SD. Teachers participating in the research presented a wide range of views on the concept of SD. Teachers' explanations about SD content and practice are based on their own beliefs, although they include all three pillars of SD. From this point of view, because teachers make their own definitions and content preferences for SD, students cannot receive consistent information about SD (Gustaffsson, Engström & Svenson, 2015). Therefore, it cannot be said that schools in Sweden provide equal education on this subject (Gustaffsson et all., 2015). All teachers in this study stated that SD is important, but they find school management weak on this regard. A common plan involving all the lessons and teachers in the school is required. As a result of the research, there is no need for further SD related training in teacher education, but a request has been made by the National Education Agency for educational tools for SD teaching. In another study conducted by Aceska & Nikoloski (2017) to investigate the views and opinions of teachers on educational competencies for sustainable development, it is stated that a curriculum that can go beyond environmental education is needed to teach students sustainable development. Sustainable development should be part of the core curriculum at all school levels (Aceska & Nikoloski, 2017). In addition, it is stated that traditional teaching methods are based on a passive narrative and these methods are insufficient to obtain the basic competencies of ESD (Aceska & Nikoloski, 2017).

In Namibia, in a study conducted to understand teachers' views of ESD and teaching practices, teachers generally defined ESD as acquiring knowledge about the environment in order to use resources in a sustainable way, taking into consideration future generations. Teachers in the research are secondary school teachers and they are familiar with sustainable development. They stated that ESD should be included in the primary school curriculum as well as the secondary school curriculum. When the teachers' suggestions were taken into consideration, it was stated that ESD should be applied as an independent subject in order to discuss SD more deeply (Anyolo, Kärkkäinen & Keinonen, 2018). Moreover, teachers stated that ESD should be integrated with other subjects as a multidisciplinary subject. Another suggestion was to use active approaches to engage students in ESD. In this way, it is ensured that the student takes responsibility for their own learning and becomes more effective in protecting the environment through practices (Anyolo et all., 2018).

2.4 ESD Content of Turkish Middle School Science Curriculum

The vision of the Turkish Science Curriculum is defined as "educating all students as science literate individuals" (Turkish Science Teaching Program, 2013). Scientific literate individuals who are researching and inquiring, able to make effective decisions, solve problems, be self-confident, open to cooperation, communicate effectively, and learn lifelong with the awareness of sustainable development; knowledge, skill, positive attitude, perception and value related to science; it has understanding and psychomotor skills related to the relationship of science with technology, society and environment (Turkish Science Teaching Program, 2013). According to Turkish Science Teaching Program, the scientific literate individuals understand the relationship between social and technological change and transformations with science and the natural environment. Moreover, those individuals who have a career consciousness in the field of science are aware that even those who do not want to work in this field have an important role in the

solution of social problems in science-related professions (Turkish Science Teaching Program, 2013).

The concept of sustainable development is also among the basic aims of the Science Teaching Program, which aims to educate all individuals as science literate. The aim of the Turkish Science Teaching Program related to sustainable development is expressed in the following way: To recognize the mutual interaction between the individual, the environment and the society and to develop awareness of sustainable development regarding society, economy and natural resources.

In Turkey primary school programs, there is no must or elective courses under the name of environmental education or education for sustainable development. However, when we look at the Turkish Science Curriculum, there are objectives related to both environment and sustainable development. Starting from the 3rd grade program, issues such as recycling, efficient use of resources and renewable energy sources have been mentioned gradually. When it comes to the 8th grade program, there is the title of Sustainable Development under the Living and Energy Relations Unit. Topics and concepts covered under this unit are sustainable living, efficient use of resources, recycling. There are two objectives under this topic in 2013 Turkish Science Teaching Program:

8.5.3.1. Designs projects for the efficient use of resources.

8.5.3.2. Discusses the importance of the separation of solid wastes for recycling and their contribution to the national economy by using research data and offers solutions for this issue.

A quality environmental education for students will probably be achieved during real life experiences. Experiences in nature will enable students to build relationships and empathy with nature. Knowledge and skills gained from real-life experiences are the key to protecting the environment. Teachers can help raise and develop children's curiosity and awareness of the environment. However, an environmentally sensitive teacher can be effective in providing students with information about the environment and raising their awareness of the environment (Doğan, 2007). In

addition to environmental education, it is sighting that ESD is an undeniable need of the 21st century (Karaarslan & Teksöz, 2016). However, integrating ESD into science education programs is not sufficient to advance; it is needed competent science teachers for ESD (Karaarslan & Teksöz, 2016).

2.5 Turkish Practice on ESD

In our country's education education programs, there is no independent course in which sustainable development or education for sustainable development is given**.** There is an elective environment course, but it is not selected in the schools where the teachers I interviewed work. Environmental issues are scattered in the curriculum of Life Science course in primary school, Social Studies and Science courses in elementary school. It is seen that environmental issues take place in other courses in a very limited and scattered way (Özdemir, 2007). Besides, studies about ESD in Turkey mostly have been carried out to reveal the pre-service teachers' views of SD. In a study conducted to determine the environmental literacy level of pre-service teachers in 2007-2008 period, environmental knowledge score of pre-service teachers was found to be unsufficient by Teksöz et all. Pre-service teachers have an environment-oriented thinking way and a positive environmental awareness. However, high attitudes and behaviors towards the environment will be possible with adequate environmental knowledge (Teksöz, Şahin & Ertepınar, 2008). In 2015, a similar result was observed in the pre-service science and social science teachers' awareness of the concept of SD. According to the results of the study, the individual awareness of the pre-service teachers is above average and their interest in the subject is positive. However, the knowledge of pre-service teachers is not sufficient, and it is thought that the deficiencies in the content of the courses given in the faculties of education should be eliminated (Çobanoğlu & Türer, 2015). In another study conducted to analyze SD definitions of pre-service science teachers, it was stated that pre-service teachers had an SD views although they did not have strong educational backgrounds (Aydın & Kılınç, 2013). Teachers defined SD in terms of

environment, technology, society, economy, politics, energy and education. The fact that most of the teachers define SD in terms of environment is due to taking courses such as Environmental Science and Environmental Awareness in their undergraduate education (Aydın & Kılınç, 2013). As a result of the research, it was considered that in order to increase the effect of ESD, science teachers should have the opportunity to become more aware of their individual opinions and prejudices about SD, to enable pre-service teachers to combine and discuss their existing ideas to raise awareness of the diversity of SD concepts and ESD programs in teacher education should be made more adequate (Aydın & Kılınc, 2013). In a study with elementary school teachers, teachers saw the curriculum, class size, and deficiencies in teaching materials as barriers to ESD (Sagdic & Sahin, 2016). In addition, teachers stated that the educational projects they participated shaped their beliefs and perspectives on ESD. The interaction between teachers and school administrators was thought to have a significant effect on incorporating ESD into formal education (Sagdic & Sahin, 2016).

CHAPTER 3

METHOD

3.1 Research Design

The research of this thesis has been designed as qualitative through semi-structured interviews with middle school science teachers, in line with the definition that qualitative research methods provide toned understandings of complicated phenomena; thus qualitative research methods are precious in assisting researchers develop an understanding of the experiences of people (Wu, Wyant and Fraser, 2016).

Moreover, qualitative research examines the quality of interactions, relationships, events, situations, and focusing on a relatively small context and small number of people in detail. By the aid of qualitative research method accompanied with in-depth interviews, the researcher can understand people's opinions and focus on the parts that need to be detailed. Bogdan and Biklen (1998) identify the general characteristics of qualitative research as follows: Data source is the natural setting and most of the time researcher is the major data collection tool; Data in qualitative research are people's expressions, their behaviors, documents, pictures, but not numbers; Process is as important as product in the qualitative researchers; Data are analyzed inductively, so there is no hypothesis testing (Bogdan & Biklen, 1998). The main purpose of the qualitative research is to document the events in detail and to define the meaning of the events (Fraser, 2012). Qualitative research in education is suitable for detailed information on implementation; for example, identifying the subjective thoughts and nuances of the participants on a topic; qualitative research is

particularly suitable for identifying and understanding change over time. (Fraser, 2012)

Therefore, it is well suited to use qualitative research for this thesis, which aims to learn science teachers' views and practices on Education for Sustainable Development in line with the above-mentioned features.

3.2 Population and Sample

The population of this study is science teachers working in the middle schools in Turkey. As it is not possible to work with all the middle schools in Turkey, the accessible population is narrowed down to those working in middle schools in Mamak district of Ankara. The sampling method used therefore is cluster random sampling method. In line with the method, according to the definition made by Neuman (2006); first the middle schools in Ankara were identified as clusters, then schools were selected randomly; for the second stage, science teachers working in the randomly selected schools (clusters) contribute the sampling of this thesis. Accordingly, among a total of 608 middle schools in Ankara, 5 of them were selected randomly and 27 science teachers working in these schools comprised of the sample of this thesis.

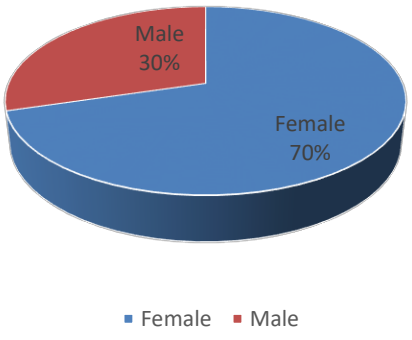

Figure 3.1 Gender percentages of teachers

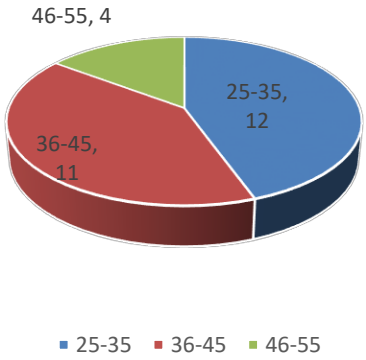

Figure 3.2 Age range of teachers

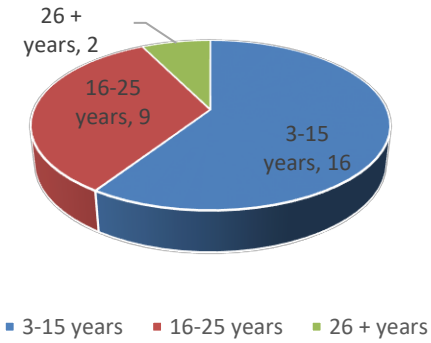

Figure 3.3 Teachers' years of experience

3.3 Data Collection

Data collection process was realized through semi-structured interviews with the middle school science teachers by the use of the instrument titled “Semi structured interview questions for Science Teachers: Views on Sustainable Development and Views on the ESD content of the 2013 Turkish Middle School Science Education Program” and comprised of 5 sections and 7 questions related with the research questions of this study (Appendix A).

The original data collection tool developed by Summers&Childs (2007) is titled as of "Sustainable Development Questionnaire" and comprised of 3 sections. In section 1, the demographic information is asked; then in section 2 included the rating of personal view of Sustainable Development. In section 3, it was asked the meaning of sustainable development to teachers. After adaptation the instrument for this study we ended up with 5 sections and 7 open-ended questions. The questions are constructed in such a way to explore science teachers' views on sustainable development and the concept as it is contained in the 2013 Turkish science curriculum. The questionnaire is divided into 5 sections as follows:

1. Demographic Information
2. Self-evaluation

3. Views on Sustainable Development

4. Views on ESD

5. Science teachers' suggestions and practices about ESD

Accordingly, the questions proposed for interviews are presented in Table 3.1 below:

Table 3.1. Semi-structured interview questions. The instrument: "Semi structured interview questions for Science Teachers: Survey of Science Teachers' Views on Sustainable Development and Education for Sustainable Development

Sections	Questions
I. Demographic Information	• Age: • Gender: • Teaching Experience (years): • Have you participated a training/course program related to ESD during your education? • What was the title of the training program/course did you participate?
II. Self-evaluation	1. Evaluate your knowledge of Sustainable Development. (Tick one) Very good ☐ Quite good ☐ Medium ☐ Little bad ☐ Very bad ☐
III. Views on Sustainable Development	2. What do you understand from the concept of Sustainable Development?

Table 3.1. (continued)

IV. Views on ESD	3. What do you understand from the concept of Education for Sustainable Development? 4. Is the Education for Sustainable Development necessary? Why? 5. Which of the aims of the 2013 Turkish Ministry of National Education Science Curriculum relates to Education for Sustainable Development?
V. Science teachers' suggestions and preactices about ESD	6. How will the concept of Sustainable Development be more useful in the context of the middle school science curriculum? 7. How do you apply the Education for Sustainable Development context that situated in the 2013 Turkish Ministry of National Education Science Curriculum?

The sample selected for the pilot study was a science teacher working in a middle school in Ankara. The questions prepared to get the views of teachers about ESD were asked to the teacher in the pilot study by interview. The final version of the questionnaire was designed according to the pilot study and it used in the interviews with the teachers participating in the current study.

3.4 Data Analysis

Data analysis was conducted by examining semi-structured interviews with middle school science teachers. Data Analysis of this study focuses principally on the recorded and written responses to the questions. The stages to be followed for the analysis of data were set as suggested by Miles, M.B., Huberman, A.M. and Saldana, J., 2014:

1. Familiarization with the data through review, reading, listening. This is an essential stage for familiarization with the data and includes listening to tapes, reading and re-reading the data, making memories and summaries before the formal analysis begins.
2. Transcription of tape-recorded material
3. Organization and indexing of data for easy retrieval and identification
4. Coding (indexing)

After familiarization with the material, it is necessary to do some preliminary coding. For this study, we are interested in ideas of how the respondents perceive sustainable development. Certain ideas crop up in the transcript readily, and we can give these a preliminary code. For example, if in one of the teacher's interview she/he talks environmental protection, then this sentence will be highlighted which refer to one possible code.

5. Identification of themes
6. Development of categories
7. Exploration of relationships between categories
8. Refinement of themes and categories

9. Development of an explanation (including excerpts from the data; like quotes from interviews) through related literature and pre-existing knowledge.

3.4.1 Identification of Themes and Categories

Themes and categories are identified according to each research question as follows:

1. The Meaning of Sustainable development in the words of teachers
    - 1.1 Development of categories to capture the features of sustainable development appearing in the responses of the sample as a whole, and counting their frequency of occurrence;
    - 1.2 Examination of individual responses for the presence or absence of certain key features (specifically environmental, economic and social factors).
2. ESD in the 2013 Turkish Science Curriculum
    - 2.1 Content wise by development of categories to capture the main features of teachers' views – Inductive category development.
    - 2.2 Examples on Implementation: Content wise by development of categories to capture the main features of teachers' implementations.

3.4.2 Evaluation of Results

Results will be presented in 3 headings as:

1. Self-ratings of view of sustainable development

2. The meaning of *"sustainable development"* in the words of science teachers

    2.1 Development of categories to capture the features of sustainable development.

    2.2 Examination of individual responses for the presence or absence of environmental, economic and social factors.

3. The meaning of *"education for sustainable development"* in the words of science teachers

    3.1 Content wise by development of categories to capture the main features of teachers' views – inductive category development

    3.2 Examples on implementation

3.5 Validity, Reliability and Reflexivity

In this part of the current study reliabilty, validity and reflexivity of study was mentioned.

3.5.1 Reliability

In terms of assessing qualitative research the emphasis is on the reliability of the methods employed. The followings will be considered in order to demonstrate that the methods used in this study are reproducible and consistent:

1. Describing the approach to and procedures for data analysis
2. Justifying why these are appropriate within the context of the study
3. Clearly documenting the process of generating themes, concepts or theories from the data audit

4. Referring to external evidence, including previous qualitative and quantitative studies, to test the conclusions from the analysis as appropriate.

3.5.2 Validity

The validity of the study will be emphasized through the validity of the interpretation. Since validity is the extent to which an explanation/interpretation seems to fairly and accurately represent the data collected. Therefore, the followings will be considered while interpreting the data:

1. The consistency of the findings, for example has analysis been undertaken by more than one researcher (inter-rater reliability).
2. The extent to which all relevant views are represented
3. Adequate and systematic use of the original data (for example using quotations, and not all from the same person).

3.5.3 Inter-rater Reliability

Inter-rater reliability is the level of agreement between raters. There are several methods for calculating the inter-rater reliability; for example, a percentage agreement or Cohen's Kappa. In this study, in order to provide significance of interrater reliablity Cohen's Kappa was used. Kappa value varies between -1 and 1 between the observed and expected agreement. While "1" showing the perfect deal; "0" means an agreement that is less than coincidence. The following table contains the interpretation scale of the kappa value.

Table 3.2 Interpretation of Kappa Value

	Poor	Slight	Fair	Moderate	Substantial	Almost Perfect
Kappa	0.0	20	.40	.60	.80	1.0
Kappa		**Agreement**				
<0		**Less than chance agreement**				
0.01-0.02		**Slight agreement**				
0.21-0.40		**Fair agreement**				
0.41-0.60		**Modarete agreement**				
0.61-0.80		**Substantial agreement**				
0.81-0.99		**Almost perfect agreement**				

In this study, Kappa value was found in order to measure interrater reliability for the determination of categories for each question. The categories created for each question in this study were determined by both the researcher and an expert. Then, Kappa values were found to determine the interrater reliability between the researcher and the expert.

For interrater analysis of interviews' SD views, Kappa value was found as .66, $p<0.001$ that is substantial agreement. For interrater analysis of interviews's ESD views, Kappa value was found as 1,000, $p<0.001$ that is perfect agreement. For interrater analysis of interviews's views on the necessity of ESD, Kappa value was found as 1,000, $p<0.001$ that is perfect agreement. For interrater analysis of interviews's suggestions on ESD Kappa value was found as .571, $p<0.001$ that is modareta agreement. For interrater analysis of interviews's practices on ESD Kappa value was found as 1,000, $p<0.001$ that is perfect agreement. Interrater reliability analysis using Kappa statistics for this study showed consistency between the researcher and the expert. The results were satisfactory to indicate that the categories used were valid and reliable.

3.5.4 Researcher Perspective

Reinharz (1992) have highlighted the necessity to make clear the perspectives of the researcher themselves in demonstrating the validity (they would call it credibility) of the research. Because qualitative analysis is an interpretative process, the preconceptions, assumptions and ‘worldview’ of the researcher are likely to influence the process and any emerging theory, despite use of rigorous approaches. These needs acknowledging, by making the researcher more ‘visible’ in the analysis process, some call this ‘reflexivity’. A reflexive explanation is an honest attempt by the researcher to declare their conceptual journey through the research, perhaps by including sections of their own reflective diaries as they undertook the research. Hence, reflexivity statement will be written in this study to declare conceptual journey of the researcher through the research.

