ANALYSIS OF SCIENCE CURRICULUM AND TEXTBOOKS IN TERMS OF SUSTAINABLE DEVELOPMENT GOALS: A CASE STUDY

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

EDA TATLILIOĞLU

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
MATHEMATICS AND SCIENCE EDUCATION

SEPTEMBER 2019

Approval of the thesis:

ANALYSIS OF SCIENCE CURRICULUM AND TEXTBOOKS IN TERMS OF SUSTAINABLE DEVELOPMENT GOALS: A CASE STUDY

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ABSTRACT

ANALYSIS OF SCIENCE CURRICULUM AND TEXTBOOKS IN TERMS OF SUSTAINABLE DEVELOPMENT GOALS: A CASE STUDY

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September 2019, 293 pages

Education for Sustainable Development (ESD) will provide individuals to gain the perspectives of value, ethics, foreseen and long-term decision making on our future. Necessary knowledge and behavior related to Sustainable Development (SD) can be acquired with the help of education. Curriculum, on the other hand, can help students gain competences related to Sustainable Development Goals (SDGs) as well as guide them to achieve the goals of SD. Accordingly, equipping individuals of the future citizens with competences related to SDGs are important to handle challenges of global world.

The purpose of the study is to investigate how SDGs considering SDGs relevant competences (Knowledge and understanding; Skills and applications; Values and attitudes) are addressed in Middle School Science Curriculum (2018) and Science Textbooks (from 5^{th} to 8^{th} grades). In the study, a qualitative case study was conducted. Content analysis was applied for the analysis of the objectives of Science Curriculum and document analysis was employed for the analysis of Science Textbooks from 5^{th} to 8^{th} grades to present how SDGs related objectives are addressed in the textbooks.

According to the result of the study, there were reflected most of SDGs related objectives in 8^{th} grade. There were founded at least 6 out of 17 SDGs in each grades.

Moreover, Knowledge and understanding competence was founded dominant in the curriculum, while values and attitudes competence was addressed in only 7th and 8th grades. Considering SDGs in the three dimensions of SD, environmental dimension was stressed more in SDGs related objectives in the curriculum.

Keywords: Competences, Content Analysis, Science Curriculum, Science Textbooks, Sustainable Development Goals

ÖZ

FEN BİLİMLERİ DERSİ ÖĞRETİM PROGRAMININ VE DERS KİTAPLARININ SÜRDÜRÜLEBİLİR KALKINMA HEDEFLERİ AÇISINDAN ANALİZİ: BİR VAKA ÇALIŞMASI

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Tez Danışmanı: Prof. Dr. Gaye Teksöz

Eylül 2019, 293 sayfa

Sürdürülebilir Kalkınma için Eğitim (SKH) bireylere değer, etik, öngörü ve geleceğe yönelik uzun vadeli karar verme perspektifi kazanmalarını sağlamaktadır. Sürdürülebilir Kalkınma (SK) ilgili gerekli bilgi ve davranış eğitim ile edinilebilir. Müfredat ayrıca öğrencilerin Sürdürülebilir Kalkınma Hedefleri (SKH) hakkında yeterlilikler kazanmalarına yardımcı olmakta ve SKH'nin başarılması için onlara rehberlik etmektedir. Bu nedenle, geleceğin bireylerini kürsel dünyanın zorluklarıyla başa çıkmak için SKH ilgili becerileri kazandırmak önemlidir.

Çalışmanın amacı, Ortaokul Fen Bilimleri Dersi Öğretim Programı'nda (2018) ve Fen Ders Kitaplarında (5.-8. sınıflar) SKH ilgili yeterlilikler (Bilgi ve anlayış; Beceriler ve uygulamalar; Değerler ve tutumlar) dikkate alınarak Sürdürülebilir Kalkınma Hedefleri'nin nasıl ele alındığını araştırmaktır. Çalışma nitel araştırma yöntemleri kapsamında bir durum çalışması olarak yürütülmüştür. Fen müfredatının kazanımlarının analizinde içerik analizi uygulanmış ve SKH ilgili kazanımların ders kitaplarında nasıl yansıtıldığını göstermek amacıyla döküman analizi kullanılmıştır. Araştırma sonuçlarına göre, SKH ilgili kazanımların çoğu 8. sınıf da yer verilmiştir. Her bir sınıf düzeyinde için 17 SKH'den en az 6 sı bulunmuştur. Ayrıca, bilgi ve anlayış yeterliliği müfredatta en çok yer verilen yeterlilik iken değerler ve tutumlar

yeterliliği ise sadece 7. ve 8. sınıflarda bulunmuştur. SKH'in SK'nın üç boyutunda düşünüldüğünde, SKH ilgili kazanımlarda çevre boyutu daha fazla bahsedilmiştir

Anahtar Kelimeler: Fen Bilimleri Dersi Öğretim Programı, Fen Ders Kitapları, İçerik Analizi, Sürdürülebilir Kalkınma Hedefleri, Yeterlilikler

TO MY FAMILY

ACKNOWLEDGEMENTS

To begin with, I would like to express my sincere gratitude to my supervisor Prof. Dr. Gaye TEKSÖZ who always support, guide as well as encourage and believe me during my thesis writing process. I would also like to thank her for informing me about this important and valuable topic as Sustainable Development since my knowledge of this subject has changed my perspective on life. Throughout this process, my advisor always welcomed me with her smiling face and helped me with her valuable views. In addition, her effort, motivation and guidance helped me complete my study, while increasing my self-belief and confidence. I hope I can be someone like her and I thank for everything.

Moreover, I would like to express my gratitude to the members of thesis committee as Prof. Dr. Ceren ÖZTEKİN and Assist. Prof. Dr. Güliz KARAARSLAN SEMİZ for their contributions, valuable feedbacks and suggestions.

I am also thankful to my dear family as Huriye, Yusuf and my little sister Rüveyda TATLILIOĞLU. They always support and encourage me in this process. Their supports as well as their faith and trust me are the main reasons why I have proceeded confidently and steadily in my career and also my gratitude and love to my family cannot be expressed in words. I am grateful to them.

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LIST OF ABBREVIATIONS

→ **DESD:** Decade of Education for Sustainable Development

→ **ESD:** Education for Sustainable Development

→ **MDGs:** Millennium Development Goals

→ **MoNE:** Ministry of National Education of Republic of Turkey

→ **SD:** Sustainable Development

→ **SDGs:** Sustainable Development Goals

→ **UN:** United Nations

→ **UNESCO:** United Nations Educational, Scientific and Cultural Organization

→ **UNCED:** United Nations Conference on Environment and Development

→ **UNCHE:** United Nations Conference on Human Environment

→ **WCED:** World Commission on Environment and Development

→ **WCESD:** World Conference on Education for Sustainable Development

CHAPTER 1

INTRODUCTION

In this chapter, the sections of background of the study, the purpose and significance of the study as well as definitions of the terms finally are introduced.

1.1. The Background of the Study

The Industrial Revolution, which showed its effect in the 18th century, was a consequence of increasing population and emerging technology. In spite of the increase in scientific developments and human well-being, it has paved the way for the emergence of environmental problems, labor, urbanization and colonialism. The effects of humanity on society, environment and economy continued to increase exponentially since then. The results of these effects appeared in the history scene for the first time with the books which are both ‘‘Silent Spring’’ (Carson, 1962) and ‘‘The Population Bomb’’ (Ehrlich, 1968) that are about not only the impact of pesticide usage in agriculture on human and environment but also forcing population growth both environment and resources. These subjects were actually the first warning to humanity to show catastrophic impacts. However, the chain of events continued and great problems were encountered during the history such as oil spill, ozone layer depletion, nuclear accident, acid rains, debt crisis, health problems, toxics etc. (IISD, 2012).

The global world already begins to warn humanity about taking urgent measures for these issues. It led to the search for solutions both at the global level and locally to provide continuity of what we have as inherited our ancestors for future generations to benefit what nature provide. This case results in increasing significance of ensuring the sustainability since we do not live alone; therefore, livings around us also are

affected what we do. Accordingly, protection of the world should be continued by considering the world as a ‘‘home’’.

The concept of continuity was first embodied in the concept of sustainable development. This concept entered in our life with this definition of Brundtland Commission. It was described as ‘‘meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development [WCED], 1987, p.43). This shows the needs of the maintaining existing ones by adequately using without too much consumption. Sustainable development (SD) is not just as a concept or factors.

In 1992, Agenda 21(Earth Summit) as one of the outcomes of the United Nations Conference on Environment and Development (UNCED) was on about sustainability and global environmental problems solutions (Kates, Parris & Leiserowitz, 2005; Tuncer, Tekkaya & Sungur, 2005). Chapter 36 especially was devoted to the role of education for realization of Sustainable Development. The main issues were ‘‘reorienting education towards sustainable development, increasing public awareness, and promoting training’’ (United Nation Conference on Environment and Development [UNCED], 1992, para. 36.2). Therefore, it is noteworthy that Sustainable Development related revision should be made for the inclusion of the concepts in education.

In the meeting held in 2000, Millennium development goals (UN, 2000) can be seen as an important step for the certainty of sustainable development’ objectives and the place of education to achieve such goals. Education constitutes the heart of these goals since it is possible to tackle these problems via education.

Then, in 2002, at the Johannesburg Summit, the message of bringing people together and emphasized the pillars of sustainable development (economic- environment – social) at every levels from local to global (UN, 2002). In Rio de Janeiro, Brazil, the United Nations Conference on Sustainable Development was held (2012) and the aim of conference was stated that ‘‘renew our commitment to sustainable development and

to ensuring the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations'' (United Nations Conference on Sustainable Development, 2012, p.1). This shows that not only Sustainable Development concept but also taking an important role in education alone are not sufficient. At the same time, it is necessary to shape sustainable development around these three dimensions and to bring this vision to the people through education.

Education for sustainable development (ESD) is an inclusive structure of issues related to sustainable development; for example, reduction of poverty, biodiversity, sustainable consumption, climate change etc. Sustainable Development Education from this perspective aims not only to enhance the individual's consumption habits in terms of sustainability, but also to improve his / her attitudes and behaviors in this respect, to consider and decide on a sustainable future, as well as to improve the individual's ability to take action. For this reason, education and training applications should be developed in this regard (Teksöz, Ertük & Lise, 2014).

In addition, the United Nations (UN) decided on a training process to cover the 10-year period for embedding SD in education, in order to accelerate the work done in this field and ensure inclusion of sustainable development into education (Huckle & Wals, 2015). In 2015, 17 sustainable development goals (SDGs) covering all issues were decided in ''the United Nations Sustainable Development Summit'' (UN, 2015). The contents of SDGs constitute important issues such as poverty, hunger, water, cities, peace, health, education, energy, job, industry etc. The role of education, one of the targets of sustainable development, was described as:

> *By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and*

appreciation of cultural diversity and of culture's contribution to sustainable development. (UN, 2015, p.17)

While sustainable development targets bring a vision for change and development, education enables and facilitates these goals to be realized (Awate et al., n.d.) so acquiring the necessary skills as well as knowledge are requisite for the realization of Sustainable Development and its goals. In addition, both a sustainable world, the decision-making and participation in SD related issues are possible with the individuals who can change and do something in this direction. In order to create a sustainable future, individuals should have necessary knowledge, skills, values and attitudes; and therefore, education plays a crucial role in achievement of Sustainable Development. Moreover, ESD aims to acquire and develop skills such as questioning individuals ' own behavior, thinking about what their impact might be on social, environmental as well as economic aspects (Rieckmann, 2017).

Students' skills such as knowledge, skills, value and attitude can be provided with well-designed textbook and curricula which have the characteristics of a guide and shape the education. To this end, a curriculum framework as ''Curriculum Framework for the Sustainable Development Goals'' (Osman et al., 2017) has been prepared considering the impact of education on achieving development and Sustainable Development Goals. With the guide of the framework, individuals will acquire the competences as knowledge, skills, values and attitudes. It can guide countries to revise their curricula in order to fulfillment of Sustainable Development. Also, it is aimed at in this study, growing individuals who have played a role in achieving sustainable development goals should gain competences such as '(a) knowledge and understanding, (b) skills and applications and (c) values and attitudes' through education and learning (Osman et al., 2017).

In addition to curriculum, the importance of textbooks for conveying of Sustainable Development should be regarded since textbooks involve values of a society, policies as well as knowledge and comprehending of the history. From the perspectives of both

teachers and students, textbooks are considered informative and authoritative. Moreover, information in textbooks are assumed as accurate as well as including practices related to pedagogy and recent scientific related results. They have also a determinative role in teaching (UNESCO, 2016). Textbooks also address values and priorities for communities, so examination of the content of textbooks will provide high quality curricula in education (Jimenez, Lerch & Bromley, 2017). In the available textbooks, on the other hand, there are topics from behavior related norms in cultures or contexts, issues related to environment to technology, health, animals etc. (Mohammadnia & Moghadam, 2019). Accordingly, it may be inferred that textbooks cover many issues or topics related to our life. When reviewing the context of SDGs, they also include the issues related to daily life problems. Therefore, embedding these issues in textbooks is noteworthy. Teachers also can design their plans and teaching practices based on well-designed textbooks which contain variety of crucial issues of worldwide in this way. Analysis of the content of the textbooks, therefore, should be made to see which extent these tools promote actualization of the goals of SD.

Furthermore, one of the lessons that will have crucial a role for training of individuals with Sustainable Development skills is Science Education since Science Education has inter disciplinary structure (biology, chemistry, physic, astronomy and geology). It means that it is possible to find all issues from biodiversity loss to disaster reduction which there can be encountered in our daily life as well as global issues. In Turkey, Sustainable Development Education was included in both 2005 and 2013 Science Curriculums (Ateş, 2019).

When considering the importance embedding such competences and sustainable development concept into national curricula as well as inclusion of SD in previous curriculums, it raises questions of the place of both competences, SDGs and SD in updated Science curriculum.

1.2. The Purpose of the Study

The aim of the study is to explore how Sustainable Development Goals (SDGs) considering SDGs relevant competences (Knowledge and understanding; Skills and applications; Values and attitudes) are reflected in Middle School Science Curriculum (2018) and Science Textbooks (from 5th to 8th grades).

The research questions of the thesis to be answered in for the first part (examination of the curriculum) are as following:

1. Which objectives in Middle School Science Curriculum (2018) for 5-8 grades are related to Sustainable Development Goals (SDGs)?
   - **1.1.** What are the ratios of the SDGs in determined objectives in the 5th to 8th grade Science Curriculum?
2. What are the clusters of learning competences (knowledge and understanding; skills and applications; values and attitudes) for the SDGs in the Science Curriculum for 5-8 grades?
   - **2.1.** How are the clusters of learning competences (knowledge and understanding; skills and applications; values and attitudes) of SDGs distributed in the Science Curriculum for grades 5th to 8th?
3. What are the learning outcomes for the learning competences for the SDGs in the Science Curriculum for 5-8 grades?
4. How is the distribution of the SDGs related objectives in three dimensions of SD (economic, social and environmental)?
5. How is the distribution of the SDGs related objectives according to the total number of objectives in the Science Curriculum (2018)?
6. How is the distribution of SDGs related chapters and subject areas by grade levels in the Science Curriculum (2018)?
7. How is the distribution of SDGs related objectives according to grade levels and learning areas in the Science Curriculum (2018)?

The research questions of the thesis to be answered for the second part (examination of the textbooks) are as following:

1. How are SDGs related objectives in Middle School Science Curriculum (2018) reflected in Science Textbooks approved by the Ministry of National Education?
   - **1.1.** How is the distribution of activities related to SDGs according to the total number of activities in Science textbooks by grades?
   - **1.2.** How is the distribution of SDGs related objectives in the parts of Science textbooks by grade levels?

1.3. Definitions of the Terms

►**Sustainable Development**: ‘‘Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs’’ (World Commission on Environment and Development [WCED], 1987, p.43).

►**Education for Sustainable Development**: it is related to:

> A learning process based on the ideals and principles that underlie sustainability and is concerned with all levels and types of learning to provide quality education and foster sustainable human development – learning to know, learning to be, learning to live together, learning to do and learning to transform oneself and society. (UNESCO, 2011, para.1)

►**Sustainable Development Goals**: these goals are the global targets integrated into the environment, economy and social dimensions of SD aiming at achieving global issues such as:

> no poverty; zero hunger; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; sustainable industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice and strong institutions; partnerships. (UN, n.d.)

►**Competence:** According to Weinert (2001), competencies are that ‘‘the positive combination of knowledge, ability and willingness in the ability of individual to cope successfully and responsibly with changing situations’’ (as cited in Adomßent & Hoffmann, 2013, p.3).

►**Knowledge and understanding**: It is related to the concepts as

> understanding of environmental, social and economic as well as local, national and global challenges and complexities and also conflicts and challenges related to socio-political ones; differential and multiscalar understanding; knowledge to respond to these challenges and complexities; multiple literacies; life skills; systems theory and reflexivity. (Osman et al., 2017, p. 11)

►**Skills and applications:** It is pertinent to the concepts as:

analysis; factfinding; listening, observing and problem solving; independent learning and critical thinking; planning and decision making; ability to identify and solve problems, and to set goals; capacity to think independently; goal- setting, effective communication and social integration, self-reflective and reflective skills. (Osman et al., 2017, p. 11)

►**Values and attitudes:** It is about the concepts as:

sense of purpose and hope; Confidence, resilience and adaptability; openness, respect for diversity; communication, engagement and integration; Responsible, active, productive and engaged citizens; duty bearers; Self-esteem, self-understanding and clearer sense of identity; commitment to justice and community engagement for constructive responses to societal issues. (Osman et al., 2017, p. 11)

1.4. The Significance of the Study

Sustainable Development (SD) concept begins to take place firstly in developmental countries as a gate to possess people (student, teachers and other people) necessary knowledge on understanding changing world and continuity in future generations with well-preserved world. In that point, the importance and place of education is increasing. The importance of education was stated as ‘‘*Education is key to the global integrated framework of sustainable development goals. Education is at the hearth of our efforts both to adapt to change and to transform the world within which we live’’* (Didham & Manu, 2015, p.96).

ESD not only provides information on issues such as environment, social and economy, but also gives individuals values, perspectives and skills on issues such as sustainable life, decision-making and livelihood in society. In addition, local and global issues are the subjects of education for sustainable development so 'knowledge, skills, values, perspectives and global issues' should be addressed in the curriculums; and therefore, it requires revision on the curriculums accordingly (McKeown et al., 2002).

In view of the place of education in achieving SD, skills acquisition and sustainable development goals, curricula and textbooks, which are the cornerstones of education, should prepare students for the sustainable future as decision-makers and citizens; and therefore, it is important to identify both objectives and content of the textbooks to present to which extent Science Education Curriculum and Textbooks are successful to address these important subjects.

From the perspectives of SDGs, ESD is important for realization of SDGs by individuals. Accordingly, ESD prepares individuals to gain necessary both competences and knowledge, while it provides understanding of SDGs as well as engagement of citizens who are informed (UNESCO, 2017). The current study, therefore, will present how updated Science Curriculum together with Textbooks reflect SDGs and the place of curriculum for achievement of SDGs. Furthermore, there will be addressed corresponding SDGs competences for each grade levels in the curriculum. The findings of the current study may provide creation of a pathway to determine the ways of realization the goals in education and educating students to equip with competences related to SDGs for overcoming challenges of problems.

When examining the curriculums, Sustainable development was included in the previous curriculums as well. To illustrate, for 2005 Science Curriculum, there were included many objectives related the goals of sustainable development. Besides the interaction of science, technology and environment, it was emphasized to educate individuals who are aware of social, values, environmental and health problems as

well as economy. In the curriculum of 2013, the purpose was to develop awareness of Sustainable Development. In the curriculum, a title for Sustainable Development was devoted to the concept. In addition, the acquisition of behaviors towards Sustainable Development Goals was at the focus (Atmaca, 2018).

In addition, ‘‘textbooks present a largely untapped opportunity to integrate peace, global citizenship and sustainable development into formal education’’ (UNESCO, 2017, p.23).

It is noticeable to see linkage of science to Sustainable Development. In Science textbook, during teaching of ecosystem dynamics, the declination of bee population signs of human action results on ecosystem disruption can be discussed. Through this learning process, students will be active to make decisions and to solve problems about related environment, social, technology, economy, politics or scientific (UNESCO, 2017).

The study will show how the textbooks reflect SDGs and relevant competences. With this study, it can be helpful to revise textbooks to be a resource in providing students to find and understand solutions to the problems of the global world, and to guide them through their content as well as to gain the necessary competencies.

In the renewed curriculum, it is important to reveal the type of skills to be given to students as knowledge, skill or value as well as which Sustainable Development Goals taught individuals since considering that sustainable development has an important place today, it is important for the revision of curriculums (primary, secondary and higher education) with respect to inclusive of SD. In this way, the number of individuals who become more aware and sensitive to the environment will increase; and therefore, curricula in this respect should be revised (Türer & Çobanoğlu, 2015).

In this respect, the study will promote presenting of necessary competences for achieving SDGs and will be able to provide information on which goals are addressed in the curriculum and textbooks. The study will guide policy-makers, curriculum developers, educators, teachers to embed SDG in the curriculums, courses, textbooks,

teaching etc. Moreover, the study will also provide improvement of both the curriculum and textbooks for inclusion of SDGs and relevant competencies.

Moreover, there exist reports, documents and studies related to SD and SDGs in Turkey. For example, some of documents are ‘‘Turkey’s Sustainable Development Pathway Towards Agenda 2030’’ (Ministry of Development, 2015), ‘‘Report on Turkey’s Initial Steps Towards the Implementation of the 2030 Agenda for Sustainable Development’’ (Ministry of Development, 2016) and the project of Ministry of Development on ‘‘Turkey's Current Situation Analysis Project within the Scope of Sustainable Development Goals (Sürdürülebilir Kalkınma Hedefleri Kapsamında Türkiye’nin Mevcut Durum Analizi Projesi)’’ (Kalkınma Bakanlığı, 2017). Regarding of these documents, it shows the importance of Turkey to SDGs. Therefore, it is important to the investigation of the current situation related to SDGs in the curriculum as well; and therefore, both 2018 Science Curriculum and Science Textbooks were analyzed.