The researcher in this study is a graduate of science education department. Moreover, the researcher has a background on SD and ESD. During the writing process, the concept of SD and ESD was better assimilated by the researcher. She is worried about the future of the world and believes that ESD can change people's priorities in a sustainable direction. It was thought that for a sustainable lifestyle, it should be integrated into the science curriculum by addressing the concept of SD in a holistic way. The views of in-service teachers on the concept of sustainable development already in the curriculum were considered important. The basic idea behind this study was to have knowledge of the current state of ESD based on the views and practices of science teachers. In line with the positive attitudes and behaviors of the interviewed teachers, the researcher's belief in the necessity of ESD increased.

CHAPTER 4

RESULTS

This chapter is comprised of seven sections in line with the research questions of this thesis. Each section is designed as to answer one research question. The answer for each research question, however, is presented through the table presenting the results of content analysis that includes related themes and categories as well as the number and characteristcs of the teachers who answered the question.

4.1 Science Teachers' Views on Sustainable Development

Science teachers' views on sustainable development (SD) concept have been evaluated through interview questions 1 and 2.

Question number 1: Evaluate your knowledge of Sustainable Development.

Question number 2: What do you understand from the concept of Sustainable Development?

4.1.1 Self Evaluation

Among 27 science teachers 14 of them expressed their knowledge on SD as "medium". None of the teachers expressed their knowledge on SD as "very good". Besides, only one teacher stated her/his knowledge about SD as "very bad". (Table 3.1. & Figure 3.1.)

Table 4.1. Science teachers' self evaluations for sustainable development

Category	Number of science teachers
Very good	0
Quite good	8
Medium	14
Little bad	4
Very bad	1

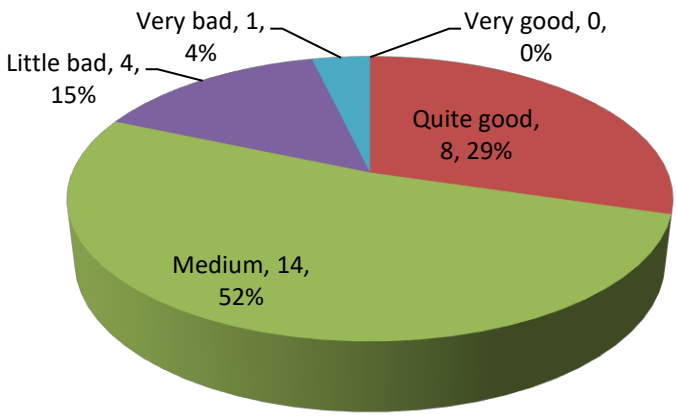

Figure 4.1. Science Teachers' self evaluations for SD

4.1.2 Views

Science teachers' views of sustainable development was obtained as a result of the content analysis of the answers given for first and second questions. The results revealed 3 themes and 6 categories (Table 4.2). Themes 1 and 2 were determined as explaining science teachers' view of the concept through the two pillars of the concept; economy and environment. The third theme, however, is found as related to continuity; cyclic character of nature. Categories defined under the first theme are related to efficient use of natural resources and use of renewable energy sources. The

categories determined under the second theme on the other hand, are related to human behavior and the need for awareness raising. The categories for the third theme are related to recycling and continuity. As a result, it may be conferred that most favourable theme among the science teachers (23 teachers) of this study for defining SD is the first theme; that is SD is defined through national economy and efficient use of resources. Human and environment concept, however, arose as the second favorate theme with 12 teachers using this context to define the SD concept (Table 4.2).

Table 4.2. Themes and categories for science teachers' view of Sustainable Development (SD)

Themes	Categories	Number of teachers
1. National economy and efficient use of resources		
	National economy	8
	Efficient use of natural resources	8
	Use of renewable resources	7
2. Human and environment		
	Human behaviours	4
	Developing environmental consciousness	2
	Recycle	6
3. Cyclic nature of nature and continuity		
	Continuity	2

4.1.2.1 National Economy and Efficient Use of Resources

As a result of the content analysis, the core of the Theme 1 was defined through*"national economy and efficient use of resources*". In this section, teachers have dealt SD with the economic dimension, while describing SD as the national economy, efficient use of resources and the use of renewable energy resources. Three categories under theme, however, were defined as follows:

- National economy
- Efficient use of natural resources
- Use of renewable resources

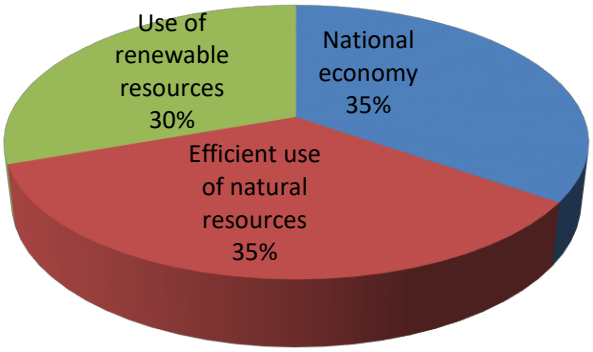

Figure 4.2. The distrubiton of the science teachers' view of SD for the Theme 1: National economy and efficient use of resources

- ***National Economy***

Content analysis resulted that, three teachers out of twenty-seven answered the second question agreed on the idea that SD is related to the efficient use of resources. One of these teachers, for example, explained the concept of SD as efficient use of existing energy resources with leaving energy to the future. As it is seen from the below given quotes, teachers explained sustainable development in terms of concern for national economy. Therefore, their definition of sustainable development can be summarized as contributing to the country's economy through efficient use of natural resources.

Some quotes from the interviews are as follows:

> *Contributing to the national economy and conserving existing resources by making them sustainable as our natural resources are limited. (hüseyin)*
>
> *Contributing to the country's economy. More efficient use of resources, more efficient use of land. Using all resources at the highest level of capacity. (özlem)*

- ***Efficient Use of Natural Resources***

Five out of twenty-seven teachers of this study explained SD through efficient use of natural resources. All the answers in this theme consisted of the words “efficient” and “source” therefore emphasizing the available natural resources. The common ideas of teachers in this category about SD were to consider the future when using natural resources. The followings are some quotes taken from the teachers’ answers:

> *Using our existing energy resources not by using them up but by keeping available them for the future.* (*ceylan)*
>
> *Using all energy resources around more efficiently and promoting recycling for the purposes of increasing efficiency. (gonca)*
>
> *Planning the present and the future whilst using natural resources. (gülşirin)*

- ***Use of Renewable Resources***

Seven of twenty-seven teachers explained SD through use of renewable resources. Teachers in this category emphasized that renewable energy resources exist and should be used. All the answers in this theme consisted of the word "renewable energy" and two of the teachers stated about sun, wind and geothermal as types of renewable energy. Accordingly, the follwings are some quotes taken from the teachers' answers:

> *Polluting the environment less via using renewable energy resources. (özlem_eg)*
>
> *Advancement of the country with her existing resources. Should I include the word "sustainability" to the context, I perceive that such resources should not be among those that will run out. They should not be such exhaustible resources as coal, natural gas etc. but be such renewable resources as solar energy, wind energy etc. (selin)*
>
> *Using energy resources without carbon emission. In other words, using renewable energy resources which may be wind energy, geothermal energy etc.(ufuk)*

4.1.2.2 Human and Environment

The second theme for explaining science teachers' view of sustainable development concept is titled as human and environment, as the teachers explained the concept through human behavior towards environment. When describing SD, teachers under this theme addressed the environmental dimension, which is one of the three dimensions of SD. Accordingly, the categories under this theme are as follows (Figure 4.3):

- Human Behavior
- Consciousness-raising
- Recycling

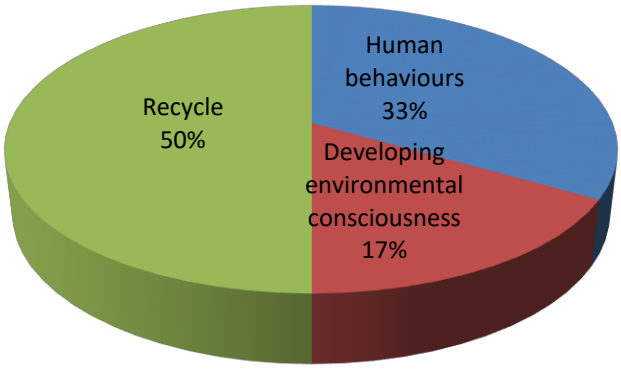

Figure 4.3. The distrubiton of the science teachers' view of SD for the Theme 2: Human and Environment

- ***Human Behavior***

Four of the teachers explained SD in terms of the importance of how human behave toward environment. As is presented in the quotes below, science teachers perceive positive human behavior toward environment as one of the basic requiremens for a sustainable future:

> *The behaviours of people against the world to manage to hand a better world down to future generations. (sevil)*
>
> *Favourable environmental behaviours to be adopted for humanity, world and future generations, and maintaining such behaviours. (aysun)*

The most remarkable feature of the answers of this category is that, science teachers used the words "future" and "future generations" while explaining sustainable development.

- ***Developing Environmental Consciousness***

Teachers' explainations for this category clearly indicate the need for developing consciousness for environment for achieving SD. Although only two science teachers out of twenty-seven mentioned about raising environmental consciousness, it is an important issue as one of teachers quoted:

> *It concerns entire public as it contains socio-economic factors. People should be made to adopt an environmental consciousness. (istemihan)*

- ***Recycling***

Six of the teachers of this study explained SD in terms of recycling. As most of them stated "recycling" is the first word they think about, when they were asked about SD. Some quotes from teachers' answers are below:

> *I think about recycling when it comes to sustainable development. We can say that it is the reuse of the used material wastes. (özgül)*
>
> *Recycling and inexhaustible energy. (ebru)*
>
> *Using all energy resources around more efficiently and promoting recycling for the purposes of increasing efficiency. (gonca)*

4.1.2.3 Cyclic Nature of Nature and Continuity

The third theme defined as a result of content analysis of the interviews is *" cycle nature of nature and continuity "*. The category defined under this theme is "continuity".

- ***Continuity***

Two teachers explained SD with the term “continuity”. The remarkable feature that makes this quates a category is that the teachers did not mention the term “sustainability” instead they prefer to state “continuity”, implying that they may not be familier with the term sustainability. Followings are the qutoes from the teachers’ interviews:

> *Self-sufficiency in terms of economic and environmental factors; a sort of recycling, renewing or continuity. (ayten)*
>
> *Favourable environmental behaviours and maintaining such behaviours. (aysun)*

As is seen from the above quotes, teachers do not refer only to continuity of the environment but also continuity of positive behavior toward environment.

4.2 Science Teachers’ Views of Education for Sustainable Development

Science teachers’views on Education for Sustainable Development (ESD) concept have been evaluated through interview questions 3, 4 and 5.

Question 3: What do you understand from the concept of Education for Sustainable Development?

Question 4: Is the Education for Sustainable Development necessary? Why?

Question 5: Which of the aims of the 2013 Turkish Ministry of National Education Science Curriculum relates to Education for Sustainable Development?

The themes and categories resulted from the content analysis of the above-mentioned questions are presented in Table 4.3. As it seen from the table, science teachers’ views on ESD have been explained through three themes as related to the three pillars of SD: environment, economy and politics.

Science teachers of this study explained the need for ESD through their concerns related to environmental, economic and development as well as ESD needed by everybody.

Teachers' answers related to the aims of the 2013 Turkish Ministry of National Education Science Curriculum related to ESD on the other hand have been categorized into two as all the aims and specific aims (Table 4.3).

Table 4.3. Science Teachers' views of Education for Sustainable Development (ESD)

Question 3: Science Teachers' views on ESD	
Themes	Categories
ESD for environment	Environmental education at early ages
	Environmental awareness
	Recycle
	Continuation of life
	Use of renewable energy sources
ESD for economics	Contribution to family economy
	Saving
	Efficient use of natural resources
ESD for politics	Government policy
Question 4: Is the Education for Sustainable Development necessary? Why?	
Themes	Categories
ESD for environment	The need for developing environmental consciousness
	The need for energy awareness
	The need for recycling awareness

Table 4.3 (continued)

ESD for economy	ESD for national economy and development
Education for everyone	Education for everyone
Question 5: Which of the aims of the 2013 Turkish Ministry of National Education Science Curriculum relates to Education for Sustainable Development?	
Themes	
All the Aims of the Curriculum are Related to ESD and/or SD.	
Some Aims of the Curriculum are Related to ESD and/or SD.	

4.2.1 Views on ESD

Science teachers' views of Education for Sustainable Development was obtained as a result of the content analysis of the answers given questions. While teachers defined ESD; they have touched on environmental, economic and policy dimensions. In addressing the environmental dimension, they pointed out that environmental education should be provided at an early age, and also pointed out the importance of recycling, environmental awareness and the use of renewable energy sources. On the other hand, while addressing the economic dimension, they pointed to family and local economy, saving and efficient use of natural resources.

Table 4.4. Themes and categories for views of ESD

Themes	Categories	Number of teachers
1. ESD for environment		
	Environmental education at early ages	4
	Environmental awareness	10
	Recycle	6
	Use of renewable energy sources	5
2. ESD for economy		
	Local / Family economy	2
	Saving	2
	Efficient use of natural resources	9
3. Governmental policy		3

4.2.1.1 ESD for Environment

The first theme defined as a result of content analysis of the interviews is *"ESD for environment"*. When describing ESD, teachers under this theme addressed the environmental dimension, which is one of the three dimensions of SD. Five categories were defined under this theme are:

- Environmental education at early age
- Environmental awareness
- Recycle
- Continuation of life
- Use of renewable energy resources

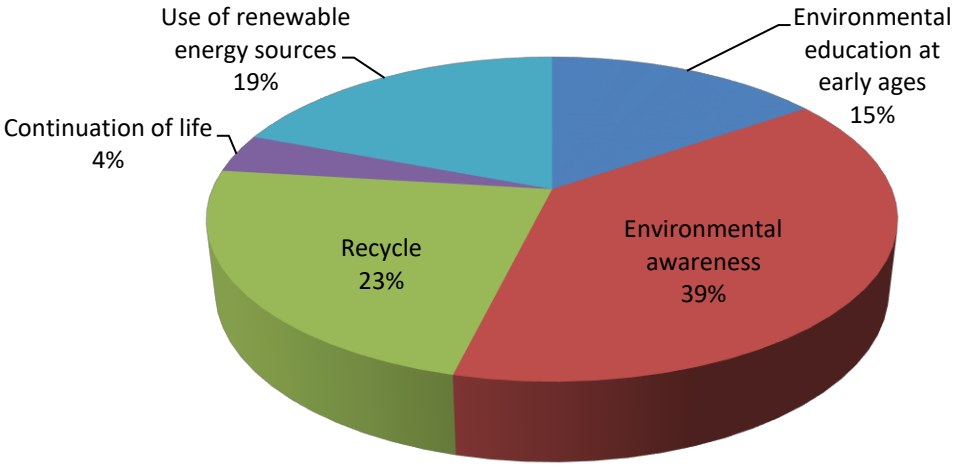

Figure 4.4. Science Teachers' views on ESD for Theme 1: ESD for environment

- ***Environmental Education at Early Ages***

Four teachers out of twenty-seven interviewee, explained ESD through emphasizing the "age" that ESD should began to be given. They specifically mentioned "environmental education at early ages" while defining ESD. The common ideas of teachers in this category are that behavioral change can be gained at an early age and the attention of younger students can be more easily attracted. Followings are the quotes related to this category:

> *Providing the education of positive behaviours at schools at young ages since this issue concerns everybody at all times. (aysun)*
>
> *Such an education should be provided at young ages at nursery classes and handled spirally at all grades. The aforementioned education arouses interest in the kids at the 5th and 6th grades, and the kids are interested in such issue until the 7th grade, but their interest is diverted when they reach puberty. Therefore, such education should be given at young ages. (ayten)*
>
> *Especially teachers should be provided with this education so that they can rise children's awareness. I think the awareness should be raised at young ages. (gülşirin)*

As it is seen from the above given quotes, teachers defined ESD as environmental education at early ages emphasizing "behavioral change" and "teacher education". Therefore, it is possible to infer from the quotes related to Theme 1 that, ESD in the teachers' mind coincides with environmental education and they believe that it is needed to be given at early ages and shall be together with teacher education and behavior change.

- ***Environmental Awareness***

Four of the science teachers of this study defined ESD through developing "environmental awareness":

> *Creating environmental awareness against unfavourable outcomes which may stem from exhausting the natural resources unconsciously. (serkan)*
>
> *Education oriented to creating environmental awareness. (kemal)*
>
> *Education to be provided to raise environmental awareness. (özgül)*

- ***Recycle***

Six of the science teachers expressed ESD in terms of "Recycle". Teachers in this category interpreted ESD as raising awareness of students about recycling and knowing materials that can be recycled. Some quotes from teachers' answers are below:

> *Ensuring the recyclable materials (paper, plastic, etc.) not to be considered as wastes but to be recognised as those to be reusable materials. (gonca)*
>
> *Certain regulations should be made with respect to recycling for the purposes of effective use of natural resources, which can be realised by means of education. (hüseyin)*

Raising children's awareness of recycling starting from nursery classes. (özlemeg)

- ***Use of Renewable Energy Resources***

Three of the interviewes expressed ESD through teaching renewable resources. The main points emphasized were, awareness-raising and behavior change for using renewable resources as well as describing renewable energy sources in relation to environment. Followings are the quotes from the science teachers' interviews:

Putting the significance of renewable energy resources across to students via establishing a connection with environment. (hüseyingazi)

Environmental education, being aware of ecological degradation and sensitivity in the choice of renewable energy resources. (gülşen)

Giving information to and raising awareness of the citizens of the country about such matters as sustainable development, consumption of resources and recycling. Leading the people to renewable energy resources more and more. (gülşirin)

4.2.1.2 ESD for Economy

The second theme defined as a result of content analysis of the interviews is *"ESD for economy"*. When describing ESD, the teachers under this theme addressed the economic dimension, which is one of the three dimensions of SD. They highlighted the positive consequences of efficient use of resources and savings and their contribution to the local and family economy. The categories were defined under this theme are:

- Local / Family economy
- Saving
- Using natural resources efficiently

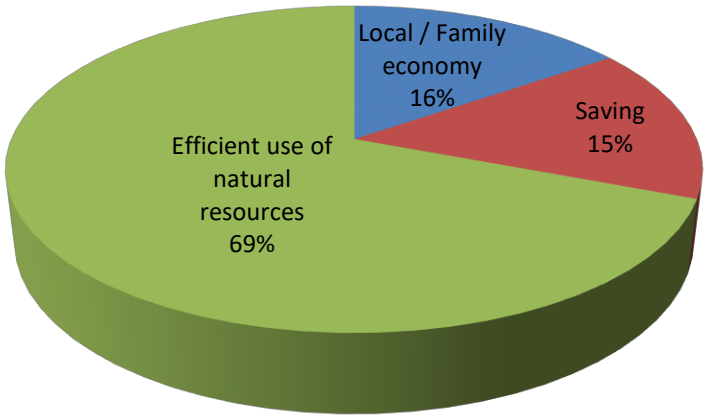

Figure 4.5. Science Teachers' views on ESD for Theme 1: ESD for economy

As it is seen from the above-mentioned categories, this theme reflects those views of teachers that define ESD in economy point of view. The categories defined however, reflect three areas of economy as related to family, self and nature.

- ***Local / Family Economy***

Two of the teachers defined ESD through "local/ family economy" is considered. In this category, teachers touched on the economic pillar of SD, while highlighting the importance of ESD on the local and family economy. Teachers talked about the importance of ESD first for the family economy and then for the local economy. The quotes from the interviews are as follows:

> *Such concepts as family economy, national economy, environmental economy and world economy should be known. Individuals need to know what the economy means, and their awareness should be raised in order to contribute to this issue. (ismet)*
>
> *Sustainable Development is important in determining the economic position of the countries in the world. Making aware of the country's resources,*

explaining that sustainable development is parallel with the economy and family budget. (Hüseyin gazi)

Local/Family economy as defined by the teachers of this category may be evaluated as handing a broad meaning as related to economic status of the country, the world and even the economy of the sources. One of the teachers for example was mentioned, *individual contribution to the country's economy* and awareness on the *limits of local sources*.

- ***Saving***

Teachers who defined ESD as *"saving"*, as given in the following quotes:

When it comes to Sustainable Development, saving comes first to my mind. Raising students' awareness about saving and giving education about this issue. (ceylan)

Making students aware of such issues as environmental, water and electricity saving. (sevil)

As is inferred from the above quotes, science teachers emphasized the importance of awareness "saving" as a general term, including saving water, electricity.

- ***Efficient Use of Natural Resources***

Nine of the science teachers defined ESD as "Efficient use of natural resources". Teachers in this category, while addressing the economic dimension of ESD, interpreted this dimension as efficient use of natural resources. Teachers mentioned the contribution of efficient use of natural resources to the national economy. Followings are quotes from their definitions:

When it comes to education, on the basis of secondary school level, the subjects of recycling and using resources economically tip the balance. (ebru)

Education to be provided for more efficient use of resources. (özlem)

Minimising environmental pollution and using natural resources more efficiently by means of making the use of recyclable product prevalent. (serkan)

4.2.1.3 Governmental Policy

The third theme defined as a result of content analysis of the interviews is *"governmental policy".* As Tilbury (2011) states that, ESD should be handled not only in educational programs but also by related institutions and organizations that will facilitate these learning processes. Therefore, science teachers in this category emphasized that sustainable development must be a state policy, primarily. The government should support education in this area through projects. As Sustainable Development has a wide range, other occupational groups should be aware of this issue. In particular, the ministries of economy and environment should carry out policies on this issue.

Three out of the tweny-seven science teachers defined ESD as *governmental policy* and quotes from the interviews are as follows:

First of all, this should be a state policy and this education should be supported by the state with projects. (istemihan)

Sustainable development should be a state policy. For example, not only teachers and students, but also farmers who are engaged in agriculture and animal husbandry should be ensured to be aware. Other professional groups should also be educated on this matter. (özlem)

It is necessary that ministries such as economy and environment have policies on this issue. (gülşirin)

4.2.2 Science Teachers' Views on the Necessity of ESD

Science teachers' views on the necessity for ESD opinion on ESD have been investigated through the answers given to the question 4 (Table 4.3.).

The question (Is the Education for Sustainable Development necessary? Why?) answered by twenty-seven middle school science teachers. All the teachers agreed that ESD is necessary for middle school students, except two; one of these teachers explained the reason why ESD is not necessary as ESD being a complicated subject and may be suitable for college education. As well the teacher argued that there are ESD related topics in the Science curriculum so there is no need for a separate course. The other teacher however argued that education is not necessary for sustainability but what is necessary is to make people informed:

> *I don't think it's necessary. I think it is a very comprehensive topic. There may be courses in universities on this. It is already available in the Science classes and we touch on it in Science topics. (kemal)*
>
> *Education is not necessary for this. Giving information to people is enough. (özgül)*

Analysis of the interviews of the rest twenty-five science teachers who agree on the idea that ESD is necessary, resulted three themes (Table 4.5.).

Table 4.5. Science Teachers' views on the need for ESD: Themes and categories resulted from Content Analysis

Themes	Categories	Number of teachers
1. ESD for environment		
	The need for developing environmental consciousness	9
	The need for energy awareness	4
	The need for recycling awareness	2
2. ESD for economy		
	ESD for national economy and development	5
3. Education for everyone		
	Education for everyone	8

4.2.2.1 ESD for Environment

The first theme defined as a result of content analysis of the interviews is *"environment"*. Teachers under this theme, while defending the necessity of ESD, highlighted the need for future energy, likewise recycling awareness and a general need for environmental awareness. The three categories were defined under this theme are:

- The need for developing environmental consciousness
- The need for energy awareness
- The need for recycling awareness

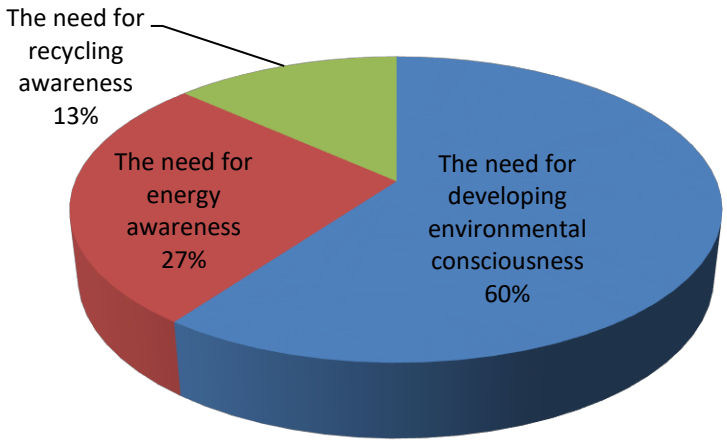

Figure 4.6. Science Teachers' views on the need for ESD: Theme 1- ESD for environment

- ***The Need for Developing Environmental Consciousness***

Nine science teachers out of 25 explained the need for ESD through the need for developing environmental awareness. As the result for this category "Consciousness-raising (Environmental awareness)" is considered. The common idea of teachers in the category is that environmental awareness is a need and that this is possible through education. Therefore, ESD is necessary to develop this awareness. Some quotes from the interviews are as follows:

> *People need to be aware of this, which is possible with education. (ufuk)*
>
> *Our people are very unconscious about it. Such an education is necessary to establish a conscious consumer society and will have an impact on the environment and the national economy in the future. (gülşirin)*

Everywhere in the world is polluted and unfortunately it is getting too late. We continue to live in the world right now and we need to be conscious for future generations to survive, for which an education is essential. (aysun)

Awareness and consciousness are very important concepts. An education on this subject matter should be provided at an early age so that an awareness can be created. (hüseyingazi)

Teachers in this category are emphasized that the importance of raising people's awareness about environmental, nature and energy. They are pointed out that it is possible to gain this consciousness only through education. It is emphasized that such education is necessary to create a conscious consumer society. It has been mentioned that the existing energy must be consciously consumed with the thinking of the future.

- ***The Need for Energy Awareness***

Three of the science teachers among twenty-five explained the need for ESD through the need for energy: their explanations were in line with the need for making the students aware of the need for energy for future. The teachers explained the need as follows:

Our energy resources are limited and the clean energy resources we use are also limited; therefore, it is necessary to know the importance and necessity of this. (seda)

It should be aimed to ensure that people use the energy they need in a way that minimizes environmental pollution. (serkan)

It is necessary to know what the energy is and how it should be used. (şahin)

Therefore, teachers in this category emphasized the necessity of the Education for Sustainable Development that the need for energy to live, the importance of energy resources and efficient use them. They think that understanding the importance of energy and consciousness in this matter can be achieved through education.

- ***The Need for Recycling Awareness***

Two of the science teachers of this study explained the need for ESD through the need for awareness for recycling. Because as they stated, knowing about the basic concepts like recycle is a key for view of the concept of sustainable development. Followings are the quotes from the teachers' interviews:

> *To begin with, students cannot understand the concept of sustainability if they do not know what materials to be recycled. If they do not have the consciousness to throw a recyclable material into the recycle bin or if they do not know what energy efficiency is, they cannot proceed to implement such behaviours. First of all, they should know what these concepts are and why they are important so that they can apply them in their own lives. (ebru)*
>
> *Recycling can be taken as a very simple matter by everyone. But only when an education regarding this is provided, people can reinforce their ideas and thoughts. (seçil)*

It may be inferred as a result that recycling is one of the concepts that is to be thought with ESD for helping students to better understand the sustainability concept. Thus, as two of the science teachers mentioned, ESD is needed to help students to understand the key concepts like "recycling" thus to help them understand sustainability.

4.2.2.2 ESD for Economy

The second theme defined as a result of content analysis of the interviews is *"ESD for economy"*.

- ***ESD for National Economy and Development***

In this category, there are five interviews. Five of the science teachers of this study explained the need and the reason for the need for ESD through the need for strengthening national economy. As the quotes given below present, their idea was that, being a conscious consumer requires to be trained to be so and a nation's economy depends strongly on how aware the young people/future citizens about sustainable consumption is. Hence the following quotes present the teachers' idea that ESD is needed for a stronger national economy and development

> *Such an education is necessary to establish a conscious consumer society and will have an impact on the environment and the national economy in the future. (gülşirin)*
>
> *It contributes to both the development of the country and its economy. All classes should be organized to include this subject. (hüseyin)*
>
> *It should be known what the development of the country means, and an education should be given about what can be done for the country on this subject matter. (istemihan)*

Therefore, teachers point for this theme is that Education for Sustainable Development is needed and important to educate individuals who will contribute to economic development of the country; generations grow through ESD will be conscious on the environment and economy relationships and it will be the country's benefit for constructing a sustainable future.

4.2.2.3 Education for Everyone

The third theme defined as a result of content analysis of the interviews is titled as *"education for everyone"*. The common point of the quotes of this theme is that, they focused on to whom ESD shall be given, instead of the context. Answers within this

theme do not contain a specific need for ESD, instead they focus on who the education should be given. Teachers under this theme drew attention to teacher education as well as student education. From this point of view, Tilbury (2011) noted the importance of initial teacher training and the need for training for the professional development of existing teachers among the changes required for ESD.

Four of the teachers mentioned that ESD shall be given especially to teachers. Some quotes from these teachers' answers are below:

> *It contributes to both the development of the country and her economy. All classes should be organized to include this subject. Firstly, teachers should internalise this issue well and pass it on to the students. (hüseyin)*
>
> *The concept of Sustainable Development and its content should be known. The education of both the teacher and the student should be attached importance to. (selin)*

Four of the science teachers however, emphasized the age ESD shall begin:

> *I believe that such education should be provided at an early age. If a child comes with a certain background, s/he can perceive these issues more easily. (gülşen)*
>
> *Education should be given to a certain age group. These children will be tomorrow's adults. The age group, which will currently not be able to receive this training, should also be considered. The public should be made aware of this issue. (merve)*

The common idea of teachers in this category is that not only students but also teachers and even families need such education**.** They emphasized the importance of educating and informing everyone about this issue.

4.2.3 Science Teachers' Views on the SD/ESD Related Aims of 2013 Turkish Science Curriculum

This section is comprised of the analysis of the teachers' answers for question 5:

"What are the aims of the 2013 Turkish Ministry of National Education Science Curriculum that coincide with the general idea of the ESD in your mind?"

In this question, the aims of the Turkish Science Curriculum are given as a list to the teachers. The question was answered by 27 Middle School Science Teachers and the answers were explained in two themes (Table 4.6).

Table 4.6 Science Teachers' views on the SD/ESD related aims of 2013 Turkish Science Curriculum

	Themes	Number of teachers
1.	All the aims of the curriculum are related with ESD and/or SD.	14
2.	Some aims of the curriculum are related with ESD and/or SD.	13

4.2.3.1 All the Aims of the Curriculum are Related to ESD and/or SD.

Fourteen of the science teachers of this study stated that all of the aims of the 2013 Turkish Ministry of National Education Science Curriculum could be related to the concept of sustainable development. Rest of the teachers however, stated several specific aims which were related to the general idea of the ESD and the concept of sustainable development.

4.2.3.2 Some Aims of the Curriculum are Related to ESD and/or SD.

According to the science teachers of this study, among the 12 aims of the Turkish Science Curriculum (Table 4.8.) followings are the ones that are related to the definition of ESD and/or SD.

Table 4.7. Science Teachers' views on the aims of the 2013 Turkish Science Curriculum that coincide with the general idea of the ESD /SD

The aim in the 2013 Turkish Ministry of National Education Science Curriculum	Number of teachers who agrees that the aim is related to ESD/SD
1. To gain basic knowledge about Biology, Physics, Chemistry, Earth, Sky and Environmental Sciences, Health and Natural Disasters.	8
2. In the process of discovering nature and understanding the relationship between human and environment, produce solutions to the problems encountered by adopting scientific process skills and scientific research approach.	11
3. To raise awareness of how science affects society and technology, and how society and technology affect science.	3
4. To realize the interaction between individual, environment and society and to develop awareness of sustainable development related to society, economy and natural resources.	11
5. To develop career awareness about science.	1

Table 4.7. (continued)

6. To take responsibility for daily life problems and to use knowledge, scientific process skills and other life skills to solve these problems.	9
7. To help to understand how scientific knowledge is created by scientists, and help to understand the processes in which this information is generated and how it is used in new research.	**0**
8. To contribute to understanding that science is produced as a result of joint efforts of scientists from all cultures and to develop a sense of appreciation of scientific studies.	**3**
9. To appreciate the contribution of science to the development of technology, the solution of social problems and the understanding of relationships in the natural environment.	11
10. To develop curiosity, attitudes and interest on the natural events.	8
11. To realize the importance of security in scientific studies and contribute to the implementation of security.	0
12. To develop scientific thinking habits by using socio-scientific subjects.	5

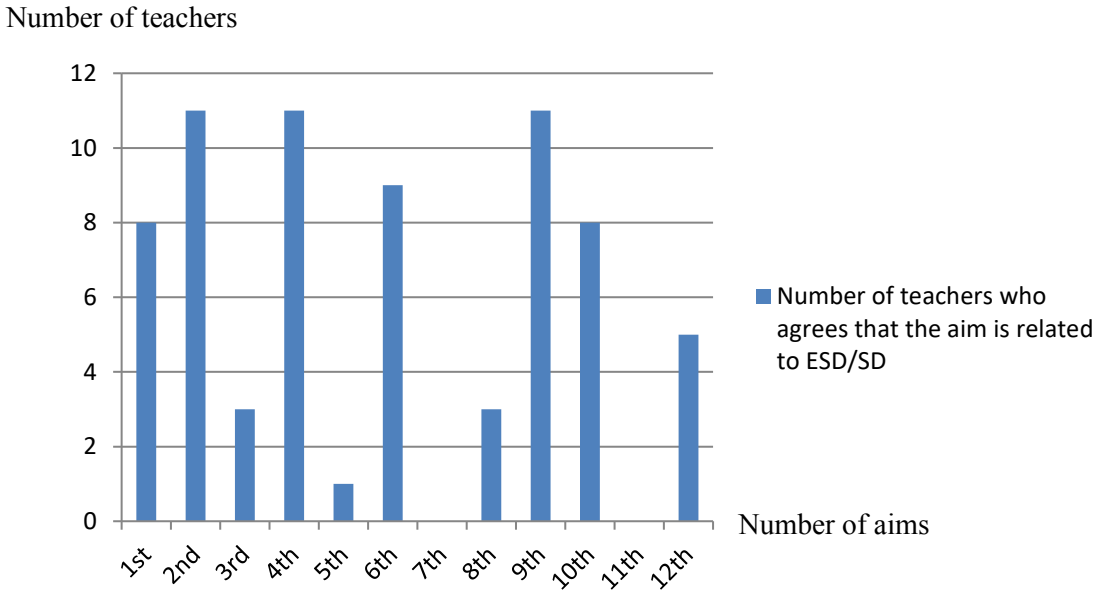

Figure 4.7. Number of teachers who agrees that the aim is related to ESD/SD

Teachers who stated that there are specific aims that coincide with those of ESD and/or SD have never mentioned about 7th and 11th aims of science curriculum. Aims nembered 2, 4and 11, on the other hand, were the ones mentioned most frequently.

Eleven science teachers stated that sustainable development is related to the 2nd aim: *" In the process of discovering nature and understanding the relationship between human and environment, produce solutions to the problems encountered by adopting scientific process skills and scientific research approach."*

Furthermore, another 11 teachers stated that sustainable development is also related to the 4th aim: *" To realize the interaction between individual, environment and society and to develop awareness of sustainable development related to society, economy and natural resources."*

Another 11 teachers stated that, sustainable development is related to the 9th aim:" *To appreciate the contribution of science to the development of technology, the*

solution of social problems and the understanding of relationships in the natural environment."

As it is presented in Table 4.7. above, 5th aim of the 2013 Turkish science curriculum *("To develop career awareness about science.")* was seemed as the least mentioned one; as was mentioned by only one teacher.

4.2.4 Science Teachers' Suggestions to Improve ESD

This section comprises analysis of the answers for the Question 6; that is Science teachers'suggestions to improve ESD have been evaluated through the answers given to the interview question 6: How will the concept of Sustainable Development be more useful in the context of the middle school science curriculum?