In the literature, it has been noticed that the number of studies conducted in this area is a few and these studies focus on examining the curriculum (Tanrıverdi, 2009; Kaya & Tomal, 2011; Demirbaş, 2011; Yalçınkaya, 2013; Şahin, 2016; Demirci, 2017; Ateş, 2019) and competences as knowledge, skills and values (Boehn & Hamann, 2011; Jóhannesson et al., 2011; Haque, 2014; Sætre, 2016) separately. This gap will be completed and the study will bring a new perspective on the curriculum and textbooks in terms of SDGs and relevant competencies.

CHAPTER 2

LITERATURE REVIEW

Examination of SDGs reflections in both science curriculum and textbooks construct the main scope of the research. As a new developing concept and for sustainable future, the beliefs on fulfilling such future with education is increasing day by day so in this condition, those who will achieve these goals are students acquired with essential knowledge, understanding, pedagogy and all competent so due to structure of science education like consisting of subjects from daily life and most related to SD with especially environment and other dimensions.

Therefore, this field requires looking with sustainable perspective gaining through science education and to understand this perspective and necessary skills to integrate learning of science this concept causes detailed examination of the concept from curriculum perspective. Therefore, in this chapter there are presented the theoretical background of Sustainable Development (SD) at the beginning. Later, brief description of Education for Sustainable Development are presented and finally Sustainable Development Goals (SDGs) are introduced in terms of education perspective.

2.1. Sustainable Development

The most faced term in this global world conditions is ‘’Sustainable Development ‘’. In addition to sustainable development, first comes into mind is what sustainability is. Two terms seem similar actually they are two interrelated terms. According to O’ Riordan (1985), the separation among term is sustainability is related environment. On the other hand, sustainable development is mostly about development. The term of sustainable development may be placed into many concepts in our life but the understanding the concept occur in the Brundtland Commission and its report as Our

Common Future (WCED, 1987). The definition of the concept in the conference held in 1987 at Nairobi is "*development that meets the need of the present without compromising the ability of future generations to meet their own needs"* (p.43). As seen in the definition, it can be thought as in briefly thinking twice before acting, using and fulfilling in or for our needs since all things present now are shaped by past and present will shape the future so future generations should be focus of our actions. Moreover, when the general structure of the report is examined, it is seen that the report has twelve subheadings and issues covered in each were (WCED, 1987):

Table 2.1. *The Issues Covered in the Report of Our Common Future in Its All Chapters (World Commission on Environment and Development [WCED], 1987)*

Chapters	The Issues Covered in the Report
Chapter 1	Threatened future: poverty, growth, economic crisis etc.
Chapter 2	Towards Sustainable Development: sustainable development concept, quality of growth, meeting essential human needs, sustainable population, conservation of resource, reorienting technology and risk management, environment and economic
Chapter3	International Economy: trade, finance, sustainable world economy, investments etc.
Chapter 4	Population and Human Resources: environment and development, population etc.
Chapter 5	Food Security: soil resources, chemicals, forests, deserts, sustainable food security, land usage, water management, agriculture, aquaculture, technology, equity etc.
Chapter 6	Species and Ecosystem: extinction, causes of extinction, species etc.
Chapter 7	Energy: energy, economy, environment, fossil fuels, nuclear energy, renewable energy, energy efficiency etc.
Chapter 8	Industry: industry impact, sustainable industries etc.
Chapter 9	Urban Challenge: cities, urban challenges etc.
Chapter 10	Managing the Commons: oceans, space, Antarctica etc.
Chapter 11	Peace, Security, Development and Environment: environmental stress, security and SD, wars and weapons etc.

Table 2.1 *Continued*

Chapters	The Issues Covered in the Report
Chapter 12	Common Action: international cooperation, rights, institutional and legal change etc.

As it can be seen in the report, global equality can be realized when the economic development that will bring equal distribution between the poor and the rich provide meeting of the needs of people especially in poor regions. Besides, in the report, it was reflected a belief that the environment was preserved, social equality was ensured and at the same time the economy was possible to growth (Du Pisani, 2006; Barbosa, Drach & Corbella, 2014). In addition to the first definition of the concept at this conference, it is possible to see more than one interpreted definition of SD (e.g. Lele, 1991; Sterling, 2010).

Moreover, the term does not involve environmental dimension as well as economic and social dimensions too. On the other hand, SD is not sufficient for achieving its objectives by itself. SD has been fully realized when thinking the environment, economy and social dimensions are thought as a whole, inseparable and these are fulfilled together and integrated to the term (Goodland, 1995; Turan & Çobanoğlu, 2012). This shows that sustainable development is not just a concept itself, it includes economic, social and environmental aspects as well. The most final shape of sustainable development was seen in the Brundtland model of SD. The reaffirm sustainable development key areas at Johannesburg Summit and UNESCO (2006) indicated these three dimensions of SD as:

- **Economic dimension:** to be aware of not only the restrictions but also potential of economic development and to consider the extent to which the environment and society will be affected. In this respect, evaluation of the level of consumption and society based on justice and environment is provided

- **Social dimension:** to grasp not only democratic system where everyone can express their opinion freely, common opinions are shared, providing of the right to be part in vote and privileges are removed but also the roles of institutions in the society
- **Environmental dimension:** to comprehend the vital importance of the environment and resources and consider the consequences of sanctions on these issues in terms of economics and social aspects.

The relationship of three pillars of SD are figured out in *Figure 2.1.* There exists an interaction in each three aspects and if one of them cannot be achieved, others will be affected, and sustainable development will not be provided.

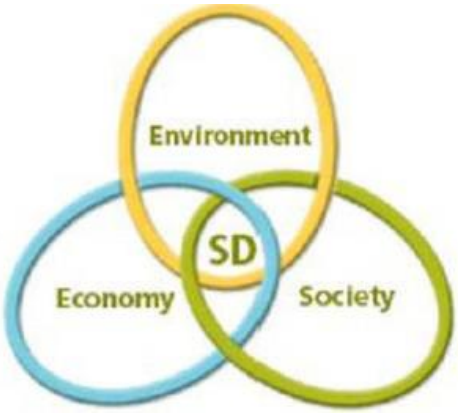

Figure 2.1. Sustainable development three dimensions (Şahin, 2008, p.26)

Fifteen sub-topics were identified for each dimension of SD and these sub-themes or perspectives are (UNESCO, 2006, pp.18-20; Olsson, 2014, p.18; Berglund et al., 2014, p.320):

- **Economic perspectives**: ‘‘poverty reduction, corporate responsibility and accountability and market economy’’.

- **Socio-cultural perspectives**: ‘‘human rights, peace and human security, gender equality, cultural diversity and intercultural understanding, health, HIV/AIDS and governance’’.
- **Environmental perspectives:** ‘‘natural resources (water, energy, agriculture, biodiversity), climate change, rural development, sustainable urbanization and disaster prevention and mitigation’’.

Without one of the pillar, SD will move away from the concept of development and this will be result in not fulfilling of as a whole development with its society, economy or environment since all these concepts is actually are like chain and affect each other. The importance can be resembled as in the center of same size overlapping circles of three dimensions is thought, the area of overlapping part become increasing so it results in human well-being (McKeown, 2002) so this shows how three dimension are powerful for development together.

Later, there occurs the other dimensions in such studies and one of them in addition to these dimensions as cultural aspect and in the study of Mignaqui (2014), there is added the political dimension as well.

As a result, every country needs or development of some policies to fulfill such principles so it shows that all that needs to be done should be done together but while implementing sustainability both economy, environment and society should be taken consideration. All these principles present a need of action to integrate them into our lives so for this purpose there should be goals to put into practice sustainability into life as in national and international level.

2.1.1. The Historical Development of SD

The 1960's can be considered as the years when Sustainable Development slowly emerged on the stage of history. In this respect, the first study published by R. Carson ‘s Silent Spring book in 1962 can be shown (Kaya, Çobanoğlu & Artvinli, 2010). The book was written due to prevent the problems that may arise on the increased usage of pesticides before it was too late for humanity and environment. It emphasized that

the use of these long-term pesticides will result in destroying not only environment such as the natural life and species but also people as well since the toxic chemicals either kill species or destroy food chain and the chemical structure of the soil. Over the years, it was understood that the after the emergence of the damages caused by the use, warnings were important so later, the use of the drugs was ended (Carson, 1962).

After four years later, Paul Ehrlich published ‘‘the Population Bomb’’ in 1968. He described Earth current situation as that together with increasing of birth rates and together with the need for food and this was forcing cultivation. This resulted in environmental damage and the stretching carrying capacity of the world (Ehrlich, 1968). Consequently, this situation would end with that the existing resources could not meet the need after a period of time (Gudmundsson et al., 2016). For this reason, the book contains recommendations on how to take control of the population.

In 1972, a study called ‘‘the Limits to Growth’’ as a kind of report, was published in the form of a book by the Massachusetts Institute of Technology as a request of the Roma club (Bozloğan, 2010). Poverty, environmental degradation, increase in urbanization, lack of job security, fair institutions, economic losses and demolitions, youth and traditional values are the main themes of the study. Moreover, the focus of the team as five main factors can be listed as ‘‘limit, growth on the planet, population, agriculture, natural resources, pollution and industrial production’’ (Meadow et al., 1968, p.11). It was thought the growth in both population and economic would force the nature and increasing this rate end up with not supporting the Earth at all. In addition, the effects of all these factors was presented over the exponential growth curves. (Meadow et al., 1968). It is emphasized that development policies should also be considered in relation to the environment and economy and that the natural environment is damaged due to development (Kaypak, 2011). Besides, one of the greatest outcomes of the current situation such as environmental problems and scarcity of raw materials was thought to be the extinction of humanity (Bozloğan, 2010).

All these events have led to the necessity to make common decisions on these problems. The United Nations Conference on Human Environment (in 1972, Stockholm) was one of the most important steps taken for this purpose. Environmental Protection and strengthening of human relations were the main issues of the conference (United Nations [UN], 1972).

During 26 principles in the report of the conference, some issues were addressed that humanity destructs ecology, causes pollutions, deplete natural resources and also problems as a result of population growth. Also, harmless effects of toxic substances, nonrenewable resources, urbanization, education's role, technology and research, economy and natural disasters were some of issues discussed in the conference. In terms of results, the conference is globally important (Özmehmet, 2008).

Later, the United Nations Conference on Environment and Development (as ''Earth Summit'') was hold in Rio de Janerio, Brazil, 1992 with a great participation of the countries to see challenges, improvements or other issues derived until this time and review previous declaration. The conference focuses on natural resource destruction, pollution and economy in addition to economic development. The massage was on environmental effects of both poverty and consumption. As a result of the conference five agreements were adopted and these agreements were ''Agenda 21, the Rio Declaration on Environment and Development, the Statement of Forest Principles, the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity'' (Ergün & Çobanoğlu, 2012, p.105).