The results of the content analysis of the teachers' answers for question 6 revealed four themes and eight categories (Table 4.8.).

The first theme resulted from the content analysis is defined as "ESD as an applied course". The idea for this theme is that, the teachers suggested a practical (outdoor) course to raise the impact of ESD. Three categories were found under this theme are defined as; trips and observations, projects and school backyards.

The second theme is about the position ESD shall be placed in the curriculum. The categories for the theme, however, are defined as ESD as interdisciplinary course and ESD as an elective course.

The third theme is arosed as related to teacher education. The related categories, on the other hand, are about college education and in-service education.

The last theme for the answers for question 6 is defined as policy with a category public awareness.

The most favorite category of the above-mentioned ones, however, is related to the position of ESD in the curriculum; “ESD as an interdisciplinary course” (Table 4.8.).

Table 4.8. Themes and categories about science teachers’suggestions to improve ESD

Themes	Categories	Number of teachers
1. ESD as an applied course		
	Trips and observations	7
	Projects	5
	Backyard as a study area	2
2. The position of ESD in curriculum		
	Interdisciplinary	8
	An elective/environmental course	4
3. Teacher' education		
	College education	2
	In-service education	3
4. ESD policy		
	Raising public awareness	5

4.2.4.1 ESD as an Applied Course

The first theme defined as a result of content analysis of the interviews is *"an applied course"* and, three categories were defined under this theme are:

- Trips and observations
- Projects
- School backyard as a study area

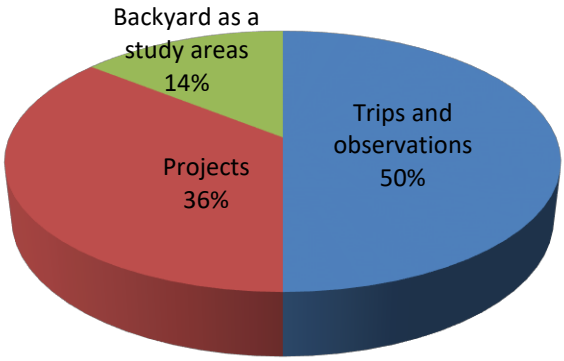

Figure 4.8. Science teachers'suggestions for improving ESD for Theme 1: ESD as an applied course

- ***Trips and Observations***

When interviews with teachers are taken into account, this category includes 7 teachers. Teachers in this category think that it is useful to make trips and observations in order to make the subject concrete. They are pointed out that a more effective and permanent education can be achieved in this way. Some quotes from the interviews' answers are as follows:

> *Children think these issues very abstract. If trips are organised to places where energy is produced, they can understand better how important energy is for our lives. It should be concretised more. (ceylan)*
>
> *I think it can be supported very well by the trips. These issues remain very abstract. Even at the 8th grade, I can say that the students could not imagine them. (ebru)*
>
> *We always think that the teachers solely have a duty on this subject matter. there are some projects which schools are obliged to conduct; specific trips can be planned and every school can do this. For example, while the subject*

of animals is being studied, I should be able to take students to the zoo; they should be able to learn by seeing and traveling. Such learning becomes more permanent. It is a very nice activity to take the students to the Mamak garbage dump for the subject of recycling. (kemal)

- ***Projects***

Five of the science teachers of this study explained the improving effectiveness of ESD through the making practical projects. Teachers in this category believe that students will be actively involved in projects to increase their awareness in a better way. They think that the course will be more practical and make the students more active and the information will be more permanent. As the result for this category "Projects" is considered, some quotes from the interviews are as follows:

I can say that the projects rise the students' awareness. For example, we have a project this year. We will collect at homes our items that are usable and distribute them to needy people. We will do this as an entire school, thus creating a general consciousness. (gülşirin)

Students can be assigned to various projects related to these subjects. There should be practical education in a way the actions count, not the words. (hüseyin)

Sustainable development education should be taken out of school. In the first place, it should be given importance to the project designs in which the students actively support development by supporting recycling starting firstly with saving at home. (serkan)

It may be inferred as a result of quotations, making projects about ESD is one of the concepts that is improved the effectiveness of ESD. For this reason, as five of the science teachers mentioned, projects related to ESD in the school will help students to better understand the ESD concept.

- ***School Backyard as a Study Area***

According to Tilbury (2011), it is very useful opportunity to have practical learning that invites students to participate in sustainable development and to respond to real-life conditions. There are two teachers in this category. As the result of this category "school backyard as a study area" is taken into account, the quotes from the interviews are as follows:

> *Schools should be environments with more green spaces rather than being in the form of jails. Our schools are not suitable for this situation. Children can be made to build boutique gardens. Solar panels can be installed at schools with the help of the government so that the children can see how the energy is obtained. Trees must be planted. For example, the student may eat the apple of the apple tree s/he has planted in the 5th grade when s/he visit his/her school after years. (ayşe)*
>
> *There must be an application. At the very least, the student should know how to plant a tree and what its contribution is to the nature. There may be hobby gardens at schools. (istemihan)*

Teachers in this category draw attention to there must be an area in the school where EDS objectives can be applied; it could be a hobby garden where students can plant in the trees.

4.2.4.2 The Position of ESD in Turkish Science Curriculum

The second theme defined as a result of content analysis of the interviews is *"the position of ESD in curriculum"* and, two categories were defined under this theme are:

- Interdisciplinary
- An elective/environmental course

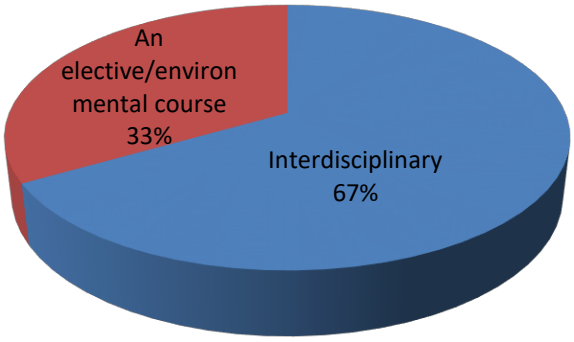

Figure 4.9. Science teachers'suggestions for improving ESD for Theme 2: The position of ESD in curriculum

- ***Interdisciplinary***

There are eight science teachers in this category. According to teachers' views, ESD is not a concept that is concerned only with science education. It should be handled interdisciplinary because it is a concept that should be in other courses' context as well as in science education. Thus, students can be given more effective awareness. As the result for this category "Interdisciplinary" is considered some quotes from the interviews are as follows:

> *This subject is also related to the Social Studies class, and as far as I can see, it is more related to it than the Science class. It can also be given in classes other than science. (ebru)*
>
> *I think the subject of environment is an interdisciplinary phenomenon. It should definitely be associated with other classes. It is not only a subject that should be dealt with in the Science class, but also in Mathematics, Social Studies and Art. Thus, it becomes more permanent. (seçil)*
>
> *If it is dealt with all the units and other classes in a structured way, and if a joint action taken, the children's awareness can be raised. While a Social Studies teacher talks about mines and minerals, a Science teacher can talk about recycling, energy sources, fossil fuels, and a Mathematics teacher can*

solve problems dealing with these issues. In this way, the child gains awareness. (şahin)

- ***An Elective/Environmental Course***

There are four science teachers in this category. Science teachers stated that, aims of the science course in the Turkish Science Curriculum are related to SD and ESD. However, the science curriculum was already very intensive. Teachers in this category are stated that there may be an extra lesson to be addressed in ESD a broader way apart from science lesson. As the result for this category "An elective / environmental course" is taken into account, some quotes from the interviews are as follows:

There are various non-governmental organizations related to the environment. Schools should be members of them and participate in their works and activities. Various people from such organizations may give education at schools. Children should be assigned tasks on these issues. There should be a separate environmental class where all such can be accomplished. (ayten)

It should be taught not only in a Science class but as a separate and applied environmental course. The child should practice. We cannot raise every child's awareness of sustainability within four walls. (özlem)

4.2.4.3 Teachers' Education

The third theme defined as a result of content analysis of the interviews is "Teachers' education". Tilbury (2011) noted the importance of initial teacher training and the need for training for the professional development of existing teachers among the changes required for ESD. The categories were defined under this theme are:

- College education
- In-service education

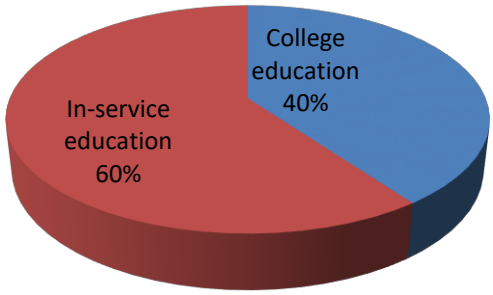

Figure 4.10. Science teachers'suggestions for improving ESD for Theme 3: Teacher education

- ***College Education***

In this category, there are two science teachers. Teachers in this category have touched upon the importance of Education for Sustainable Development in teachers' university education. The subject that makes teachers think in this category is that, whether the teachers who can easily reach the students and inform them about SD have sufficient information about this subject. The quotes from the interviews are as follows:

> *Social environment and family education are also important. However, more emphasis should be placed on the education of teachers who can reach students more easily. (ismet)*
>
> *I may be considered as a new graduate. I studied environmental education at the university, and I was wondering if those having become teachers before me had any education on this subject. We have a lot of fellow teachers who are working as Science teachers although they are not actually Science teachers. There are teachers who are graduates of Chemistry and even Engineering. I doubt their knowledge. That's why I think teacher education is important. (selin)*

- ***In-service Education***

There are three teachers in this category. Teachers in this category have drawn attention to working teachers' knowledge about ESD. So, they have stated that teachers should be given in-service education on this topic in order to improve effectiveness of ESD. As the result for this category "in-service ecuation" is considered quotes from the interviews are as follows:

> *When I observe the other teachers, I do not think that even they are very conscious about these issues. MEB (The Ministry of National Education) should organize educations for teachers in all branches with the help of universities.* (özlem)
>
> *Seminars may be organized for teachers to gain knowledge about the subject matter. Teachers are not conscious about it. This applies to teachers in all branches. (sevil)*
>
> *Seminars should be organized for the teachers. It would be even better if such seminars were organised for all people. I think public service announcements are effective, and they should be shown more often and more. (ufuk)*

4.2.4.4 ESD Policy

As a result of the content analysis of the interviews, the core of the Theme 4 is defined as *"policy"*. As Tilbury (2011) states that, ESD should be handled not only in educational programs but also by related institutions and organizations that will facilitate these learning processes. One category was defined under this theme is "Raising public awareness."

- ***Raising Public Awareness***

In this category, there are five science teachers. Teachers in this category have mentioned that the state must be reached to the public by carrying out various studies. It is stated that the awareness of the public on this issue will enhance the effectiveness of this education. As the result for this category "Raising public awareness" is considered some quotes from the interviews are as follows:

> *I don't think that the education provided at school alone is enough. It should not be limited to students and teachers but should be accessed by the public through various social works and seminars to be organised on this subject by the state. (banu)*
>
> *This education should indeed be a state policy. Ministries and municipalities should work on this issue to raise people's awareness. (gülşirin)*

4.2.5 Science Teachers' Practice of ESD

This section is set by the results of the content analysis of the teachers' answers for question 7. There are four themes and seven categories resulted from the analysis as in the Table 4.9.

The first theme of question 7 is about visualization and under this theme it is mentioned about using technology and organizing trips as categories of theme. In the second theme of this question concretizing of ESD with real lifeis considered as the theme. The categories under this theme are about being a modal as a teacher, giving stories from real life and giving roles to students about issues. In the third theme, it is mentioned about the category of attending of projects and campaign under the theme of project. The last theme is Investigate and make inferences and under this theme there is a category that is mentioned about finding a solution about ESD issues.

According to the results of content analysis, most of science teachers make a point to the category of using technology under the theme of visualization.

Question 7 of the interview schedule: How do you implement the Education for Sustainable Development content of the 2013 Turkish Middle School Science Curriculum?

Table 4.9. Science teachers' practice on ESD

Themes	Categories	Number of teachers
1. Visualization		
	Using technology	18
	Organizing trips	8
2. Stimulating with real life examples		
	Teacher as a model	3
	Stories from real life	13
	Giving roles	1
3. Projects		
	Participating projects and campaigns	4
4. Investigate and make inferences		
	Propose a solution	4

4.2.5.1 Visualization

The first theme defined as a result of content analysis of the interviews is *"visualization"*. Science teachers in this study stated that the use of video and visual materials is thought-provoking and memorable when dealing with issues such as

global warming, water pollution, acid rain etc. In addition, they stated that organizing related trips on the subject is memorable. Tilbury (2011) stated this process as "Stimulus activities" as pedagogical strategies of ESD. Two categories were defined under this theme are:

- Using technology
- Organizing trips

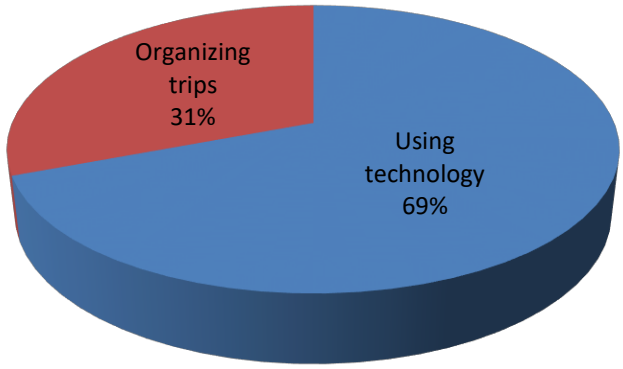

Figure 4.11. Visualization

- ***Using Technology***

When interviews with science teachers are taken into account, this category includes 18 teachers. Teachers in this category are emphasized that while handling context of sustainable development in science classes supporting the issue visuals and videos by using technology is more understandable and memorable for students. As the result for this category "using technology" is considered, some quotes from interviews are as follows:

> *I use the smart board effectively (for visuals and videos). Visuals ensure permanent learning. (ayten)*

I use the videos and visuals on the smart board rather than making verbal presentation. I can't take my students to trips. But these videos change the perspective of some students, they listen to the lesson better and they can put what they see into practice in real life. I think it is useful for some students. (ceylan)

We have to use technology. We reinforce the subjects more with images and videos, which ensures memorability. If I present verbally how the water in a dam is transformed into energy, the student may not understand or imagine, but when I support it with a video, s/he can understand and diversify his/her dreams. (kemal)

- ***Organizing Trips***

This category has eight science teachers. Teachers in this category emphasized that the handling of these topics visualizing by trips creates a greater awareness among students. As the result of this category "organizing trips" is taken into account, some quotes from the interviews' answers are as follows:

Every year, I take students to AFAD (Disaster and Emergency Management Presidency) and MTA (General Directorate of the Mineral Research and Exploration). At AFAD, natural disasters are described in an apprehensible way by means of slides and models suitable for the age group. In the MTA, the students gain knowledge about fossils and renewable energy sources by seeing them. As I said, I think these issues can be well supported with visual resources and trips. (ebru)

I took the students to the Mamak garbage dump, I think it's helpful to take them to the recycling facilities. Visiting and seeing will be more beneficial for them. (gülşirin)

I organized trips to the Natural History Museum and the Energy Museum. When we take the students there, they pay attention to saving electricity and water at home and school as soon as they begin to understand what energy is produced how and what it does. If even one student gains this awareness, and if even one unnecessary light in his/her house is turned off, a huge amount of energy is provided. (şahin)

4.2.5.2 Stimulating with Real Life Examples

The second theme defined as a result of content analysis of the interviews is *"Stimulating with real life examples"* and, three categories were defined under this theme are:

- Role model
- Stories from real life
- Giving role

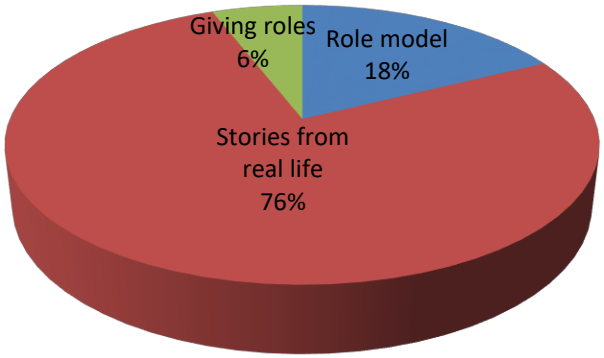

Figure 4.12. Stimulating with real life examples

- ***Role Model***

There are three science teachers in this category. Teachers in this category give examples for their individual activities for sustainable development in everyday life. They stated that they should be a model to the students and that this creates an awareness to students for a sustainable life. As the result for this category "Role model" is considered, some quotes from the interviews are as follows:

> *First of all, the teacher should be a role model for the students. I try to raise the students' awareness telling them what I do for recycling at home. I tell them that we do not pour the oil into the sink, and that the oil can be left at*

the collection points. I say that its purification from water is a costly and long process. (gülşirin)

For example, in the classes I teach, I turn off the lights that are on when there is daylight and mention global warming and energy use. The students are aware of this and when I enter the classroom, they are running and turning them off themselves. I think I've raised their awareness. (özlem)

- ***Stories from Real Life***

There are thirteen science teachers in this category. Science teachers in this category stated that while handling sustainable development topics in science classes, they give examples from everyday life. They are indicated that it is more effective for gaining awareness with present stories from real life by given concrete examples from the student's life. As the result for this category "Stories from real life" is taken into account, some quotes from the interviews are as follows:

I handle it giving examples from everyday life. We are aware that it does not rain or snow and the seasons change. The children need to be led using the facts of life, so examples from daily life are important. We always talk about keeping our living spaces clean. (istemihan)

I try to get the students to talk about these issues. While giving examples they see, they enjoy the lesson more because they attend the lesson. I try to have them give examples from their real life. I always say that not everyone has to understand physics, chemistry and mathematics; but I explain by giving examples from everyday life that everyone has to respect the environment they live in and leave the environment as clean as possible to the next generations. (selin)

I give examples from Turkey and the world. I begin the class by giving examples of world wars as I am doing the warm-up about the subject of energy. I want them to think about geography and underground wealth. (şahin)

- ***Giving Roles***

In this category, there is only one science teachers. Teacher in this category stated that handling sustainable development topics by giving role an awareness environment is being created by approaching the issue from a different point of view. Tilbury (2011), stated this process as “Role-plays and simulations” as a pedagogical strategy in learning processes aligned with ESD. As the result for this category "Giving roles" is considered, the quote from the teacher is as follows:

> *I give roles to the students regarding the issues such as energy conservation and we deal with it from different perspectives, which I think also raises awareness effectively. (seda)*

4.2.5.3 Projects

The third theme defined as a result of content analysis of the interviews is *"projects"* and the category defined under this theme is “Participating projects and campaigns”.