Agenda 21 documents aims to mention today world problems and guide humanity facing challenges during life time. It involves 40 chapters that covers the issues such as poverty, consumption, health conditions, sustainable settlement, protection of atmosphere, land resources, deforestation, desertification, rural development, agriculture, biodiversity, oceans, toxic chemicals, wastes, global action, children and youth, ingenious people, non-governmental organizations, industry, technology, financial resources, education role etc. (UN, 1992). In each chapter, environment and

Sustainable Development issues come forward. Moreover, due to the agenda that includes a wide range of global what should be done for these problems, it can be thought as handbook of humanity.

United Nations Millennium Development Summit is one of the most important summits related to SD. The summit was hold in 2000 (New York) and eight millennium development goals (MDGs) were set in order to achieve SD and it was decided to be realized by 2015 (UN, 2000). The specified Millennium Development Goals (MDGs) were (UN, n.d.):

1- Eradicate extreme poverty and hunger
2- Achieve universal primary education
3- Promote gender equality and empower women
4- Reduce child mortality
5- Improve maternal health
6- Combat HIV/AIDS, malaria and other diseases
7- Ensure environmental sustainability
8- Develop a global partnership for development.

In 2002, the World Summit on Sustainable Development hold in Johannesburg (South Africa) was made to evaluate whether the decisions taken at the conference in 1992 in Rio de Janerio were carried out or not (Bozloğan, 2010) so it also known as Rio + 10. Accordingly, it is important to strengthen and incorporation of the sustainable development dimensions as social, economic as well as environmental in both local and global level. The realization of SD depends on the end of poverty, management and conservation of natural resources, sustainable production and consumption. In addition to these issues, health and SD, the situation of SD in Africa and in the world were covered. (UN, 2002). At the end of the conference, documents including ‘‘Action Plan and ‘‘Johannesburg Declaration’’ were accepted (Bozloğan, 2010).

United Nations conference on Sustainable Development (Rio + 20) was done in Rio de Janerio, Brazil (in 2012). There were made revisions and commitments both

whether tree aspects of SD as social, economic and environmental ones were promoted or not and sustainable development. The urgency of poverty reduction and hunger were addressed. Moreover, the achievement previous goals, Rio principles and outcomes of summits and action plans were evaluated.

At the end of the conference, a document named ‘‘The Future We Want’’ appeared as a document (Aytar, 2016, p.12). According to this document, three pillars of SD and intergovernmental arrangements should be strength. Apart from this, green economy should be provided for SD. Furthermore, some issues mentioned were ‘‘reduction of poverty, sustainable agriculture, food security, water and sanitation, energy, sustainable transport, cities and transport, population, health, decent work, oceans, small islands, climate change, biodiversity etc.’’ (UN, 2012).

Later, the governments and representatives met in New York in 2015 for the United Nations Headquarters for agreement on SDGs. At the end of the meeting, ‘‘Transforming our world: The 2030 agenda for sustainable development’’ (UN, 2015) was declared and decided to achieve 17 goals together with corresponding 169 targets by 2030.

In addition to the determination of the targets, the aim was to realize the goals of the thousand years that have not been realized before and to integrate and achieve the three dimensions of SD. Moreover, the realization of SD takes place around five basic themes about (UN, 2015):

- **People**: ensuring of poverty reduction, equality, dignity, healthy environment and reducing of hunger.

- **Planet**: elimination of degradation on account of protection of planet through sustainable natural resource management, consumption and production as well as action related to resilience for climate change.

- **Prosperity**: promotion of a welfare and desired life for people and continue harmony within the economy, social, environment and technology.

- **Peace**: creation of societies where peace is dominant, and fear and violence do not involve. Peace can be equal to sustainable development as a vice versa relationship.

- **Partnership**: encouragement of cooperation for SD and focusing on vulnerable and the poor by empowering global solidarity.

17 objectives and objectives that are important for the realization of SD are described in *Figure 2.2 (UN, 2015, p.14) as:*

Figure 2.2. Sustainable Development Goals (UN, 2015, p.14)

From beginning and continuing sustainable development's historical development can be presented in the following *Figure 2.3.*

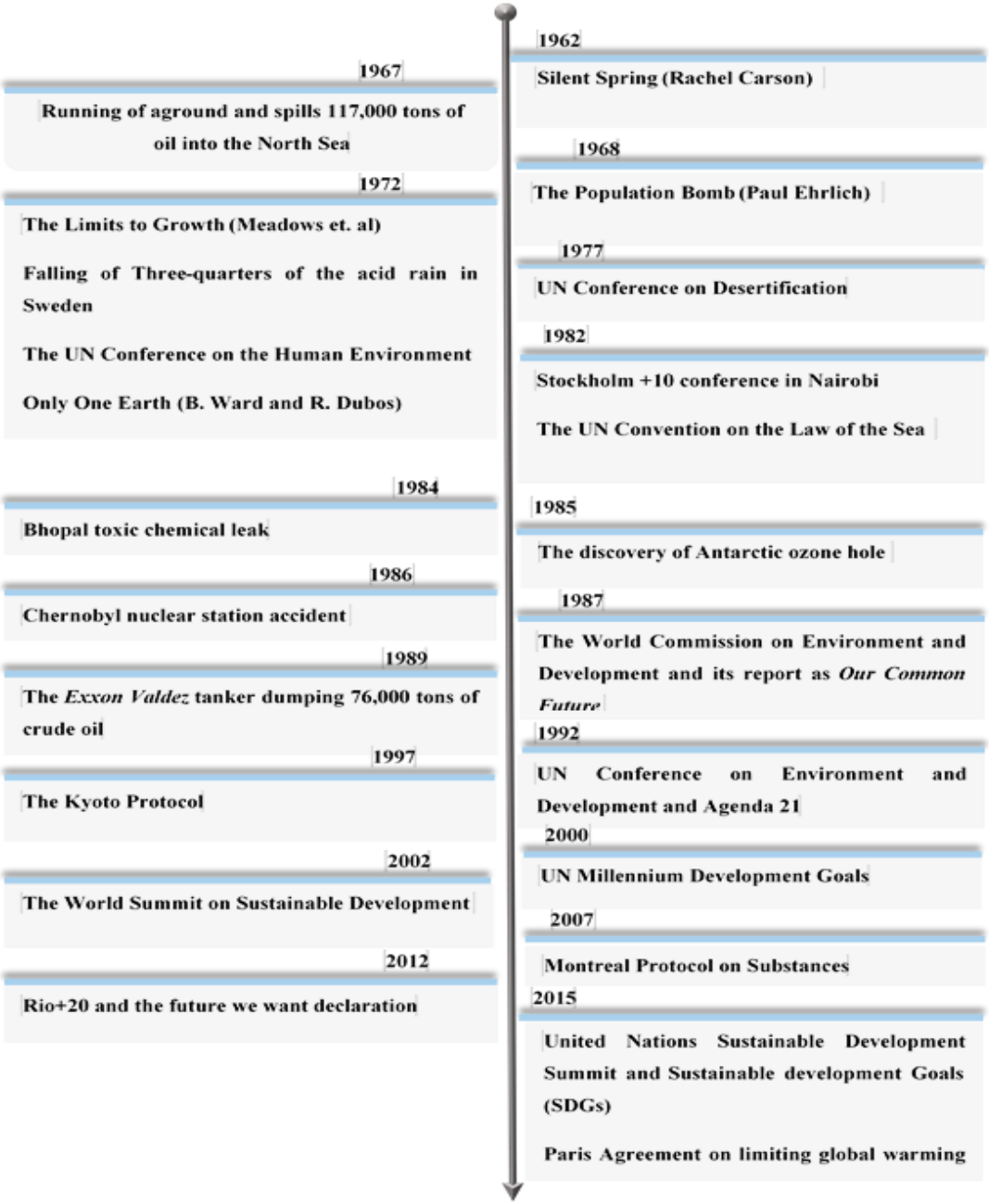

Figure 2.3. A Brief Historical Development of Sustainable Development (International Institute for Sustainable Development [IISD], 2012; Worldwatch Institute, n.d.)

2.2. Education for Sustainable Development and Sustainable Development Goals

Education is a long-term process that starts in the early childhood and continues throughout life (UNECE, n.d.). During this process, because of education shaping our lives in all aspects, it is possible to see reflection of education outcomes in lifestyles of today, tomorrow and future individuals and these individuals will also affect the societies in which they are in this direction. Also, it can be ensured by the guidance of training people to find solutions to problems and to search for new ways for a sustainable and better future. Therefore, education is important for implication of sustainable development (UNESCO, 2012) and it is also prerequisite for SD (Keleş, 2007).

‘‘Education for sustainable development is an emerging but dynamic concept that encompasses a new vision of education that seeks to empower people of all ages to assume responsibility for creating a sustainable future’’ (UNESCO, 2002, p.7). The integration of the important issues related to SD into education and to gain people necessary competencies and behaviors for a sustainable lifestyle are all about ESD (Dannenberg & Grapentin, 2016).

The main goal of ESD is to ensure quality education for a sustainable life and society, as well as to provide related value, lifestyle and behavior (UNESCO, n.d.). Some of ESD characteristics are (UNESCO, 2005b, p.30-31; UNESCO, 2007, p.6):

- has values and also principles regarding to SD
- includes economic, environmental and social dimensions of SD
- adopts a lifelong learning approach
- is culturally reflective in addition to locally inclusive
- presents local needs as well as cases
- embraces new subjects involving SD

- highlights not only local issues but also global issues
- aims at the realization of the management of the environment, quality life, decision making, labor force and also tolerance
- has a structure involving all disciplines
- the application of teaching techniques to increase higher order skills.

Furthermore, three dimensions as economic, environmental and social of SD should be included in ESD as a whole so it can be stated as information coming from these aspects form the basis of sustainable development education (Engin, 2010) since SD can be realized if all the dimensions of the concept are mentioned together. Only the environment alone does not mean that SD is and also economy and social issues are also directly related to this concept. For this reason, an effective ESD can be achieved by focusing on both environmental, economic and social outcomes (UNECE, n.d.).

In addition, education is indispensable for the realization of the goals for SD and it will encourage individuals to live, decide and act in line with these targets at every moment of their life. The part that is specifically devoted to education among 17 SDGs of UN (2015) shows that these goals are focused on education. The specified targets for education and SD under Goal 4 (Quality Education) are stated (UN, 2015, p.17).

Figure 2.4. Goal 4 (Quality Education) (UN, 2015, p.17)

Especially in the goal of 4.7, the goal of education is to provide the necessary not only knowledge but also skills for SD. In this sense, it is thought that the education system in Ireland should contribute to sustainable development. That SD related knowledge, skills and values of individuals will provide them to become knowledgeable, as well as to become an active citizen to take action for a sustainable future are highlighted (DES, 2014).

2.2.1. The Emergence of the Concept of ESD in History

The history of Sustainable Development Education dates back to conference related to environmental education hold in Tbilisi (1977) before appearing of SD concept in Brundtland report. The subject of UNESCO conference was on understanding environmental education as lifelong learning process. Also, awareness, participation, competences, knowledge and attitudes now known as the targets of environmental education (Michelsen & Wells, 2017). ESD was defined the first time at Agenda 21 at Chapter 36 as one of outcome of the United Nations conference on the Environment and development (in Rio de Janerio, Brazil, 1992) (Atmaca, 2018). In the document, education had an important role to attain a sustainable future (Ryan & Tilbury, 2013).

In Chapter 36, the role of education in sustainable development was explained that both formal and informal education as well as public awareness together with training are important process for societies and humanity to reach to peak. Therefore, education is necessary for promotion of Sustainable Development in addition to improvement of the capacity for highlighting development and environment related issues. On the other hand, both environment and development education are promoted by basic education so it should be also integrated into learning as well. Education (both informal and formal) can change attitudes people. In this manner, there can be expressed and assessed concerns related to sustainable development (UN, 1992).

There were indicated four major thrusts in Chapter 36 ‘‘improve basic education, reorient existing education to address sustainable development, develop public understanding, awareness and training’’ (McKeown, 2002, p.15; McKeown &

Hopkins, 2003, p.119). Later on, United Nations Millennium Declaration (2000) specified the necessity of basic education and access to education equally without discrimination between boys and girls. The Earth Charter prepared by the United Nations in 2001 also indicated that knowledge, values and skills should be integrated into formal education as well as lifelong learning for sustainable life. For this purpose, some of the goals under this principle were educational opportunities contributing to SD for children and youths and increasing the effectiveness of science, arts and also humanities in sustainable education (Earth Charter Initiative, 2001).

Later, it was decided that the periods of 2005-2014 as 'the Decade of education for Sustainable Development' in 2002 by United Nations (Venkataraman, 2009). The aim of the declaration was that for a sustainable society, education and learning encompass sustainable development from all aspects while promoting of knowledge, attitudes as well as values (UNESCO, 2014b). In addition, it was emphasized that education was an inevitable factor for actualizing of Sustainable Development (UN, 2003). Besides, the focused implementation strategies of the Decade were (UNESCO, 2005a):

- **Promoting and improving quality education**: encouragement of sustainable livelihood and lifestyle through knowledge, skills, values and perspective during lifetime
- **Reorienting educational programmes:** revising programs by including SD related knowledge, skills, perspectives and values
- **Building public understanding and awareness:** increasing of awareness with help of education for community and media to inform citizens
- **Providing practical training:** sectors such as business or industry can provide training their workers to gain sustainable perspective in their acts and decisions. From local to global, sustainability can be ensured by all sectors.

In 2005, UNECE member states gathered at ‘‘High-level meeting of Environment and Education Ministries’’ in Vilnus and adopted ‘‘UNECE Strategy for Education for Sustainable Development (UNECE, 2009). The focus of the strategy was to placing of ESD in all learning types as formal, non-formal and in formal, equipped educators with related SD competences for their teaching, ensuring of accessible materials for ESD, promoting cooperation, research and development for ESD (UNECE, 2009). Another event that advocates the need for education for sustainable development is ‘‘Bonn Declaration’’ which was adopted at the conference of ‘UNESCO World Conference on Education for Sustainable Development’ (2009).

The declaration underlined that ESD brings a new perspective on education and learning education and includes people in this process as well as providing quality education for all. Also, there was identified the necessity of values, principles and practices in order to cope with the challenges of today or future. At policy and practice level: embedding ESD in education ensuring quality education, informing people about SD, reorienting education for sustainability, incorporation of issues on SD into not only formal but also non-formal education and including ESD in curriculum and programmes for teacher education were some of considered implementations for ESD.

Afterwards, the United Nations Conference on Sustainable development (Rio +20) hold in 2012 published a document as ‘‘The Future We Want’’ (UN, 2012). One of the thematic areas was about education. According to the document, quality education is effective in achieving Sustainable Development, but also the need for gender equality, human development and poverty reduction as well as realization of MDGs etc. Moreover, development of education systems should be improved in order to ensure continuity of people in their lives along with SD and some of the things to be done in this respect were revising of teacher training, curricula, education programs and communication technologies in accordance with sustainability (UN, 2012). After two years later, ‘‘Aichi-Nagoya Declaration on Education for Sustainable Development’’ (UNESCO, 2014a) adopted in the UNESCO World Conference on Education for Sustainable Development in 2014 in order to achieve the goal of the

concept of sustainable development while accelerating the implementation of ESD and to integration of three dimensions of Sustainable Development.

Furthermore, it was emphasized that the necessary knowledge, behavior, skills and values are needed for individuals who have a global citizenship and a solution to the problems of the present and the future while performing critical thinking, problem solving, systemic thinking etc. and ESD should increase capacity of embedding this issues. Moreover, it was aimed at integration of ESD into from curricula to policies (UNESCO, 2014). By 2015, the relationship among education and sustainable development becomes more evident. At agenda ‘‘Transforming our world: the 2030 Agenda for Sustainable Development’’ (UN, 2015) identified 17 objectives for SD, in addition to stressing accessing not only quality, equal, free but also basic education for all, it was emphasized encouragement of acquiring such as knowledge and skill for SD until 2030 via education for sustainable development while envisioning the issues such as gender equality, rights, peace, sustainable lifestyle etc. (UN, 2015).

When overviewing main targets and also principles, they put the center education and the place of sustainable development in education. In addition, it is thought that sustainable development can be reflected in both lifestyle, perspective, attitudes and values with the help of education. The historical development of ESD can be summarized in *Figure 2.5.*

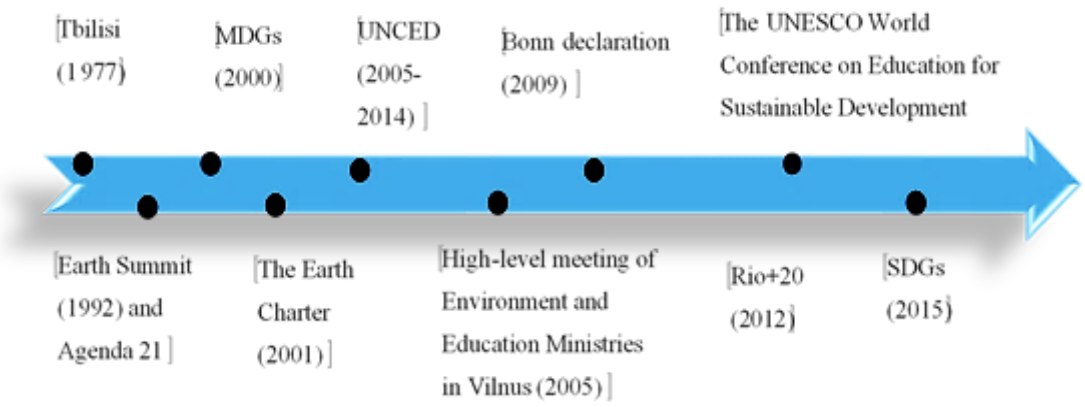

Figure 2.5. The Historical Development Timeline for Education for Sustainable Development

2.2.2. Competencies for Education for Sustainable Development

Integration of SD three aspects (social, economic and environmental) in ESD is not enough to educate individuals who understood and adopt SD alone. There is a need to be citizens who well equipped with SD related competencies because the problems we face in this globalizing world, the solutions we produce or the new developments that are found no longer affect just locally but also concern the entire humanity. From this perspective, this necessitates the existence of individuals who can cope with the difficulties, think about futures while considering the solution of today's problems such as social, economic or environmental and are an example to society according to knowledge, skills and behaviors that SD are at the center of them and have a sustainable lifestyle.

Therefore, ESD aims at educating individuals to have competencies which provide individuals to think about the effects of their movements globally and locally, economically, socially and environmentally, to contribute to sustainability with their behaviors in any case and also to carry their society towards sustainable development with their ideas and participation (Rieckmann, 2018) so a sustainable behavior is possible if related knowledge, skills and values are adopted (Engin, 2010). OECD Education Ministers also state that acquisition of competencies such as knowledge, skills as well as values are necessary for sustainable development and also social solidarity in a society (OECD, 2005). Consequently, formal curriculum embeds knowledge, issues, skills, perspectives and also values to address sustainability so curriculum should be reoriented in this manner. These five components of ESD are (McKeown et al., 2002; Engin, 2010):

- **Knowledge:** Due to SD's scope of fundamental components such as economics, environment and society, individuals need knowledge of science, social as well as humanities to understand in order to understand sustainable

development. Besides, ESD can benefit from Information containing traditional discipline.

- **Issues:** ESD contains the issues related to the sustainability of the world and the situations that threaten this situation and these basic issues are mentioned in Agenda 21 adopted at Earth Summit. Also, in addition to local issues, these issues should be taught and addressed in programs for sustainable development to take place in education.
- **Skills:** A successful ESD should not only provide teaching of global subjects but also promote individuals continue learning in the out-of-school lives of them by gaining the skills necessary for sustainable life and livelihoods. These skills can vary according to communities' contexts.
- **Perspectives:** ESD presents different perspective to local issues along with global issues as global issues. The fact that each subject has its own history (from past to future) makes this situation important. Also, the link between global issues in sustainable development education, the main reasons for these issues and the predictions for the future are part of this education. To illustrate, Evaluation of that an excessive paper consumption cause deforestation and looking this case a different perspective is an important competence for ESD. It is important to look an issue from others perspective for ESD and it will result in understanding national as well as international worldviews.
- **Values:** Values have an important role in ESD. In some societies, values are taught in schools, while others are preferred to be explained or discussed the values so this situation is an important factor in understanding both world view and other people's perspective. Accordingly, it is important for a sustainable future to know the perspective of both own, society live in and also other people in the world in ESD.

Afterwards, in 2017, there was created a curriculum framework for revision of other national curriculums to integrate sustainable development goals considering to the competences. The rationality of the curriculum framework bases on embedding and

indicating of SDGs and their targets in education in a holistic manner by considering in the 2030 Agenda. In addition, there is given place SDGs and connections among them from early child education adult education and learning within a lifelong learning concept. Together with the framework, education quality, the SDGs inclusion and transmission, awareness and exploration of the surrounding environment and society with gaining necessary knowledge and skills to deal with all problems that learners will meet in now or in the future are provided for all learners and these concepts were in the focus of the framework. The highlighted competencies in the curriculum framework are defined as the clusters of learning competencies such as ‘‘knowledge and understanding, skills and applications and also values and attitudes’’ (Osman et al., 2017, p.7). These competences are described as:

Knowledge and understanding: It is related:

> understanding of not only environmental, social and economic but also local, national and global challenges and complexities and also conflicts and challenges related to socio-political ones; differential and multiscalar understanding; knowledge to respond to these challenges and complexities; multiple literacies; life skills; systems theory and reflexivity. (Osman et al., 2017, p.11).

Skills and applications: It is pertinent to:

> analysis; factfinding; listening, observing and problem solving; independent learning and critical thinking; planning and decision making; ability to identify and solve problems, and to set goals; capacity to think independently; goal- setting, effective communication and social integration, self-reflective and reflective skills. (Osman et al., 2017, p.11).

Values and attitudes: It is about:

> sense of purpose and hope; Confidence, resilience and adaptability; openness, respect for diversity; communication, engagement and integration; Responsible, active, productive and engaged citizens; duty bearers; Self-esteem, self-understanding and clearer sense of identity; commitment to justice and community engagement for constructive responses to societal issues. (Osman et al., 2017, p.11).