- ***Participating Projects and Campaigns***

In this category, there are four science teachers. In this category, teachers have indicated that including projects and campaigns attract students’ attention. When students actively take part in the work, the subject becomes more understandable. As the result for this category "Participating projects and campaigns" is considered, some quotes from the interviews are as follows:

> *We participated in the Water Explorers project. Within the scope of the project, we investigated how much water is used to make a hamburger. Such projects are more useful for attracting students' attention. (gonca)*

For recycling purposes, we ask students to bring their previous school books and notebooks to school at the end of the year. We receive and send them for recycling. Besides, we organize campaigns for planting seedlings, collecting waste batteries and blue caps under a community service activity. The event becomes more effective when students get involved. (selin)

We had a battery collection campaign and it was more effective for children when we give an award for it. (ufuk)

4.2.5.4 Investigate and Make Inferences

As a result of the content analysis of the interviews, the core of the Theme 4 is defined as *"investigate and make inferences"* and one category were defined under this theme is "Propose a solution".

- ***Propose a Solution***

In this category, there are four science teachers. Teachers in this category have emphasized that researching on a problem about sustainable development topics and presenting a solution proposal is more effective way to giving an awareness. In this way, they are thinking about the subject and making inferences. With Tilbury's (2011) list of learning strategies, the method used by teachers of this study may be defined as case studies. As the result for this category "propose a solution" is considered, some quotes from the interviews are as follows:

I give a problem about the environment to students; I want them to do research about it and offer solutions. I refer to the problems of daily life in Turkey and the world. (seçil)

Especially dealing with the environmental problems and interesting issues from real life, I ask the students what they can do about such problems. I think that thinking and making inferences have a positive-effects on the students. Thinking about the solutions for such problems and the measures to

be taken will enable the students to act more responsibly for the environment. (serkan)

As the results of this study revealed, science teachers' suggestions and practices for effective ESD is as follows:

Table 4.10 Science teachers' suggestions and practices on ESD

Suggestions	Practices
Trips and observations	Using technology
Projects	Organizing trips
Backyard as a study area	Teacher as a modal
Interdisciplinary	Stories from real life
An elective / environmental course	Giving roles
Collage education	Participating projects and campaigns
In-service education	Propose a solution
Raising public awareness	

The results of this thesis revealed that the suggestions made by the science teachers for strengthening ESD coincide with those of their practice. For example, they have suggested that trips and observations will be effective while learning issues that they think are related to Sustainable Development (e.g. recycling). Besides, while discussing the issues related to sustainable development in their lessons, eight out of twenty-seven teachers stated that they organized trips if the conditions of the school and time were appropriate. Another topic that teachers said they were implementing in the scope of ESD was the projects. They stated that they participated in some recycling projects such as waste batteries and waste oil collection, and since the students actively participated in these projects, they observed that the projects were effective in raising awareness for the students. Although, they stated that they participated in the projects with their students, they have suggested that the projects

shall be used frequently and that they should cooperate with the municipalities and thus the education for sustainable development should be taken out of the school.

4.3 Summary

4.3.1 Turkish Science Teachers' Views on SD

Science teachers of this study described SD as national economy and efficient use of economy, human and environment and a cyclic nature of nature and continuity pillar. They conceive SD mostly as comprising national economy pillar. In the economy and environment pillars, there are teachers who will be defined as young, middle-aged and elderly in terms of age range. However, teachers in the cyclic nature of nature and continuity will be defined as middle aged teachers in this study.

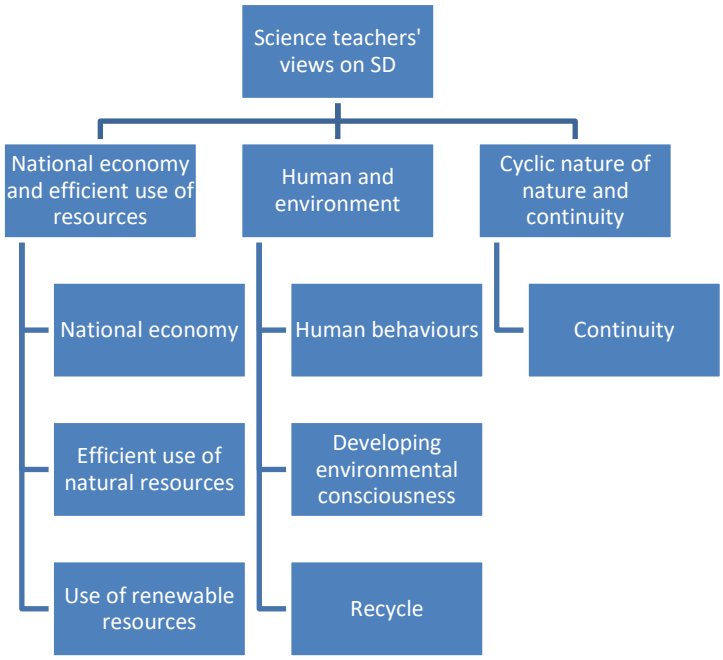

Figure 4.13. Science teachers' views on SD

4.3.2 Turkish Science Teachers' Views on ESD

Science teachers of this study defined ESD as environmental, economic and policy pillar. These science teachers conceived ESD mostly as comprising environmental pillar. In the economy and environment pillars, there are teachers who will be defined as young, middle-aged and elderly in terms of age range. Teachers in the policy pillar will be defined as middle aged teachers in this study.

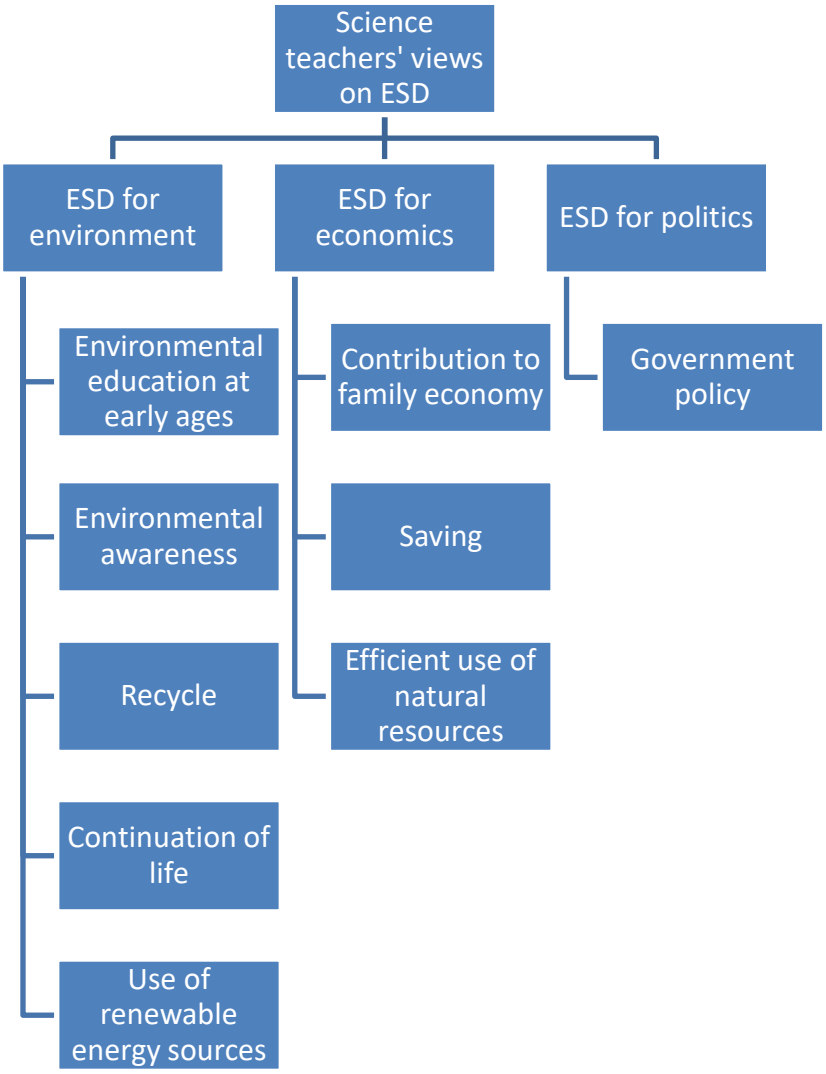

Figure 4.14. Science teachers' views on ESD

4.3.3 Turkish Science Teachers' Views on Necessity of ESD

Science teachers of this study defined the necessity ESD as environmental, national economy and development and education for everyone. These science teachers conceived necessity of ESD mostly as comprising environmental pillar. In the environment pillars, there are teachers who will be defined as young, middle-aged in terms of age range. Teachers in national and economy pillar will be defined as middle aged and elderly teachers. Teachers from all age group mentioned education for everyone pillar.

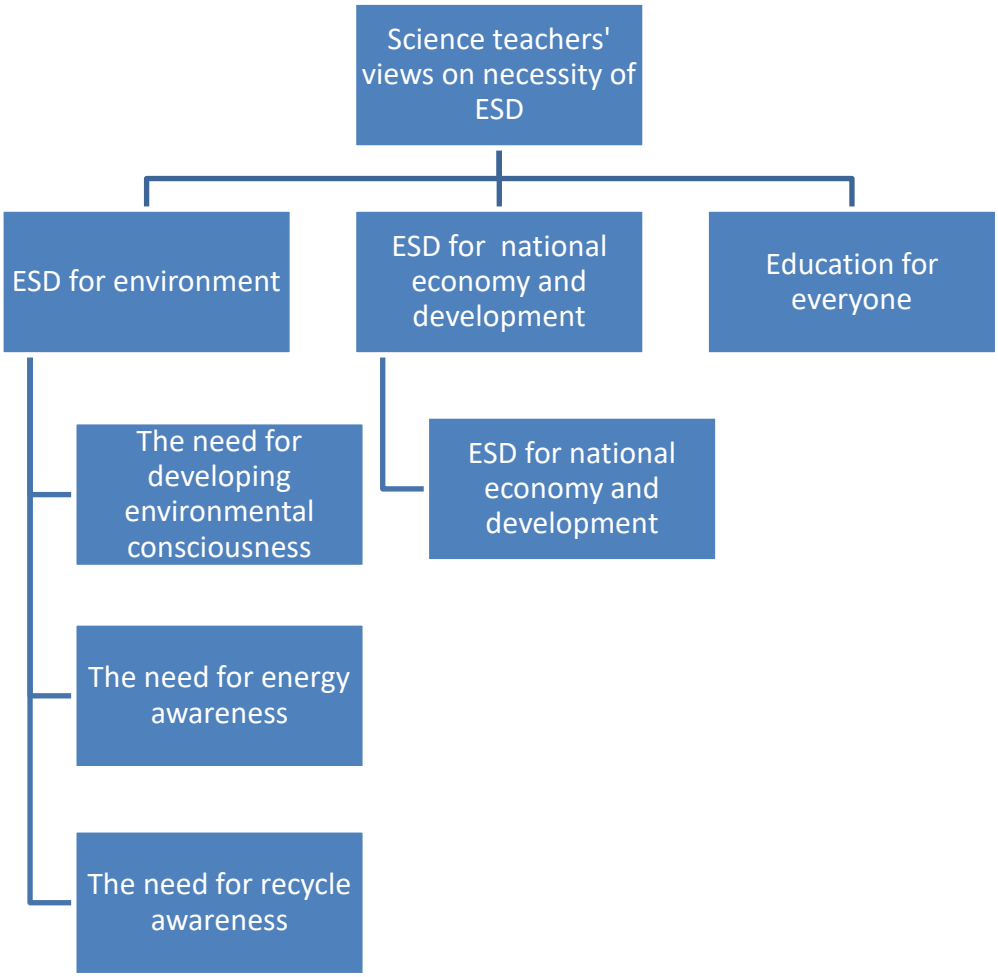

Figure 4.15. Science teachers' views on necessity of ESD

4.3.4 Turkish Science Teachers' Views on ESD in Turkish Middle School Science Curriculum

In this section of study, 14 Middle School Science Teachers were stated that all the aims of the curriculum are related with ESD and/or SD and 13 Middle School Science Teachers were stated not all, but some aims of the curriculum are related with ESD and/or SD. Teachers from all age group agree on the idea that the objectives of the science program are related to sustainable development.

According to this study, the science education's aims which science teachers think were most related to sustainable development are 2, 4 and 9th aims.

The 2nd aim: In the process of discovering nature and understanding the relationship between human and environment, produce solutions to the problems encountered by adopting scientific process skills and scientific research approach.

The 4th aim: To realize the interaction between individual, environment and society and to develop awareness of sustainable development related to society, economy and natural resources.

The 9th aim: To appreciate the contribution of science to the development of technology, the solution of social problems and the understanding of relationships in the natural environment.

The aim which was considered to be least related to sustainable development was the 5th aim. (*"To develop career awareness about science")*

4.3.5 Turkish Science Teachers' Suggestions to Improve Effectiveness of ESD

Science teachers of this study described the suggestions to improve effectiveness of ESD under the four themes: ESD as an applied course, The position of ESD in

curriculum, Teacher education, ESD policy. They conceive their suggestions about improving the effectiveness of ESD mostly under the theme ESD as an applied course. After this theme which teachers from all age groups take part, the most teachers are listed under the theme of the position of ESD in curriculum. When we examine the teachers in this part, we can see that there were teachers from all age groups, but mostly young and middle-aged teachers were there.

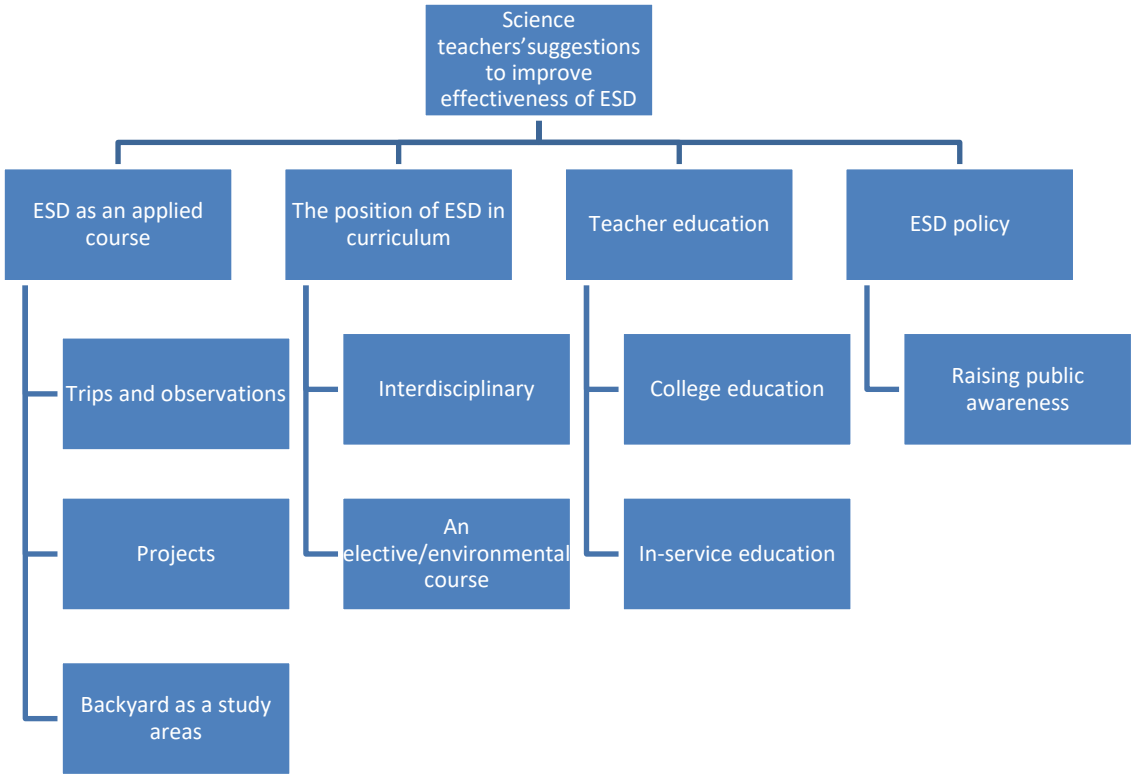

Figure 4.16. Science teachers' suggestions to improve effectiveness of ESD

4.3.6 Turkish Science Teachers' Practice of ESD

Science teachers of this study grouped the practice of ESD as, mental image, stimulating with real life examples, projects, investigate and make inferences. These

science teachers mostly adressed the mental image as practice of ESD. In this pillar, there are teachers who will be defined mostly as young in terms of age range. In "stimulating with real life examples" theme, it can be said that there are mostly middle age and older teachers. In practice of ESD teachers who mentioned "projects" have a wide age range. Teachers who mentioned "investigate and make inferences" were a young age group teacher.