In view of the scope of these skills, it is aimed that the individual will make a lifestyle regarding sustainable development goals during education and learning.

2.3. Education for Sustainable Development in Science Education

While the common use of resources and communication with each other in the world is increasing, it is an important issue how science literate individuals should be in such a global world (Bencze et al., 2013) since a community which are scientifically literate and a lively scientific as capable to tackle world problems like global warming and pandemics can be achieved with high quality science education since global problems can be solved with an effective education (van Eijck & Roth, 2007) since a quality Science Education is equal to increasing the welfare of society because of that science education develop responsible citizens and these citizens then will promote economy, ensure health environment and also a better future (Obianuju, Obiajulu & Ella, 2013).

Johnston (2011) recommended that scientific literacy is necessary not only for and effective education but also for involving in decision making in society especially for socio-scientific issues. Particularly, Science is an important vehicle for understanding students the nature and realizing relationships among them and there is aimed in science education to gain students not only theoretical knowledge but also skills for solve problems daily life in a logical way (Coştu et al., 2007); and therefore, one of

the targets of Science Education is to educate individuals who are influential in the social world. In this respect, the connection between daily life and Science should be established (Karaarslan & Teksöz, 2016). In this way, Science and daily life will be connected each other and then Science will become meaningful for students. In other words, through Science Education, food, water, air, car, pets, electricity, light and sun become meaningful for a child since these subjects are part of daily life (Hançer, Şensoy & Yıldırım, 2003).

In recent years, with the increasing awareness of sustainable development has risen the interest in education for sustainability so science education can create the necessary circumstances for sustainable education (Freire, Baptista & Freire, 2016). Almost all education levels and also science education promote for either Sustainable Development or raising responsible citizens (Eilks, 2015) so the link between Science and sustainability concepts should be established and seen while teaching the concept of sustainability in Science Education (Quinn et al., 2015). Science Education has a crucial role in sustainability education, understanding of sustainability issues and offering solutions to these issues especially for environment can be ensured with scientific literacy meanwhile education for sustainability includes elements such as economics, environmental policy and society (Quinn et al., 2015).

Roles of people in the world as well as understanding it is possible through science education. Understanding sustainability scientifically together with a sustainable perception on values, lifestyles as well as principles should be promoted in ESD (UNESCO, 2005b). According to Quinn et al. (2015), the use of both affective and cognitive domains takes place through science education when making informed decisions for sustainability by linking values in society and attitudes. In conclusion, it is an inevitable fact that students will take their places in society as citizens of the future by acquiring multiple knowledge, skills, attitude behavior through Science Education to build a better future in a sustainable manner.

2.4. 2018 Science Education Curriculum of Turkey

From beginning of 2016-2017 academic year, renovation works has been done in curriculum and the reason behind was that it has been renewed to meet the needs of the current time, changing needs of the individual and society. Later, it was decided that in the 2017-2018 academic year, the implementation of the renewed curricula in the 1st, 5th and 9th grades would begin and then in 2018-2019, all curricula and all courses would be continued with the new curriculum (Board of Education and Morality, 2017). According to the changes made, in the curriculum, there was adopted a spiral approach to objectives partially. The units in Science Curriculum were tried to be located in the order by grade level to explain spiral approach as following Table. Also, educating an individual who is integrated with values and competencies is one of the main objectives of the curriculum. The specified ‘‘the root values’’ and also competencies decided within the Framework of Turkey Competencies are given in the following Table 2.2.

Table 2.2. *Knowledge, Skills, Competencies and Values in 2018 Science Curriculum (MoNE, 2018)*

Knowledge	Skills	Competences	Values
*The world and the universe *Living things and life *Physical events *Matter and its nature	*Scientific Process Skills *Life Skills *Analytical thinking *Decision-making *Creative thinking *Entrepreneur *Communication *Teamwork *Engineering and design Skills *Innovative (innovative) thinking	*Communication in mother tongue *Communication in foreign languages *Mathematical competence and basic competencies in science/technology *Digital competence *Learning to learn *Competencies related to social and citizenship *Taking initiative and entrepreneurship *Cultural awareness and expression	*Justice *Friendship *Honesty *Self-control *Patience *Respect *Affection *Responsibility *Patriotism *Helpfulness

Furthermore, individual development processes are taken into consideration and the research-inquiry-based learning approach is based on an interdisciplinary perspective. In general, the student is responsible for his own learning, active participation in the learning process, research-inquiry and information transfer-based learning strategy is based on. Also, in the process of learning-teaching, the teacher assumes the roles of encouraging and guiding. On the other hand, in renewed curriculum, the specific objectives related to ESD in the Science Curriculum is indicated in *Figure 2.6.*

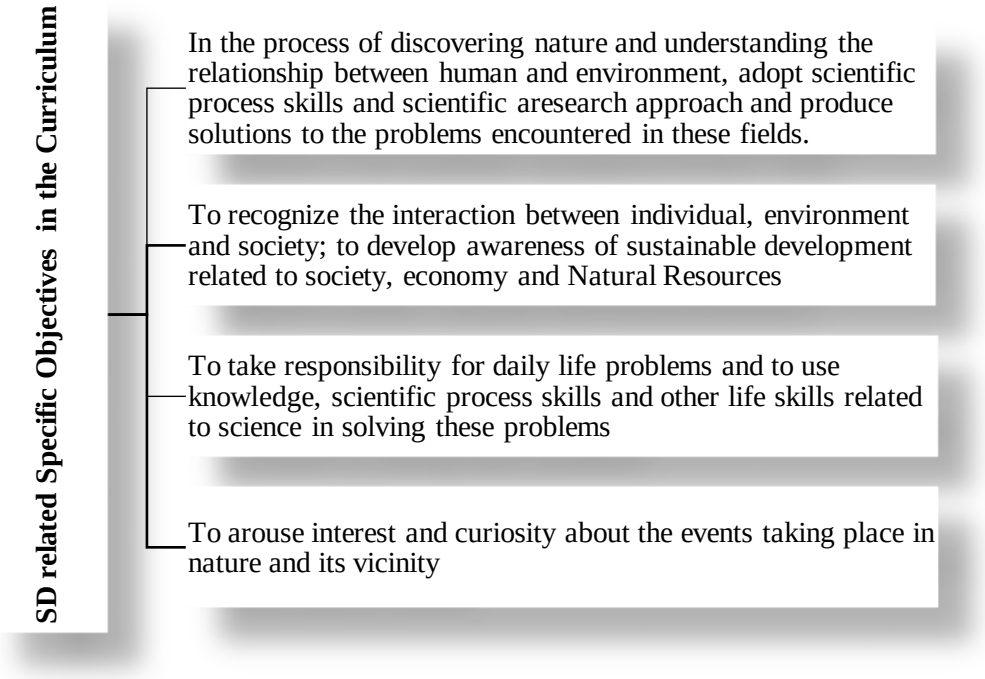

Figure 2.6. ESD related Specific Objectives of 2018 Science Curriculum (Ateş, 2019, p. 107; MoNE, 2018, p.9)

In the curriculum, the numbers used in the curriculum show, for example, for 6th grade, 6.6.4.3 means:

→ 6 indicates grade

→ 6 indicates chapter number

→ 4 indicates subject number

→ 3 indicates objective number

The aims related to SDGs are given place in the aims of the curriculum in *Figure 2.6* implicitly. It is clear the given importance both SD and indirectly to SDGs.

2.5. Competence and Curriculum related Studies on ESD

Competence and Curriculum are two interrelated broad concepts which shape sustainable development education. Curriculum is a structure where knowledge develops around important elements such as skills, values, behaviors and attitudes shaping an individual in all aspects. Therefore, Curriculum has an inclusive attribute of these structures. Competences as an essential factor in achieving sustainable development education has created the need to examine relevant studies. However, it is important to review the studies on the curriculum in which sustainable development will take place. Therefore, studies on curriculum and skills have been given.

2.5.1. Competences as Knowledge, Attitude, Behaviors, and Skills for ESD related studies

Michalos et al. (2011) conducted a study with 506 adults and 294 students in Manitoba, Canada (inclusion grades from 6^{th} 12^{th}) using two exploratory surveys considering the themes of 'UN Decade of Education for Sustainable Development (2005-2014)' to assess behavior, knowledge and attitude concerning ESD and SD. According to results of study, compared to age, education level as well as positive ESD/SD related knowledge for behaviors, positive attitudes toward ESD/SD had more influential for both students and adults. For each groups results showed that for student group, gender had an affective factor and attitude and knowledge had an equal effective. For adults group, positive attitude was influential and it was more effective considering to education.

Michalos et al. (2012) applied questionnaire as in the form of Likert- type scale to students in tenth grade level in Manitoba, Canada in order to measure behaviors, attitudes and knowledge regarding to sustainable development. The questionnaire used in the previous study (Michalos et al., 2011) for students one was improved and used for the current study. Also, the hypothesis of that favorable behaviors would be gained through both favorable attitudes and knowledge. Cronbach α ranks of ındexes of knowledge, favorable attitude and behavior were that while knowledge one (with 20-item) had 0.91, favorable behavior (with 16-item) had 0.81 and also favorable attitude (with 15-item) had 0.81.

In order to analyze knowledge on environmental issues in addition to relationship between behavior and attitudes considering to gender factor so there were focused on not only knowledge on environmental issues but also differences between knowledge, attitudes as well as behavior towards environmental issues and gender effect. The data was collected from 8th grade students in the North Cyprus via survey. In the study, assessing knowledge, attitude and behavior on environment scales developed by Cömert (2011) were used. Correlation analysis, descriptive statistics as well as independent t-test were employed. The results indicated that the knowledge of students on environment were inadequate level and also misconceptions on these issues existed. Besides, it was not enough of knowledge, attitude and behaviors of students. Gender also had effect both attitude, behavior and knowledge. There was determined a relationship between knowledge and attitudes. Improvement of curriculum on environmental issues and examination of teaching practices were suggested (Varoglu, Temel & Yımaz, 2018).

Mekhael and Shayya (2018) investigated also 437 tenth grade student's knowledge, attitudes and skills of sustainable development and also the effect of factors such as school type, gender, the presence of environmental club and membership to the club.

The study was conducted with 437 students administrated questionnaire as Likert-type scale. Social, economic and environmental pillars of SD were placed in the items of developed questionnaire. The findings presented that knowledge, attitudes and skills of students on SD was founded high. Corresponding aspects of SD in the items revealed in an order as social one and then environmental and finally economic. Besides, while environmental club membership had a positive effect on all knowledge, attitude and skills towards SD, gender had a remarkable effect on attitudes and skills regarding to SD especially for female. It was recommended integration of SD into curriculum and determination of policies for SD and also putting more emphasize on ESD.

2.5.2. The Curriculum Studies on Education for Sustainable Development

Sustainable Development has started to take place in the world agenda after a certain time since the concept has begun to explain the present situation. Afterwards, when the important place of education in achieving SD was understood, it was decided to include SD in education and also declarations (e.g. Bonn Declaration (2009), Aichi-Nagoya Declaration on ESD (2014) etc.). With the integration of SD in education, relevant research has been carried out in this direction. Furthermore, there are also studies on how to teach (Awate et al., n.d.; Manitoba Council for International Cooperation [MCIC], 2018) and how to place sustainable development with its goals in the objectives of curriculum and textbooks especially in the format of curriculum frameworks (Commonwealth of Australia, 2014; Schreiber & Siege, 2016). There are international and national studies on examination of SD in curricula and textbooks.

2.5.2.1. International Curriculum Studies on ESD

While some of the international studies focus on exploration of sustainable development in curriculum or textbooks, some have identified sustainable development in the curriculum through environmental education and also action- or task- based learning. The study on higher education curriculum examination also exist among the studies carried out on this subject.

Boehn and Hamann (2011) examined how ESD concept reflected in Geography textbooks. Qualitative, quantitative and also Meta –level analysis was used for investigation of 28 textbooks involving from 1st to 11th grades used in the federal states of Bavaria. For quantitative analysis, both manual and keyword checking in glossary was applied to find concepts of 'sustainability, sustainable and SD'. Accordingly, the frequency of these concepts were calculated in the parts of map, figures or illustrations as well as texts. The results of analyses revealed that sustainable, sustainability and sustainable development concepts were found rarely in the textbooks. While sustainability term was stated as concept and implicitly placed in some topics, sustainable development was used for defining process. Sustainable term was used modifier to other concepts. On the other hand, there are topics related to sustainability, rather than directly defining the concept in these topics. Moreover, illustrated seven topics related to ESD in the study were such as renewable raw materials, tropical rainforest etc. According to findings, environment aspects were dominant in illustrated topics compared to social and economic ones.

Jóhannesson et al. (2011) investigated how ESD included in three levels of education curriculums (the autumn of 2007) as early childhood, compulsory and also upper secondary. In order to evaluate the inclusion of ESD in the curriculums, a tool as ''key'' was developed regarding both SD three pillars; economic-social-environmental and 'United Nations Decade of Education for Sustainable Development' in accordance with its goals. Also, the study was performed by the GETA group. The listed seven characteristics of the tool were defined as ''values, opinions and emotions about nature and environment; knowledge contributing to a sensible use of nature; welfare and public health; democracy, participation and action competence; and finally, economic development and future prospects'' (Jóhannesson et al., 201, p.375). The results exhibited that there were included very few terms of sustainability and ESD in all curriculums. The concept of Sustainable Development had very little been encountered during analysis. For each characteristics of the key,

while identifying in significant number on value related characteristic, knowledge was considered an important factor to responsible for environment related decisions. Lifestyle for health and attitude together emphasized in welfare characteristic. Although self-identity, communication skills and also opinions' role are indicated for democracy related characteristics, global awareness was emphasized a little compared to others together with the characters about economy related one.

Another study was conducted to explore how ESD was placed in the national curriculum of Bangladesh in primary education level. As an exploratory study, there were used secondary data analysis and content analysis. The sample consists of new updated 2013 curriculum and textbooks from 1st to 5th grades so the study did not just focus only one education field such as science. According to the results, it was stressed that wide range of subjects related to ESD included in the books in all specified levels. In addition, there were involved issues that are important for sustainable development. Therefore, the new curriculum was considered providing opportunity inclusion of significant issues such as environmental, health, personal or social education. Researcher suggested that while constructing ESD program, there should be thought local needs, conditions as well as cultural structure (Haque, 2014).

Sætre (2016) conducted a study on how ESD concept was carried out in the geography curricula of Norwegian. Qualitative content analysis was performed. Analysis was presented under two main titles as position of environmental education and ESD in geography curricula before and after Agenda 21 in both primary, lower and upper secondary schools. The findings demonstrated that after introducing ESD concept, there was made little changes in the curricula. Also no significant difference was not found among upper secondary and mandatory ones. Besides, geographical topics are close to environmental aspect of SD and relationship between human and nature

subject was dominant. The researcher concluded that implementation and explanation parts for ESD was lack although the concept was indicated in curricula.

Andersen (2017) studied on categorization of school tasks pertinent to sustainability according to action- and task –based learning. The data consists of both textbooks and workbooks used in primary education in Luxembourg from 1st to 6th grade levels. Qualitative content analysis was applied during the analysis processes and the analysis comprised in two steps: step 1- examination of the tasks of textbooks and workbooks in terms of sustainability content to understand the content addressed in the tasks implicitly or explicitly and step 2-investigation of sustainability related tasks in terms of task- and action- based learning. The results indicated that for the first step, a little emphasis was made on sustainability in the textbooks. The topics in the textbooks covers sustainability implicitly. In addition to sustainability, environmental issues existed a few tasks. According to the researcher, neither action-based but nor task-based learning were considered in the tasks including sustainability content. It was suggested that environmental issues should be addressed explicitly in the tasks.

In the study of Mwendwa (2017), it was focused on assessing of that how sustainable development was addressed in public secondary schools' curriculum in Tanzania by means of environmental education. Moreover, both the students and the teachers had taken the ideas about to which extent the curriculum provides for environmental education. In this qualitative case study, stratifying sampling method was applied for the selection sample as students, experienced geography and biology teachers and also head teachers. It was pointed out that environmental issues were integrated in either biography or geography subjects but mostly in geography one. Furthermore, subjects in the geography course provided students gain environmental education (EE) competencies. Also, students and teachers had knowledge on as well as understand related issues. Some of challenges for implementation level of sustainable

environmental education was indicated lacks of knowledge on EE, school administration helps in this issue and culture factor.

Unlike other studies, the curriculum used in teacher training was studied in this study. Ifegbesan, Lawal, and Rampedi (2017) employed content analysis for revealing how sustainability themes as well as concepts were addressed in the curriculum of Education Social Studies (2012) in Nigeria based on developed socio-cultural, economic and environmental components of ESD with their strands. These strands promoted determination on focus of curriculum content on not only sustainability but also sustainable goals. Sustainable development and sustainability related topics were detected in the curriculum. Also, the reflected perspectives ordered according to the percentages were firstly socio-cultural and then environmental and finally economic one based on content analysis. It was concluded that the curriculum is limited on both sustainability content and sustainable goals. The suggestion was enrichment of curriculums with topics integrated three strands of ESD.

2.5.2.2. Curriculum Studies on ESD from Turkey

There are few curriculum studies in national context on ESD. One of them conducted by Tanrıverdi (2009) was about analyzing curriculum objectives in primary education in terms of sustainable environmental education and also compatibility of the curriculum with 7 main priorities of the EU Strategy of Education for Sustainable Development (2006). Other issues that are focused on the study include how environmental education was taken place in primary schools as a lesson and also in general objectives of the curriculum. Moreover, the objectives were analyzed in terms of attitude, value, skill and understanding as well as knowledge. In the results of the study, there were found that while knowledge and understanding were the priority among the objectives, skill, perspective and value were not presented sufficiently. Also, a conservation-focused environmental understanding was dominant instead of sustainable environmental education in the curriculum. In other words, education for

sustainability was not sufficiently addressed in the curriculum. Consequently, regulations and changes were proposed in the curriculum.

Moreover, social studies curriculum (2005) was studied through document analysis based on the framework of education for sustainable development. The objectives and basic elements of the curriculum were investigated with content analysis. The research data was provided from 6th and 7th grade curriculums. The results of study indicated that although the program reflected sustainable development in the best way, it was found that there were some shortcomings. In addition, there were focused more in two learning areas in terms of inclusion of SD. Prominent topics in the program were also identified as 'sustainable development, sustainability in economy, culture, natural resource usage, residence areas, peace and land usage'. Examination of textbooks and other programs were recommended (Kaya & Tomal, 2011).

The focus of another study was on investigation of reflections of sustainable development in the objectives of Geography course curriculum (2005) as well as the distributions of these objectives in the areas of 'activities, skills, values, measurement and evaluation techniques and learning areas'. Document and content analysis were used in the research. According to the results of the study, the objectives related to sustainable development were available at every grade level, especially in 11th and 12th grades. Environment and Society learning area included more sustainable related objectives compared to other learning areas and the objectives were associated with many of the geography skills. Furthermore, there were also available activities regarding to SD in grade levels but not consistent distribution of measurement and evaluation assessment techniques were determined. Also, as there were sufficient objectives and activities related to sustainable development, deficiencies in acquisition of geographic skills exist in the program (Demirbaş, 2011).

Yalçınkaya (2013) explored to which extent UNESCO's ESD themes considering three perspectives (socio-cultural, environmental and economic) were addressed in Primary Social Studies curriculum. Only the 4th grade curriculum constitutes the data of the study. The conclusion was that ESD was given place in the curriculum but not enough. Some topics such as climate change or urbanization were not indicated. Also, while environmental perspective was insufficient, other perspectives were not reflected much. The suggestion on the curriculum was improvement regarding ESD.

Şahin (2016) analyzed middle school science textbooks with content analysis in accordance with the Council for Environmental Education's reports (1998) on seven dimensions in ESD as ''interdependence; citizenship and stewardship; needs and rights of future generations; diversity; quality of life; equity and justice; sustainable change; and uncertainty and precaution in action'' (Şahin, 2016, p.34). The results showed that sustainable development related dimensions were not referred enough and determined dimensions were: 'interdependence and citizenship and stewardship' (p.39).

One of the studies carried out by Mamur and Köksal (2016) on this subject was the examination of the visual arts lesson 'curriculum (2014) from 1st to 8th grades in terms of education for sustainable development via document analysis and content analysis. It was reported that as though cultural sustainability came forward in the curriculum, either sustainable economy or sustainable environment were reflected not much. The curriculum was insufficient due to not reflection of 'justice, responsibility for nature, understanding, culture-nature relationship'. Each grade levels also included the objectives related to sustainable development.

Based on the reviewed studies considering the scope of the current research, it revealed that there is enough work in both curriculum and competences on ESD. However, it is possible to achieve ESD with SD literate citizens equipped with

competences, so it raises out necessity a good guider as curriculum for teacher to educate students to fulfill specified goals. Therefore, these competences should be integrated to curriculum context. Considering curriculum from this perspectives, studies examination of how competences related SD are placed in the curriculum were looked at.

Most of the studies in the literature are mostly about students ' views and consciousness on sustainable development (Berglund, Gericke & Chang Rundgren, 2014; Olsson, 2014; Berglund & Gericke, 2016), Pre-service teacher's conceptions, perceptions, understanding and also self-awareness on SD, sustainability and ESD (Nikel, 2007; Kilinc & Aydin, 2013; Burmeister & Eilks, 2013; Birdsall, 2014; Ambusaidi & Al Washahi, 2016) and teachers views and conceptual understanding of SD (Borg et al., 2014; Gustafsson, Engström & Svenson, 2015). Accordingly, there could not be founded related studies, so it raises importance of examination the curriculums from this perspective.

CHAPTER 3

METHODOLOGY

The present chapter presents the methodologies used in this thesis. Firstly, research design of the thesis is defined together with the research method used, the sample and the steps followed to answer the research questions. Data sources and data analysis with the rubrics used to evaluate the results are presented afterwards. Components of trustworthiness as credibility, transferability, dependability and confirmability and limitations are presented as the last section.