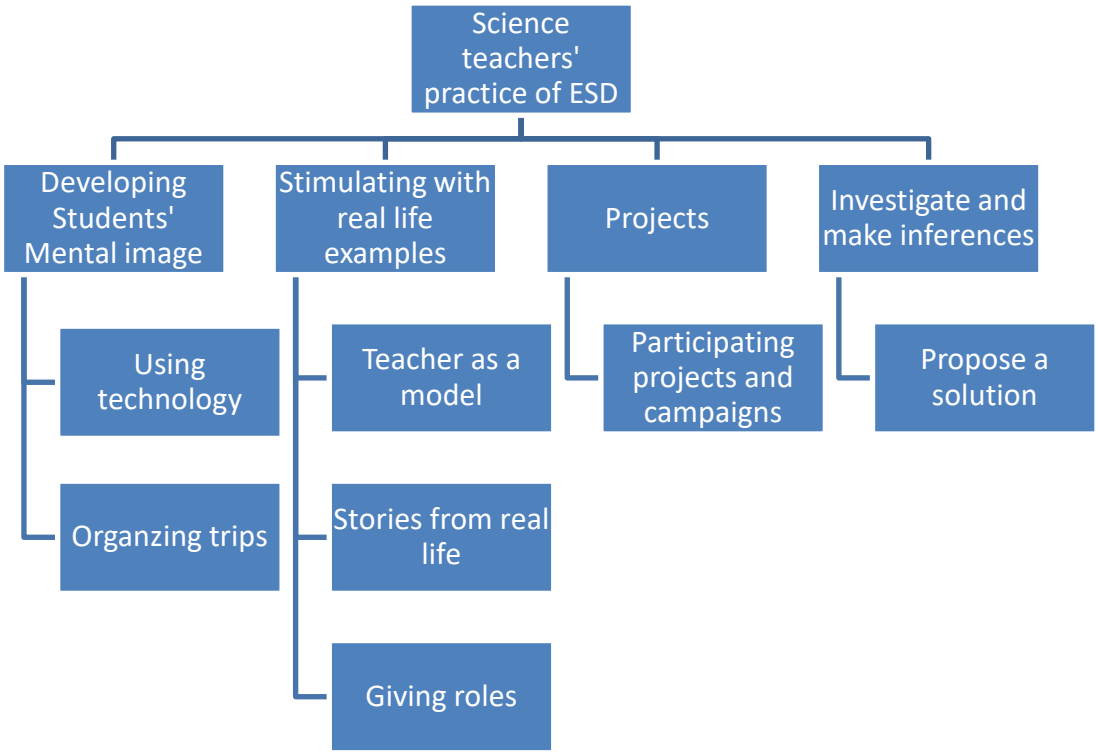

Figure 4.17. Science teachers' practice of ESD

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Summary of the Study

Education for Sustainable Development is an undeniable need of the 21st century. As is emphasized in Agenda 21, teachers are the most important agents to spread the concept. Science curriculum however, as it contains basics of environmental issues, is one of the ways to transfer ESD to the future generations. In this case, how the concept of Education for Sustainable Development in Science Curriculum is understood and handled by science teachers and their views about SD becomes important.

As far as the research related to this subject considered, it has been reported that, teachers' views on SD and ESD have been developed since 1990s. In 1990s for example, Cross (1998) investigated teachers' views on the concept of SD. The definition of teachers about SD, the effect of SD on our lifestyle and the effect of SD on teachers have begun to be investigated. Cross (1998) concluded that teachers are willing to address this issue in their lessons and contribute to the community. However, it is stated they have a superficial knowledge about the concept of sustainable development and, they have no idea how to handle the concept. On the other hand, in a study in, 2018, conducted to understand teachers' views of ESD and teaching practices, teachers generally defined ESD as acquiring knowledge about the environment in order to use resources in a sustainable way, taking into consideration future generations. Teachers in the research stated that ESD should be included in the primary school curriculum as well as the secondary school curriculum. When the teachers' suggestions were taken into consideration, it was stated that ESD should be

applied as an independent subject in order to discuss SD more deeply and also it should be considered interdisciplinary (Anyolo, et al., 2018).

The present study was conducted to learn the views of science teachers about sustainable development and education for sustainable development, how they apply these concepts in their own lessons and science teachers' views for a more effective ESD in science lessons. Today, every society aims to educate new generations with the attitudes, behaviors, knowledge and skills necessary for the protection of nature and the world for a sustainable life. This is also possible with education for sustainable development. Education for sustainable development is not only a matter to be learned or taught, it is necessary and important to turn it into action. In this case, for the students to adopt these concepts, an action plan needs to be formulated within a certain framework. There are sustainable development objectives in the Turkish Middle School Science Education Curriculum. However, teachers' views about this subject and their background are important. The aim of this research is to determine how the sustainable development objectives in the curriculum are perceived and handled by science teachers. The data collection process of the study was carried out through semi-structured interviews with twenty-seven middle school science teachers by using the questionnaire, comprised of seven open-ended questions, titled "Survey of Science Teachers' Views on Sustainable Development and Education for Sustainable Development". The questions were designed to reveal the teachers' views, ideas and how they deal with the concept of sustainable development in the science curriculum. The sample of this study consisted of twenty-seven science teachers in 4 randomly selected middle schools in Mamak district of Ankara.

The results of the thesis showed that, although they self-evaluated their knowledge about SD and ESD as “medium”, Turkish science teachers’ answers were evaluated as upper than their definition. The discussion part below, therefore, presents this feature of the science teachers, as well as their views on SD, ESD and aims of the science curriculum.

5.2 Discussion

In this part of the thesis, teachers' views about SD, ESD and need for ESD, and their suggestions and practices about ESD are discussed.

5.2.1 Self-evaluation of on Sustainable Development

Self-evaluation can help realize the areas that are needed to pursue in terms of professional development, rather than just following the local professional development train. Although sustainable development concept has been launched as one of the main topics in the Turkish middle school science curriculum, there is no such revision made for the teacher education programs. Therefore, it is assumed that science teachers in Turkey have been supporting themselves for sustainable development by several means other than regular teacher education programs. However, how they feel about their level on the concept is an important question to be answered. Because, self-assessment is notably very important in enhancing students' learning. Therefore, referring to Klenowski's (1995) definition of self-assessment; "the evaluation or judgment of 'the worth' of one's performance and the identification of one's strengths and weaknesses with a view to improving one's learning outcomes", science teachers were asked in this thesis to evaluate themselves on the concept of sustainable development. As was expressed in the 4th Chapter of this thesis, most of the science teachers of this study expressed their knowledge on SD as "medium" and none of the them expressed their knowledge on SD as "very good". The possible reason for science teachers describing their knowledge on SD as "medium" may be explained through the conclusions made by Evans et all. (2012) and Burmeister & Eilks (2013). According to the authors inadequacy of the courses at the university is a possible cause for teachers feeling their knowledge as insufficient. In their study Summer and Childs (2007) did not find it surprising that teachers' self-assessment scores for sustainable development were low. They

suggested that ESD could be regarded as the only tool for student teachers to help produce a broader view on the issue.

5.2.2 Views on SD and ESD

As the results of this thesis imply, the major feature of Turkish science teachers' views on SD is that, they define the concept through family and the national economy and environmental pillars. What makes this result different then the results conducted so far is that, teachers' definition on SD was mainly focused on environment in the late 1990s and early 2000s, whereas the content developed as containing economy at studies in the last few years. For example, Cross (1998) stated that teachers had only superficial knowledge about SD. Similarly, Gayford (2002) stated that this issue has not yet entered the expertise of teachers. Summers & Childs' study with student teachers in 2007 states that teachers mentioned more about the environmental pillar of SD. In 2012, it was stated that teachers only look at ESD from a one-dimension and that it was again the environmental pillar (Evans et all., 2012). In the study by Borg et al. (2013), among the perceptions of teachers, the most uncertain aspect of sustainable development is the economy. Unlike the related literature, the SD definition of the science teachers of this study was mainly through family and national economy.

When views of teachers belong to other disciplines has been examined it has been found that, teachers' views from different disciplines may vary. For example, in a study conducted in Sweden in 2014, while science teachers addressed the environmental dimension of SD, social science teachers addressed the social dimension of the concept. However, economic dimension was not addressed at all (Borg et all., 2014). The teachers of the current study, on the other hand, did not mention the social dimension while described their views through environment and economy and the majority of them interpreted SD as efficient use of natural resources, the use of renewable energy resources and recycling. Turkish literature

related to teachers' views on SD however, states that, science teachers in Turkey do not encounter with the concept (SD) during their undergraduate education within the must environmental science course, other than they most probably do not encounter with the concept. Therefore, the majority of student science teachers define SD in terms of the environment. (Kilinc & Aydin, 2013).

Science teachers of this study explained their views on ESD through three themes as related to the three pillars of SD: environment, economy and politics. When they were asked about their views on ESD, more than half of them answered the question through environmental pillar. This result may be attributed to the conclusion that, their views have been shaped by environmental education. That is to say, although they described SD through economy and environment, their views on ESD have been limited to the content of environmental education. While defining ESD, the majority of teachers pointed to environmental awareness, recycling and the using of renewable energy sources. Minority of them however, emphasized that ESD should be given beginning from early-ages, supporting the conclusion made by Gothenburg Environment Center (2010) that, children's early learning affects the early formation of attitudes and interest. One of the teachers participating in the present study, stated that the students take ESD course beginning from kindergarten so as to be aware of sustainable use of natural resources stating that, even learning to plant a tree will contribute to attitudes and behaviors towards the environment. Moreover, it was also emphasized that young teachers should acquire this awareness at an early age.

Another finding that draws attention in the present study was that, teachers stated that ESD should first become as governmental policy; moreover, not only teachers but also other professional groups should be informed about this issue.

Therefore, the results obtained from this thesis related to science teachers' views on SD and ESD are different in positive way in terms of both time and content. That is to say, when compared to the related literature in the early 2000s, views of science teachers on SD have been developed to include economic pillar of the concept, whereas their views on ESD is still narrow as including environmental pillar only.

5.2.3 Views on the Need for ESD

In the current study, when teachers were asked whether ESD is necessary, all of them except two, stated that ESD is necessary. The ones who disagreed stated that, awareness raising could be possible without an ESD course. On the other hand, teachers who think ESD is necessary have described the content in terms of environment in most of the cases. They explained the reason for the need for an ESD course has been explained through the future needs; as for example the need for energy in the future.

In addition, a group of teachers who participated in the study described the need for ESD in terms of the need for both teacher and student education, emphasizing that ESD should be given to individuals of all ages. This opinion of the teachers of this study has also been reported by Spiropoulou, Antonakaki, Kontaxaki & Bouras (2007). The authors emphasized that educators need to know the goals and principles set by UNESCO for ESD to make sustainable development a reality. With the intention of achieve this goal, it was recommended to reorganize nationally and internationally university education for teachers which has an active role in education for sustainable development. Similarly, according to Spiropoulou et all., (2007) there is a strong need to strengthen knowledge, research and cooperation at all levels of education related to SD and ESD.

Therefore, Turkish science teachers' views related to ESD are similar what is found in the related literature with an additional view that, they strongly emphasize the need not only for students but people at all ages. Besides, the reason for the need for ESD is explained by Turkish science teachers through future needs, which is worthy to be pointed out as far as the definition of SD is concerned.

5.2.4 Suggestions and Practice Related to ESD

Teaching Practice

Science teachers of this study were asked about their suggestions for effective ESD and also for their own practice. The results presented in Chapter 4 revealed that, science teachers suggested trips, observations, outdoor activities, in service education and an interdisciplinary course for developing effectiveness of ESD. Their practice however, included giving roles, organizing trips, telling real stories on SD, project - based learning and being a model.

In this section it is attempted to compare teachers' suggestions for effective ESD with their practice. Therefore, referring to the Table 4.10 in Chapter 4, it may be inferred that participating in SD related projects and organizing trips are among the suggestions and practices of the teachers.

As the results revealed, Turkish science teachers' suggestions and practice related to teaching ESD are in line with what is reported in the related literature. Tilbury (2011) for example states in line with the above-mentioned views of the science teachers of this study that, ESD should be handled not only in educational programs but also by related institutions and organizations that will facilitate these learning processes.

One of the ESD practice of teachers in this study was using videos/real stories as visualisation. Tilbury (2011) stated this process as "Stimulus activities" as pedagogical strategies of ESD on higher education. The videos provide a broad perspective for a critical analysis Tilbury (2011). It was stated by teachers in the present study that videos on SD subjects were effective developing students' awareness. They added that the use of video and visual materials is thought-provoking and memorable when dealing with issues such as global warming, water pollution, acid rain etc.

Moreover, it was mentioned that teachers should be a model in order to raise awareness of students on this subject. At this point, teachers stated that when they discussed SD subjects in their classes, they gave examples about what they are doing in their daily life for sustainable development. Furthermore, many teachers who participated in the study stated that touching on real examples or stories from daily life is also effective in providing students an awareness of sustainable development. One of the teachers who participated in the study stated that she gave certain roles to the students, for examples about the topic of energy saving and the teacher thought that addressing this issue from different perspectives provided an effective awareness for students. This category is described by Tilbury as "Role-plays and simulations" as a pedagogical strategy in learning processes aligned with ESD. This technique provides students with an opportunity to understand others' perspectives in more detail and empathize with others (Tilbury, 2011).

Another practice applied by the teachers participating in the current study in their own lessons was proposing a solution. For example, one of the teachers in study stated that she had brainstorming on the subject and that the students thought about the subject and put forward a solution. In addition, there was a teacher who posed an environmental problem in daily life and asked students to investigate it and propose a solution. With Tilbury's (2011) list of learning strategies, the method used by teachers of this study may be defined as case studies. Case studies enable students to finding solutions for local issue (Tilbury, 2011).

Therefore, it may be inferred as a result that, as is also emphasized in many other studies (Corney, 2006; Borg et al., 2014; Spiropoulou et al., 2007; Anyolo et all., 2018), teachers of this study have had an ESD practice and experience in their classes, even though they evaluate themselves as having medium level knowledge and thought that they did not receive adequate education on ESD.

The possibility for science teachers realizing their suggestions for ESD however, depends on the opportunities they are offered. For example, using school backyard as an area for activities depend on the condition supported by the school management and also for the physical circumstances, which is very useful opportunity to have

practical learning that invites students to participate in sustainable development and to respond to real-life conditions Tilbury (2011).

Many of the researchers in this area agree with this view related to using the school backyard for ESD activities (Gayford, 2003; Corney & Reid, 2007; Anyolo et all., 2018) however, teachers of this study stated that the majority of the school backyards in Turkey are not suitable for practice because of the inconvenient physical conditions.

The majority of the science teachers stated that the aims of the science course in the Turkish Science Curriculum are related to SD and ESD. However, since the science curriculum was already very intensive, they suggested to tackle SD and ESD through a different course or an elective course to increase the effect. Similarly, in a research conducted by Gayford (2002), teachers stated that the science curriculum was intense in order to address SD related issues. In another similar study, teachers stated that ESD should be handled as an independent subject or course in order to examine SD in more detail (Anyolo et all., 2018).

As in many other studies (Gayford, 2002; Gustaffsson et all., 2015; Anyolo et all., 2018), it was suggested by the science teachers of this study that ESD should be handled as an interdisciplinary subject. The majority of teachers who indicated that ESD should be interdisciplinary, pointed to Social Sciences course. Teachers who believe that SD can be handled in all other courses have stated that ESD can be more effective and that students can gain more awareness on SD. Similarly, in the study conducted by Gayford (2002), teachers stated that ESD should be the responsibility of the whole school. In another similar research, teachers suggested that there should be a common plan for ESD that concerns all other courses in the school (Gustaffsson et all. 2015). The teachers in the present study stated that ESD is not only related to the Science course but should be handled in a structured way with all other courses.

Teacher Training

Beginning from 1990s, teacher training is always one of the major issues discussed related to effective ESD in the related literature. For example, in a study conducted with Geography student teachers, it was stated that it would be appropriate to adopt an approach to include ESD in teacher training courses and to develop teachers' expertise in this field (Corney & Reid, 2007). In a similar study, it has been suggested that the courses at the university need to be redesigned in order to achieve ESD related success (Evans et all., 2012). In the present study however, it was stated that by the science teachers that, social environment and family education are important in this regard, but first of all, it should be given importance to teacher education which can reach students more easily. Tilbury (2011) noted the importance of initial teacher training and the need for training for the professional development of existing teachers among the changes required for ESD. Further, in the present study, the need for in-service training to make ESD more effective was addressed.

The teachers of the current study however did not attend any course about ESD, except one who attended an individual seminar on the subject. Teachers who mentioned the necessity of in-service education, stated that ESD-related seminars should be organized for teachers in all branches. Furthermore, the need for in-service training is also concern for the researchers in the literature as for the case of Burmeister and Eilks (2013) who stated emphasized the need.

Policy Requirement

The teachers who participated in the present study emphasized the need to renew the state policy as well as the renewal of school curricula in order to raising public awareness. Teachers have made recommendations that, government should support

ESD through seminars for teachers and the ministries and municipalities should work in cooperation in order to raise public awareness. The policy argument has also been stated by Kararaslan (2016). According to the author, there is not an educational policy for ESD in Turkey. However, the need has been reported in national reports. Being the focal of ESD in Turkey, UNESCO-Turkey (2011) reported the major targets for ESD implementation in Turkey as; developing connections of knowledge, sharing and experience among people, develop the quality of education in terms of ESD and assist Turkey to develop an ESD policy.

5.3 Conclusion

Although science teachers' self-evaluation is mainly "medium", their views on the science curriculum – as far as their evaluations related to the topics in the curriculum related to SD – shows that they have a view on the content of the concept.

Science teachers need to be supported by in-service training on SD and ESD.

Science teachers' definition on SD have been developed to include economy dimension of the concept, which was only on environment before 2000s.

Science teachers believe that ESD is necessary and even that education should be provided from an early age. Moreover, the need for both teacher and student education is addressed.

It has been stated that teacher education plays a major role in ESD and that both university education and in-service education should be given importance.

Science teachers stated that ESD should be primarily a state policy, and that not only teachers but all other professional groups should be informed. In addition to educational programs for ESD, science teachers stated that institutions that would facilitate this learning process, such as municipalities and related ministries, should

be interested in this issue. Besides, a state policy should also be implemented in order to make the public aware of this issue. Municipalities and ministries should take responsibility for this situation.

Suggestions and practice are similar for some of the teaching techniques such as participating projects and organizing trips which are similar what is reported in the literature. But they need school and governmental support to increase the efficiency.

The ESD practices of the teachers in this study were stated to using the technology, to be role models for students, to give roles to students and to finding solutions by making brainstorming on SD related subjects.

Science teachers addressed the intensity of the curriculum of the science course and mentioned that there should be an elective or another course about ESD in order to be able to handle ESD more effectively. In addition, it is pointed out that ESD can be more effective if it is considered interdisciplinary, not only in the science course.

In turkey and international literature, ESD studies have been conducted generally with pre-service teachers. However, further works are needed with in-service teachers, school administrators, decision-makers and students to increase the effectiveness of ESD.

5.4 Recommendation for Future Work

In this part of the present study, some recommendations are made for future researches. Suggestions are as follows:

1. A similar study may be carried out in a district with schools with different physical, social and environmental conditions or with teachers in private schools.

2. Future studies may involve not only science teachers but also teachers from other branches of the school. Thus, the idea of interdisciplinary of ESD can be shed light.
3. In another study, pre-service teachers can be interviewed to investigate their suggestions about ESD and the practices they would like to do when they start their profession.
4. In order to create sustainable lifestyles and to increase ESD effectiveness in whole school, a similar study can be conducted in which the opinions of school administrators are taken.
5. In order to reach more in-service teachers from different branches, a quantitative study can be done.
6. In future studies, students' opinions about implication of SD can be taken.
7. In future studies, sources of teachers' views on the concept of sustainable development can be explored.
8. A study may be conducted to investigate whether teachers' ages, genders and experiences affect their views on education for sustainable development.
9. While this study was conducting, 2013 Middle School Science Curriculum was used. In future studies, a similar study can be conducted with teachers implementing the 2018 Middle School Science Curriculum.

5.5 Limitations

As in many studies, the current study is subject to limitations. These limitations are as follows:

1. This study was limited to four randomly selected state middle schools in Mamak district of Ankara. Therefore, the results may not represent all middle schools and private middle schools in Turkey.

2. This study was conducted by interviewing only twenty-seven science teachers. Therefore, it could not be generalized to larger samples.
3. The opinions of the teachers were taken in fifteen- and twenty-minutes time periods. Since more time is needed some interviews, it can be said that time is a limitation for this study.
4. The curriculum change is another limitation for this study. While this study was conducting, 2013 Middle school science curriculum was used. However, there are 2018 Middle school science curriculum available now.

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APPENDICES

A. SURVEY OF SCIENCE TEACHERS' VIEWS ON SUSTAINABLE DEVELOPMENT AND EDUCATION FOR SUSTAINABLE DEVELOPMENT

FEN BİLİMLERİ DERSİ ÖĞRETMENLERİNİN SÜRDÜRÜLEBİLİR KALKINMA İÇİN EĞİTİM KONUSUNDAKİ GÖRÜŞLERİ ANKETİ

Değerli Fen Bilimleri Öğretmeni,

Ben Rengin Özsoy, Orta Doğu Teknik Üniversitesi İlköğretim Fen Bilgisi Bölümünde yüksek lisans öğrencisiyim. Bu görüşmede amacım, siz değerli Fen Bilimleri öğretmenlerinin, Fen Bilimleri Dersi Öğretim Programında sürdürülebilir kalkınma konusundaki kazanımlarla ilgili görüş ve uygulamalarınız hakkında bilgi almaktır. Bu araştırmada ortaya çıkacak sonuçların, Türkiye'de Sürdürülebilir Kalkınma İçin Eğitim uygulamalarının geliştirilmesine katkı sağlayacağını umut ediyorum.

Görüşme süresince, kişisel bilgileriniz ve verdiğiniz bütün cevaplar gizli tutulacak, çalışma yayınlandığında isminiz kesinlikle belirtilmeyecektir. Görüşme yaklaşık olarak yirmi dakika sürecektir. Verdiğiniz cevapları çalışmama eksiksiz olarak ekleyebilmek için görüşmemizi kaydetmem gerekmektedir. Sorulara objektif ve samimi cevaplar vereceğinize inanıyorum. Katkılarınız ve anlayışınız için şimdiden teşekkür ederim.

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Mezun olduğunuz üniversite ve mezuniyet yılınız:

Öğretmenlik deneyimi (Yıl):

Öğretmenlik eğitiminiz sırasında Sürdürülebilir Kalkınma ile ilgili herhangi bir derse/kursa katıldınız mı?

1. **Sürdürülebilir Kalkınma ile ilgili bilginizin derecesini değerlendiriniz.**

Çok İyi	İyi	Orta	Kötü	Çok Kötü
☐	☐	☐	☐	☐

2. **Sürdürülebilir Kalkınma kavramından ne anlıyorsunuz?**
3. **Sürdürülebilir Kalkınma için Eğitim kavramından ne anlıyorsunuz?**
4. **Sizce Sürdürülebilir Kalkınma için Eğitim gerekli midir? Neden?**
5. **T.C. Milli Eğitim Bakanlığı 2013 Fen Bilimleri Dersi Öğretim Programının amaçlarından hangileri Sürdürülebilir Kalkınma için Eğitim ile ilintilidir? (Ek1.)**
6. **Sürdürülebilir Kalkınma kavramı Fen Bilimleri Programı kapsamında nasıl ele alınırsa daha faydalı olur?**
7. **T.C. Milli Eğitim Bakanlığı 2013 Fen Bilimleri Dersi Öğretim Programında yer alan Sürdürülebilir Kalkınma için Eğitim konularını nasıl uyguluyorsunuz? Dersi anlatırken günlük hayatla bağlantı kuruyor musunuz? Örnek verebilir misiniz?**

Ek.1

Fen Bilimleri Dersi Öğretim Programının Amaçları

Fen Bilimleri dersi öğretim programı 1739 sayılı Milli Eğitim Temel Kanunu'nun 2. maddesinde ifade edilen Türk Milli Eğitiminin genel amaçları ile Türk Milli Eğitimin Temel İlkeleri esas alınarak hazırlanmıştır.

Tüm bireylerin fen okuryazarı olarak yetişmesini amaçlayan Fen Bilimleri Dersi Öğretim Programı'nın temel amaçları şunlardır:

1. Biyoloji, Fizik, Kimya, Yer, Gök ve Çevre Bilimleri, Sağlık ve Doğal Afetler hakkında temel bilgiler kazandırmak,
2. Doğanın keşfedilmesi ve insan-çevre arasındaki ilişkinin anlaşılması sürecinde, bilimsel süreç becerilerini ve bilimsel araştırma yaklaşımını benimseyip karşılaşılan sorunlara çözüm üretmek,
3. Bilimin toplumu ve teknolojiyi, toplum ve teknolojinin de bilimi nasıl etkilediğine ilişkin farkındalık geliştirmek,
4. Birey, çevre ve toplum arasındaki karşılıklı etkileşimi fark etmek ve toplum, ekonomi, doğal kaynaklara ilişkin sürdürülebilir kalkınma bilincini geliştirmek,
5. Fen bilimleri ile ilgili kariyer bilinci geliştirmek,
6. Günlük yaşam sorunlarına ilişkin sorumluluk alınmasını ve bu sorunları çözmede fen bilimlerine ilişkin bilgi, bilimsel süreç becerileri ve diğer yaşam becerilerinin kullanılmasını sağlamak,
7. Bilim insanlarının bilimsel bilgiyi nasıl oluşturduğunu, oluşturulan bu bilginin geçtiği süreçleri ve yeni araştırmalarda nasıl kullanıldığını anlamaya yardımcı olmak,
8. Bilimin, tüm kültürlerden bilim insanlarının ortak çabası sonucu üretildiğini anlamaya katkı sağlamak ve bilimsel çalışmaları takdir etme duygusunu geliştirmek,
9. Bilimin, teknolojinin gelişmesi, toplumsal sorunların çözümü ve doğal çevredeki ilişkilerin anlaşılmasına olan katkısını takdir etmeyi sağlamak,
10. Doğada meydana gelen olaylara ilişkin merak, tutum ve ilgi geliştirmek,
11. Bilimsel çalışmalarda güvenliğin önemini fark ettirmek ve uygulamaya katkı sağlamak,
12. Sosyo-bilimsel konuları kullanarak bilimsel düşünme alışkanlıklarını geliştirmektir.

B. APPROVAL OF METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof.Dr. Gaye TEKSÖZ;

Danışmanlığını yaptığınız yüksek lisans öğrencisi Rengin ÖZSOY'un **" Fen Bilimleri Dersi Öğretmenlerinin Sürdürülebilir Kalkınma İçin Eğitim Konusundaki Görüşleri"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2017-EGT-202** protokol numarası ile **15.01.2018-28.06.2018** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
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Doç. Dr. Yaşar KONDAKÇI
Üye

Doç. Dr. Zana ÇITAK
Üye

Yrd. Doç. Dr. Pınar KAYGAN
Üye

Yrd. Doç. Dr. Emre SELÇUK
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C. TURKISH SUMMARY/ TÜRKÇE ÖZET

FEN BİLİMLERİ ÖĞRETMENLERİNİN SÜRDÜRÜLEBİLİR KALKINMA İÇİN EĞİTİM İLE İLGİLİ GÖRÜŞLERİNE İLİŞKİN BİR İNCELEME

Giriş

Sürdürülebilir Kalkınma kavramı, 1987 yılında Brundtland Raporu (Ortak Geleceğimiz) tarafından ortaya atılmış, özellikle eğitimciler ve karar vericiler arasında başlıca ilgi çeken alanlardan biri haline gelmiştir. Brundtland Raporu'nda (1987), sürdürülebilir bir geleceğe giden yol boyunca "dünya öğretmenlerinin… çok önemli bir rol oynadığı" ve öğretmenlerin "kapsamlı toplumsal değişimlerin" sağlanmasında yardımcı olacakları bildirildi. (s. xiv). Bu yüzden Sürdürülebilir Kalkınma için Eğitim birçok ülkenin eğitim sistemine entegre edilmiştir. Sürdürülebilir kalkınmanın ilk ve temel tanımlarının da belirttiği gibi, dünyanın kaynakları gelecekteki talebi tehdit etmeden ihtiyaçları karşılamalıdır. Bununla birlikte, Raven ve Berg (2006) tarafından belirtildiği gibi, dünyanın kaynakları sınırsız görünebilir, ancak bir gün insanların ihtiyaçlarını karşılayamayacaktır. Bireyler, dünyadaki felaketlerle karşılaşmadan önce kaynakların sürdürülebilir kullanımının farkında olmak için erken yaşlardan itibaren eğitilmelidir. Bu nedenle sürdürülebilir kalkınma terimi, insanlar ve çevre arasındaki rekabeti dengeleyen bir eğitim politikasının olası bir başlangıç noktasıdır (Cross, 1998).

Yeni öncelikler geliştirmek ve sürdürülebilir bir yaşam tarzı benimsemek günümüzde en önemli ihtiyaçlardan biridir. Sürdürülebilir kalkınma ise ekonomik, sosyal ve çevresel olarak üç bileşene sahiptir. Öyleyse Sürdürülebilir Kalkınma kavramının anlaşılması, bu üç ana bileşen ile bu bileşenler arasındaki karmaşık ilişkilerin birlikte ele alınmasını gerektirir. Görünüşe göre, bu ilişkiler ancak bireylerin bütünsel bir bakış açısı ve eleştirel değerlendirme kazanması ile anlaşılabilir. Sürdürülebilir

kalkınmayı ancak teknolojik çözümler üreterek, politik düzenlemeler yaparak veya finansal araçlar kullanarak elde edemeyiz. UNESCO'ya göre, ancak düşünce ve davranışlarımızı değiştirirsek, sürdürülebilir kalkınmayı başarabiliriz. Sürdürülebilir Kalkınma için Eğitim, sonuç olarak eleştirel düşünme, gelecekteki senaryoları hayal etme ve iş birliğine dayalı bir şekilde karar verme gibi yetkinlikleri teşvik etmektedir (UNESCO, 2014).

Sürdürülebilir kalkınma kavramı tartışıldığında, eğitimin sürdürülebilir kalkınmanın anahtarı olduğu ortaya çıkmaktadır. Örneğin, UNESCO'ya göre Sürdürülebilir Kalkınma için Eğitim, içeriğe işaret eden, pedagoji ve öğrenme ortamı ile sonuçlanan bütünsel ve dönüşümsel bir öğrenmedir. Toplumu dönüştürerek hedefine ulaşır. Sürdürülebilir sosyal değişim biçimini meşrulaştırmanın temeli, okullarda verilen eğitim ile mümkün olabilmektedir. Bu nedenle, öğretmenler Sürdürülebilir Kalkınma için Eğitim araştırmalarının ana odak noktasıdır. Öğretmenler, öğrencilerin sürdürülebilir kalkınma kavramını netleştirmek için, onların bilgi ve becerilerini geliştirmelerine ve sürdürülebilirlikle ilgili toplumun karşı karşıya kaldığı zorlukları anlamalarına yardımcı olma sorumluluğuna sahiptir (Hungerford, 2010). Sürdürülebilir Kalkınma için Eğitim'in amacı, öğrencileri gelecekte sürdürülebilir kararlar almaları için eğitmektir (Walls, 2011). Bu, öğretmenlerin öğrencilere doğru bilgileri doğru aktarmasıyla sağlanacaktır. Tüm eğitim seviyelerinde fen eğitimi, genç kuşakların sorumlu vatandaş olmalarını sağlamayı ve dünyamızda sürdürülebilir kalkınmayı teşvik etmeyi amaçlamaktadır (Eilks, Nielsen ve Hofstein, 2014). Bu noktada öğretmenlerin SKE hakkındaki görüşleri öğrencilere geleceği öğretmek ve onları geleceğe hazırlamak için büyük önem taşımaktadır (Anyolo, Kärkkäinen ve Keinonen, 2018). Bununla birlikte, fen eğitimi aynı zamanda öğrencilerin katılımcı öğrenmeye ilişkin bilgi ve becerilerini geliştirmede büyük bir potansiyele sahiptir (Eilks ve diğerleri, 2014). Fen dersinin konuları göz önüne alındığında, sürdürülebilir kalkınmaya yönelik birçok nokta vardır. Bu nedenle, fen bilgisi öğretmenlerinin bu konudaki görüşleri, sürdürülebilir kalkınma için eğitim geliştirmek ve uygulamak ve öğrencilere ESD ile ilgili hedefler sağlamak için önemlidir.

Öğretmenlerin Sürdürülebilir Kalkınma ve Sürdürülebilir Kalkınma için Eğitim hakkında bildikleri ve düşündükleri, 1990'lı yıllardan beri araştırmacılar arasında önemli bir endişe kaynağıdır. Örneğin, 1998 yılında Cross'un rapor ettiği üzere, İskoçya'lı ve ABD'li öğretmenler insanların gezegenle etkileşimi konusunda kaygılı ve kamuoyu düzenlemesine katkıda bulunmaya istekliydiler. Bununla birlikte, genellikle konuyu yüzeysel olarak ele aldılar ve sürdürülebilir kalkınma ile ilgili teorik problemler hakkında fazla bir şey bilmiyorlardı. Dahası, ne katkıda bulunacakları konusunda net bir görüşleri yoktur. Ancak Chatzifotiou'nun (2006) bildirdiği üzere, Sürdürülebilir Kalkınma kavramının İngiltere Ulusal Müfredatı'na 1995'ten bu yana dahil olmasına rağmen, öğretmenler hem çevre konularını hem de sürdürülebilirlik kavramını tartışmak için yeterli değillerdi. Yine 2018 yılında, Namibya'da, öğretmenlerin SKE hakkındaki görüşlerini ve öğretim uygulamalarını anlamak için yapılan bir çalışmada öğretmenler, SKE'yi gelecek nesilleri dikkate alarak kaynakları sürdürülebilir bir şekilde kullanmak için çevre hakkında bilgi edinme olarak tanımlamışlardır (Anyolo, Kärkkäinen ve Keinonen, 2018).

Türkiye'de ise 2010 yılında, fen alanı öğretmen adaylarının çevresel okuryazarlık düzeyleri Teksöz ve diğerleri tarafından yetersiz bulunmuştur. Benzer şekilde, Çobanoğlu ve Türer, 2015 yılında, fen bilgisi öğretmen adaylarının sürdürülebilir kalkınma konusundaki bilgilerinin yetersiz olduğunu ve bunun sebebinin, Türkiye'deki öğretmen eğitimi programlarında SK ve / veya SKE bulunmadığını bildirmiştir. Aydın ve Kılınç'ın 2013'te bildirdiği gibi, güçlü bir geçmişleri olmamakla birlikte, fen alanı öğretmen adayları SK'yi çevre, teknoloji, toplum, politika, enerji ve eğitim açısından tanımlamışlardır. Ancak öğretmenlik eğitiminde SK kavramlarının ve SKE programlarının çeşitliliği konusunda farkındalık yaratmaya yönelik mevcut fikirlerin daha yeterli hale getirilmesi gerekmektedir (Aydın ve Kılınç, 2013).

Öğretmenler, öğrencilere sürdürülebilir kalkınma sorunlarını anlamalarına ve geliştirmelerine yardımcı olacak gerekli bilgi ve becerileri sağlamalıdır (Hungerford, 2010). Fen bilimleri dersi kapsamında etkili bir SKE oluşturmak istiyorsak, öncelikle fen bilimleri öğretmenlerinin SK ve SKE hakkındaki görüşlerini belirlemek gerekir. Fen bilimleri öğretmenlerinin görüşleri ışığında meydana gelen gelişmeler, fen

bilimleri müfredatında SKE hakkında daha sağlam fikirler sunabilir. Yukarıda belirtilenler doğrultusunda, bu çalışmanın amacı, Fen bilimleri öğretmenlerinin SK ve SKE'nin anlamı hakkındaki görüşlerini araştırmaktır.

Buna göre, bu çalışmanın araştırma soruları şu şekilde belirlenmiştir:

1: Fen Bilimleri öğretmenlerinin Sürdürülebilir Kalkınma hakkındaki görüşleri nelerdir?

2: Fen Bilimleri öğretmenlerinin Sürdürülebilir Kalkınma için Eğitim hakkındaki görüşleri nelerdir?

i: Fen Bilimleri Öğretmenlerinin Sürdürülebilir Kalkınma için Eğitimin daha faydalı bir şekilde uygulanmasına yönelik önerileri nelerdir?

ii: Fen Bilgisi Öğretmenleri 2013 Fen Ders Programında bulunan Sürdürülebilir Kalkınma Eğitim ile ilgili kavramları nasıl uygulamaktadırlar?

Bu çalışma yürütülürken, 2013 Ortaokul Fen Bilimleri Müfredatı kullanılmaktaydı. Şu an ise 2018 Ortaokul Fen Bilimleri Müfredatı kullanılmaktadır. Fen Bilimleri dersinin sürdürülebilir kalkınmaya ilişkin hedefleri ve ortaokul fen bilimleri müfredatının amaçları incelendiğinde, iki program arasında keskin bir fark yoktur. Bu nedenle, öğretmenlerle yapılan görüşmelerde 2013 Ortaokul Fen Bilimleri Müfredatı dikkate alınmıştır.

Bu çalışmanın fen bilimleri öğretmenleriyle gerçekleştirilmesinin nedeni, fen bilimleri öğretmenlerinin SK ile ilgili konuları öğrencilere aktarılmada önemli bir role sahip olmalarıdır. Öğretmenlerin SK kavramını öğrencilere nasıl aktardıkları önemlidir. Bu çalışmanın önemini vurgulayan şey, çalışmada fen bilimleri öğretmenlerinin SK ile ilgili kendilerini değerlendirmeleri; öğretmenlerin SK ve SKE hakkındaki görüşlerinin alınması ve öğretmenlerin SKE ile ilgili uygulamaları ve önerilerinin ortaya konmasıdır. Çalışmada öğretmenlerin uygulamalarına yer vermekle, Türkiye'de SKE ile ilgili mevcut durumun belirlenmesinin kolaylaştırılacağı düşünülmüştür. Ayrıca, öğretmenlerin SKE ile ilgili önerilerinin

araştırılması, SKE'nin gelişimi hakkında fikir verebileceği ve gelecekteki çalışmalara ışık tutabileceği düşünülmüştür.

Bu çalışmada elde edilen bilgilerin Türkiye'de SKE'nin gelişimine ışık tutması beklenmektedir. Sürdürülebilir kalkınma için iyi bir eğitim, öğrencilerimizin günümüz ve gelecek nesiller hakkında düşünen, çevreye ve doğaya duyarlı ve sürdürülebilir bir yaşam tarzı benimseyen bireyler olmasını sağlayacaktır.

Yöntem

Bu tez araştırması, ortaokul fen bilgisi öğretmenleriyle yarı yapılandırılmış görüşmeler yoluyla nitel olarak tasarlanmıştır. Bu çalışmanın hedef popülasyonu, Türkiye'deki orta okullarda çalışan fen bilimleri öğretmenleridir. Türkiye'deki bütün orta okullarla çalışan fen bilimleri öğretmenlerine ulaşmak mümkün olmadığından, erişilebilir popülasyon Ankara'nın Mamak ilçesindeki orta okullarda çalışan fen bilimleri öğretmenleri olarak daraltılmıştır. Bu nedenle kullanılan örnekleme yöntemi, küme örnekleme yöntemidir. Neuman (2006) tarafından yapılan tanımlamaya göre yöntem doğrultusunda; önce Ankara'nın Mamak ilçesindeki ortaokullar kümeler olarak tanımlandı, ardından okullar rastgele seçildi; ikinci aşama için, rastgele seçilen okullarda çalışan fen bilimleri öğretmenleri bu tezin örneklemi olarak belirlenmiştir. Buna göre, Ankara'daki toplam 608 ortaokul arasından, 5'i rastgele seçilmiştir ve bu okullarda çalışan 27 fen bilimleri öğretmeni ile bu çalışma yürütülmüştür. Bu 27 öğretmenin 19'u kadın, 8'i erkektir. Öğretmenlerin 16'sı 3 ile 15 yıl arası, 9 tanesi 16 ile 25 yıl arası, 2 tanesi ise 26 yıldan fazla öğretmenlik deneyimine sahiptir.

Veri toplama işlemi, "Fen Bilimleri Dersi Öğretmenlerinin Sürdürülebilir Kalkınma için Eğitim Konusundaki Görüşleri Anketi" başlıklı araç kullanılarak ortaokul fen öğretmenleriyle yarı yapılandırılmış görüşmelerle gerçekleştirilmiştir. Anket bu çalışmanın araştırma soruları ile ilgili 5 bölümden ve 7 sorudan oluşmaktadır (Ek A).

Bu bölümler şunlardır:

1. Demografik bilgiler

2. Öz değerlendirme

3. Sürdürülebilir Kalkınma hakkındaki görüşler

4. Sürdürülebilir Kalkınma için Eğitim hakkındaki görüşler

5. Fen bilimleri öğretmenlerinin Sürdürülebilir Kalkınma için Eğitim ile ilgili önerileri ve uygulamaları

Pilot çalışma için seçilen örneklem Ankara'da bir ortaokulda çalışan bir fen bilimleri öğretmeniydi. Öğretmenlerin ESD hakkındaki görüşlerini almak için hazırlanan sorular, pilot çalışmada görüşülen öğretmene, görüşme yoluyla sorulmuştur. Anketin son hali pilot çalışmasına göre dizayn edilmiş ve mevcut çalışmaya katılan öğretmenlerle yapılan görüşmelerde kullanılmıştır.

Ortaokul fen bilimleri öğretmenleriyle yarı yapılandırılmış görüşmeler incelenerek veri analizi yapılmıştır. Verilerin analizi için izlenecek aşamalar Miles, M.B., Huberman, A.M. ve Saldana, J. (2014) tarafından önerildiği şekilde belirlenmiştir.

1. İnceleme, okuma, dinleme yoluyla verileri tanıma.

2. Teyp ile kaydedilmiş materyallerin transkripsiyonu

3. Kolay erişim ve tanımlama için verilerin düzenlenmesi ve endekslenmesi

4. Kodlama (indeksleme)

5. Temaların belirlenmesi

6. Kategorilerin geliştirilmesi

7. Kategoriler arasındaki ilişkilerin araştırılması

8. Tema ve kategorilerin iyileştirilmesi

9. İlgili literatür ve önceden var olan bilgiler yoluyla bir açıklamanın geliştirilmesi (verilerden alıntılar; görüşmelerden alıntılar gibi).

Bulgular ve Tartışma

Çalışmanın bu bölümünde, Fen bilimleri öğretmenlerinin Sürdürülebilir Kalkınma ve Sürdürülebilir Kalkınma için Eğitim konusundaki görüşlerine yönelik bulgular verilmiştir.

Çalışmaya katılan öğretmenlerin çoğu, Sürdürülebilir Kalkınma hakkındaki bilgilerini "orta" olarak değerlendirmiş, hiçbir öğretmen Sürdürülebilir Kalkınma hakkında öz değerlendirmesini "çok iyi" olarak belirtmemiştir. Fakat fen bilimleri öğretmenlerinin cevapları incelendiğinde, sonuçlar öğretmenlerin SD kavramının içeriği hakkında bir görüşe sahip olduğunu göstermiştir. Fen bilimleri öğretmenlerinin SK hakkındaki bilgilerini "orta" olarak nitelendirmelerinin olası nedeni, (Evans ve diğerleri, 2013; Burmeister & Eilks, 2013) üniversitedeki derslerin yetersizliğidir. Summer ve Childs (2007) öğrenci öğretmenlerle yaptıkları çalışmalarında, öğretmenlerin sürdürülebilir kalkınma için öz değerlendirme puanlarının düşük olduğunu şaşırtıcı bulmamıştır. Sürdürülebilir Kalkınma için Eğitim'in, öğrenci öğretmenlerinin konuyla ilgili daha geniş bir görüş üretmesine yardımcı olacak tek araç olarak kabul edilebileceğini belirtmişlerdir.

Öte yandan, araştırmadaki fen bilimleri öğretmenleri SKE hakkındaki görüşlerini, SK'nin üç ayağına ilişkin olarak üç tema üzerinden açıklamışlardır: çevre, ekonomi ve politika. SKE hakkındaki görüşleri sorulduğunda, öğretmenlerin yarısından fazlası SKE'i çevre boyutu ile

ele aldı. SKE'yi tanımlarken, öğretmenlerin çoğunluğu çevre bilinci, geri dönüşüm ve yenilenebilir enerji kaynaklarının kullanımına dikkat çekti. Öğretmenlerden birkaçı ise, SKE'nin erken yaşlardan itibaren verilmesi gerektiğini vurguladı. Araştırmaya katılan öğretmenlerden biri, öğrencilerin bir ağaç dikmeyi öğrenmesinin bile çevreye yönelik tutum ve davranışlara katkıda bulunacağını belirterek, doğal kaynakların sürdürülebilir kullanımının farkında olmaları için anaokulundan başlayarak SKE almaları gerektiğini belirtti. Bu çalışmada dikkat çeken bir diğer bulgu, öğretmenlerin SKE'nin önce devlet politikası olması gerektiğini; ayrıca, sadece öğretmenlerin ve öğrencilerin değil, diğer meslek gruplarının da bu konuda bilgilendirilmesi gerektiğinin önemini vurguladılar.

Bu nedenle, bu çalışmadan elde edilen sonuçlar fen bilimleri öğretmenlerinin SK ve SKE hakkındaki görüşlerinin olumlu bir yönde ilerlemekte olduğunu göstermektedir. Bununla birlikte, bu çalışma 2000'li yılların başlarındaki ilgili literatürle karşılaştırıldığında, fen bilimleri öğretmenlerinin SK hakkındaki görüşleri kavramın ekonomik dayanağını içerecek şekilde geliştirilirken, SKE hakkındaki görüşleri çoğunlukla yalnızca çevresel boyutu dahil edecek şekildedir.

Bu çalışmada öğretmenlere SKE'nin gerekli olup olmadığı sorulduğunda, ikisi hariç hepsi SKE'nin gerekli olduğunu belirtmiştir. Gerekli bulmayanlar, bu konuda bir farkındalık yaratmanın bunun için özel bir eğitim olmadan da mümkün olabileceğini belirmişlerdir. Öte yandan, SKE'nin gerekli olduğunu düşünen öğretmenler, çoğu durumda içeriği çevre açısından tanımlamışlar ve SKE'ye duyulan ihtiyacı, gelecekte enerjiye duyulacak olan ihtiyaç, gibi tanımlarla vurgulamışlardır. Ayrıca, araştırmaya katılan öğretmen grubu, SKE ihtiyacını hem öğretmen hem de öğrenci eğitimine duyulan ihtiyaç açısından tanımlayarak, SKE'nin her yaştan bireylere verilmesi gerektiğini vurgulamışlardır. Uluslararası literatüre baktığımızda, Sürdürülebilir Kalkınma için Eğitim'de aktif bir rol oynayan öğretmenler için ulusal ve uluslararası üniversite eğitiminin yeniden düzenlenmesi önerilmekteydi (Spiropoulou, Antonakaki, Kontaxaki ve Bouras, 2007). Benzer şekilde, Spiropoulou ve diğerlerine göre (2007), SK ve SKE ile ilgili tüm eğitim seviyelerinde bilgi, araştırma ve iş birliğini güçlendirmek için güçlü bir eğitime ihtiyaç vardır. Bu nedenle, Fen bilimleri öğretmenlerinin SKE ile ilgili görüşleri, ilgili literatürde bulunanlara benzerdir; ek

olarak, sadece öğrenciler için değil, her yaştaki insanlar için olan gereksinimi kuvvetle vurgulanmaktadır. Ayrıca, SKE ihtiyacının nedeni, fen bilimleri öğretmenleri tarafından, SK'nin tanımında olduğu gibi, gelecekteki ihtiyaçları göz önünde bulundurma düşüncesi ile belirtilmiştir.

Bununla birlikte, bu araştırmaya katılan fen bilimleri öğretmenlerine etkili bir SKE için öneriler ve ayrıca kendi SKE uygulamaları sorulmuştur. Fen bilgisi öğretmenleri, SKE'nin etkinliğini artırmak için gezi, gözlem, açık hava etkinlikleri, öğretmenler için hizmet içi eğitimi ve konunun disiplinler arası olarak ele alınması gerektiğini öneri olarak sundular. Öğretmenlerin SKE ile ilgili kendi uygulamaları ise; roller vermek, geziler düzenlemek, SK ile ilgili gerçek hikayeler anlatmak, proje tabanlı öğrenme ve bir öğretmen olarak öğrencilere model olmaktı. Öğretmenlerin etkili bir SKE için önerileri ve kendi derslerindeki uygulamaları karşılaştırıldığında, SK ile ilgili projelere katılmanın ve gezileri düzenlemenin öğretmenlerin önerileri ve uygulamaları arasında olduğu sonucuna varılabilir.

Elde edilen sonuçlara göre, bu çalışmadaki öğretmenlerin SKE öğretimi ile ilgili önerileri ve uygulamaları, ilgili literatürde bildirilenlerle uyumludur. Örneğin Tilbury (2011), bu çalışmanın fen bilimleri öğretmenlerinin yukarıda belirtilen görüşlerine paralel olarak, SKE'nin sadece eğitim programlarında değil, aynı zamanda bu öğrenme süreçlerini kolaylaştıracak ilgili kurum ve kuruluşlar tarafından da ele alınması gerektiğini belirtir.

Bu çalışmada öğretmenlerin SKE uygulamalarından biri de video ve gerçek hikayeleri görselleştirme olarak kullanmaktı. Bu çalışmadaki öğretmenler, SK konularına ilişkin videoların öğrencilerin farkındalığının gelişmesinde etkili olduğunu belirtmişlerdir. Videolar, konu ile ilgili kritik bir analiz için geniş bir perspektif sunmaktadır Tilbury (2011). Küresel ısınma, su kirliliği, asit yağmuru vb. gibi konularda video ve görsel malzemelerin kullanımının düşündürücü ve akılda kalıcı olduğunu ekledi̇ler.

Ayrıca, öğretmenlerin bu konuda öğrencilerin farkındalıklarını arttırmak için bir rol model olması gerektiği belirtildi. Bu noktada, öğretmenler sınıflarındaki SK konularını tartıştıklarında, günlük yaşamlarında SK için neler yaptıkları hakkında

örnekler verdiklerini belirttiler. Ayrıca, araştırmaya katılan birçok öğretmen, günlük yaşamdan gerçek örneklere veya hikayelere dokunmanın da öğrencilere sürdürülebilir kalkınma konusunda farkındalık sağlamada etkili olduğunu belirtti. Araştırmaya katılan öğretmenlerden biri, enerji tasarrufu konusu ile ilgili örnekler için öğrencilere belli roller verdiğini ve bu konuyu farklı açılardan ele almanın öğrenciler için etkili bir farkındalık sağladığını belirtti. Bu kategori, Tilbury (2011) tarafından SKE ile uyumlu öğrenme süreçlerinde "rol oynama ve simülasyonlar" adı altında pedagojik bir strateji olarak tanımlanmaktadır. Bu teknik, öğrencilere başkalarının bakış açılarını daha ayrıntılı anlama ve başkalarıyla empati kurma fırsatı verir (Tilbury, 2011).

Mevcut çalışmaya katılan öğretmenlerin, kendi derslerinde uyguladıkları bir başka uygulama ise bir problem üzerine öğrencilerden çözüm önerisi sunmalarını beklemekti. Örneğin, günlük hayatta çevresel bir problemi ortaya koyup ve öğrencilerden araştırmasını ve bir çözüm önermesini isteyen bir öğretmen vardı. Araştırmadaki öğretmenlerden bir diğeri ise, konuyla ilgili beyin fırtınası yaptığını ve öğrencilerin konuyu düşündüğünü ve bir çözüm önerdiğini belirtti. Tilbury'nin (2011) öğrenme stratejileri listesiyle, bu çalışmanın öğretmenleri tarafından kullanılan yöntem probleme dayalı öğrenme olarak tanımlanabilir.

Bu nedenle, bu çalışmanın öğretmenleri, diğer birçok çalışmada da vurgulandığı gibi (Corney, 2006; Borg ve diğerleri, 2014; Spiropoulou ve diğerleri, 2007; Anyolo ve diğerleri, 2018), orta düzeyde bilgiye sahip olduklarını ve SKE konusunda yeterli eğitim almadıklarını düşünmelerine rağmen, sınıflarında SKE uygulamalarına ve deneyimlerine sahiplerdir.

Fen Bilimleri öğretmenlerinin çoğunluğu, Fen Müfredatı'ndaki fen bilimleri dersinin amaçlarının tamamının SK ve SKE ile ilgili olduğunu belirtti. Bununla birlikte, fen bilimleri müfredatı zaten çok yoğun olduğu için, SK ve SKE'yi farklı bir ders veya seçmeli bir ders aracılığıyla ele almayı önerdiler. Benzer şekilde, Gayford (2002) tarafından yapılan bir araştırmada, öğretmenler SK ile ilgili meseleleri ele almak için fen bilimleri dersi müfredatının yoğun olduğunu belirtmişlerdir. Bir başka benzer

çalışmada, öğretmenler SKE'nin, SK'yi daha ayrıntılı olarak incelemek için bağımsız bir ders olarak ele alınması gerektiğini belirtmiştir (Anyolo ve diğerleri, 2018).

Diğer pek çok çalışmada olduğu gibi (Gayford, 2002; Gustaffsson ve diğerleri, 2015; Anyolo ve diğerleri, 2018), bu çalışmanın fen bilimleri öğretmenleri de SKE'nin disiplinler arası bir konu olarak ele alınmasını önermişlerdir. SKE'nin yalnızca Fen Bilimleri dersiyle ilgili olmadığını, diğer tüm derslerle yapılandırılmış bir şekilde ele alınması gerektiğini ve böylece SKE'nin etkinliğinin artacağını belirtmişlerdir.

Mevcut çalışmada ele alınan bir diğer konu ise öğretmen eğitimi olmuştur. Bu çalışmada, fen bilimleri öğretmenleri sosyal çevre ve aile eğitiminin bu konuda önemli olduğu, ancak her şeyden önce öğrencilere daha kolay ulaşabilen öğretmenlerin eğitimine önem verilmesi gerektiği belirtilmiştir. Tilbury (2011), öğretmen eğitiminin önemine ve etkili bir SKE için gereken değişiklikler arasında mevcut öğretmenlerin mesleki gelişimi için bir eğitim ihtiyacına dikkat çekmektedir. Bu çalışmada da, öğretmenlerin üniversitedeki eğitimlerinin yanı sıra, SKE'yi daha etkili hale getirmek adına, hizmet içi eğitime duyulan ihtiyaçtan söz edilmiştir. Hizmet içi eğitimin gerekliliğinden bahseden öğretmenler, tüm branşlardaki öğretmenler için SKE ile ilgili seminerlerin düzenlenmesi gerektiğini belirttiler.

Öte yandan, çalışmadaki fen bilimleri öğretmenleri SKE'nin öncelikle bir devlet politikası olması gerektiğini ve sadece öğretmenlerin değil, diğer tüm meslek gruplarının da bilgilendirilmesi gerektiğini belirtti. Ayrıca, halkı bu konuda bilinçlendirmek için bir devlet politikası uygulanmasının, belediyeler ve ilgili bakanlıklar gibi bu öğrenme sürecini kolaylaştıracak kurumların bu konuyla ilgilenmeleri gerektiğini belirttiler.

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