3.1. Research Design

The aim of the study is to explore how Sustainable Development Goals (SDGs) considering relevant competences (Knowledge and understanding; Skills and applications; Values and attitudes) are reflected in Turkish Middle School Science Curriculum (2018) and Science Textbooks for 5-8 grades.

Related research questions of the study are answered through qualitative research as a case study; applying content analysis for the analysis of the curriculum objectives; applying document analysis for the textbook analysis.

Qualitative research provides understanding problem or case caused by individual, groups or society (Creswell, 1994). It promotes understanding the data that is rich, detail as well as nuanced contextually and roundly (Mason, 2002). In other words, ‘‘qualitative research is related to the meanings, concepts, definitions, characteristics, metaphors, symbols, and descriptions of things’’ (Lune & Berg, 2017, p.12).

Case study promotes understanding of the knowledge of a group, organization, society or phenomena and even if individual (Yin, 2009). Through this qualitative approach, multiple information can be collected as a result of detail data collection procedures

from one or more cases over time. The source of information can be obtained from individual, document, interviews etc., and they are reported in detail description as well as themes constructed through study. Moreover, the case can include just one individual or groups or program etc. The case studies types are 'the collective or multiple case study (even though one case exists, illustration other cases in addition to main issue), the intrinsic case study and the single instrument case study (existing just one case or issue)' (focusing on the just case due to its uniqueness in the situation) (Creswell, 2007). In addition, there exist also case study types as 'holistic versus embedded case studies' (Yin, 2003, p.42). For single case study, it was mentioned that ''single cases are a common design for doing case studies, and two variants have been described: those using holistic designs and those using embedded units of analysis'' (Yin, 2003, p.45).

Accordingly, the study has a research design of single case embedded design. In present study, Middle School Science Curriculum (2018) is a single case together with a unit of analysis as the content of Science Textbooks (from 5^{th} to 8^{th} Grades) within the context of Middle School Science Education.

The cases for this thesis are, Turkish Middle School Science Curriculum (2018) for 5-8 grades and corresponding contents from Science Textbooks (5^{th} to 8^{th} grades). The case is defined as a bounded system, since there exists one case that is restricted or bounded in time (2018), location (Turkey) and context (investigation of Middle School Science Curriculum and Science Textbooks (5^{th} to 8^{th} grades). The textbooks of 5^{th}, 6^{th},7^{th} and 8^{th} grade levels are approved by the Ministry of National Education and they were used in the 2018-2019 academic year in Turkey. This study will provide understanding the case for how SDGs with corresponding competences in the context of Turkey.

Furthermore, the research design of the study was illustrated in *Figure 3.1* as below.

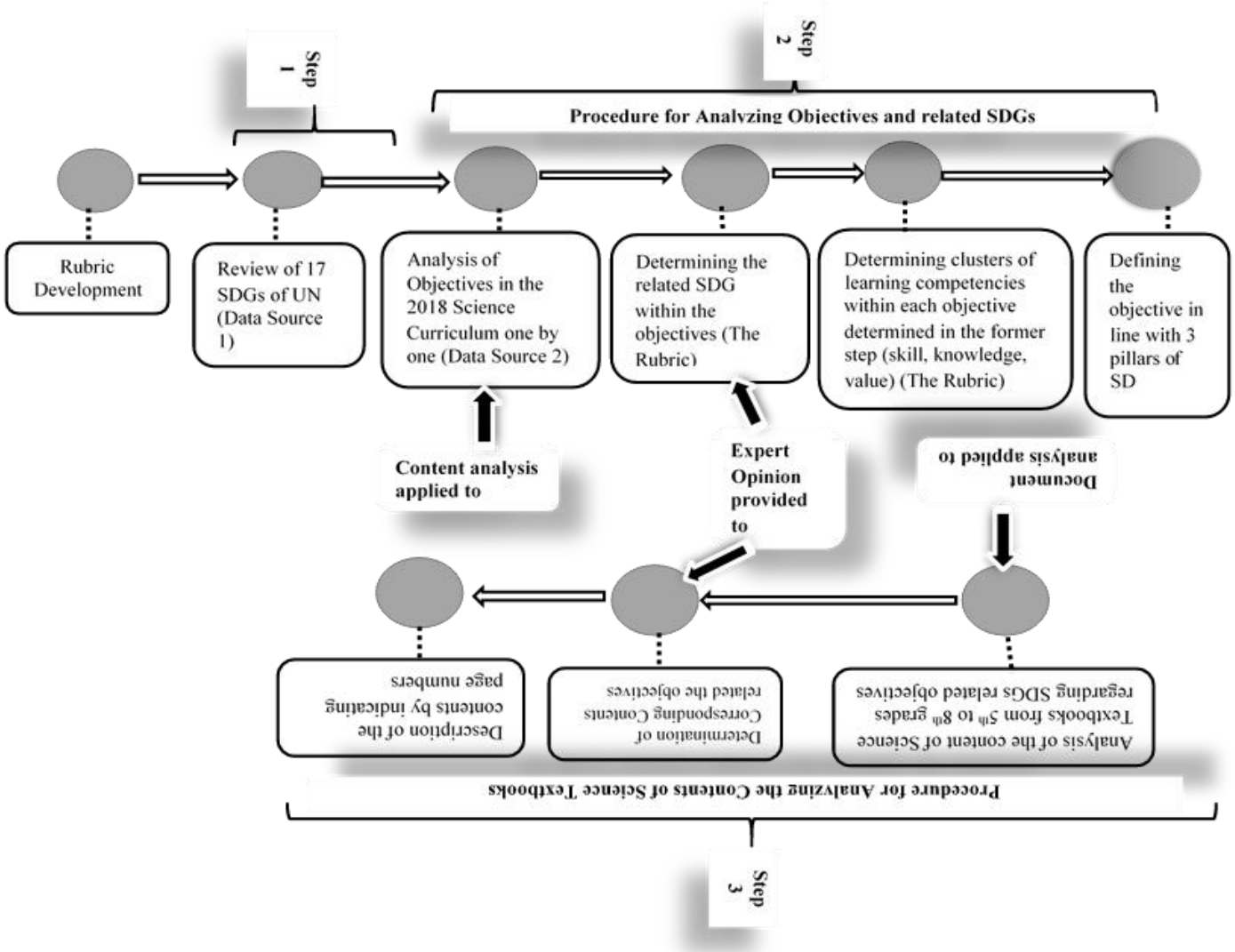

Figure 3.1. The Research Design of the Study

3.2. Data Sources

The thesis is a case study which one of qualitative method would guide emerging of specific characteristics of the sample interested since selection such sampling method based on that the cases selected for the study is rich in information and also case or cases can understand deeply so there can be learnt about the issue more since the case is important due to that it reflects purpose of the study so it is selected purposefully (Patton, 2002); and therefore, purposive sampling method is used for selection of the sample for the thesis.

Purposive sampling method is used sampling technique widely in qualitative studies especially for case studies since the researcher can select the cases purposefully due to specific purpose or to understand the specific situation (Ishak, Bakar & Yazid, 2014). In this type of sampling, specified units or cases are selected and identified selection bases on purpose instead of random (Tashakkori & Teddlie, 2003). During selection process of sample, the criteria determined at the beginning of the study based on specified research questions in this technique (Lopez & Whitehead, 2013) as criterion sampling type is selected (Palys, 2008). The criteria determined in sample selection are as follows:

- ⇒ Some changes have been made considering the current conditions by MoNE (2018) in analyzed curriculum listed as:
  - → In addition to scientific process, life skills as 21st century skills, innovative and entrepreneurial thinking skills are highlighted (as indicated in the rubric as well).
  - → It is aimed at transferring of subject to students by establishing a relationship with fun and life.
- ⇒ In the specific objectives of the curriculum, there are SD related objectives (Ateş, 2019).

⇒ Moreover, expectations of the members of society in the future have differentiated on the basis of scientific, technological, social change and developments that have occurred in recent years (MoNE, 2018) so there is defined the detail information on competences and values that an individual should have.

⇒ The curriculum was updated based on both changing requirements of current time and training individuals who can meet the requirements of society.

⇒ The new curriculum (2018) was updated after the date of presentation of SDGs (2015).

⇒ The selection of Science textbooks was also made according to approval of MoNE

The study includes two data sources as both Middle School Science Curriculum (2018) and Science Textbooks from 5^{th} to 8^{th} grades. To understand better the content of SDGs in adopted Rubric, UN Sustainable Development Goals (United Nations [UN], 2015) are summarized and decided as data source of the study. Accordingly, there are 3 data sources used in this thesis (Table 3.1):

1. UN Sustainable Development Goals (United Nations [UN], 2015)
2. 2018 Turkish Middle School Science Curriculum for 5^{th}, 6^{th}, 7^{th} and 8^{th} grades
3. 5^{th}, 6^{th}, 7^{th} and 8^{th} grades Science Textbooks approved by MoNE

Table 3.1. *Data Sources*

Data Sources	Explanations
1. UN Sustainable Development Goals (SDGs)	→ Seventeen goals with 169 targets declared by the UN (UN, 2015)

Table 3.1. *Data Sources*

Data Sources	**Explanations**		
2. 2018 Turkish Middle School Science Curriculum	→ A total of 223 objectives with 235 sub –objectives → Analysis based on objectives and sub-objectives of the curriculum → Updated in 2018 → Comprised 5th to 8th grades → There are 7 Units and 4 Learning Areas in each grades → Subject Areas in the curriculum as: *Living things and Life *Earth and Universe *Physical Events *Matter and Its Nature		
3. Science Textbooks	**Authors**	**Publishers**	**Explanations**
5th Grade Science Textbook	İlknur Özkan & Zeynep Mısırlıoğlu	ADA Publications	*Approved by the Ministry of National Education *Accepted as textbooks for 5 (five) years starting from the 2018 - 2019 academic year with the decision of the Board of Education and Morality and the Ministry of National Education dated on 28.05.2018
6th Grade Science Textbook	Coşkun Çiğdem, Gizem Minoğlu Balçık & Dr. Özgün KARACA	SEVGİ Publications	
7th Grade Science Textbook	İsmail Gezer	AYDIN Publications	
8th Grade Science Textbook	Ayşe Aytac, Sümeyya Türker, Tuğba Bozkaya & Zühre Üçüncü	TUTKU Publications	

Moreover, the parts of the textbooks are described in Appendix C as well.

3.3. Data Analysis

Data analysis are realized in three steps. First of all, the framework used in the study and the rubric development are presented. Afterwards, data analysis steps are introduced as; the first step is review of UN SDGs (2015) as a background for the analysis. The second step is determination of SDGs related objectives of the Turkish Middle School Science Curriculum (2018) by the use of content analysis. Final step is exploring the Science Textbooks (from 5^{th} to 8^{th} grades) for their content for the objectives determined in the second step by using document analysis. Expert opinion was also used for this step in order to ensure trustworthiness of the study.

3.3.1. Curriculum Framework for the Sustainable Development Goals

The rubric used for the thesis was developed by the use of the framework title as ‘‘The Curriculum Framework for the SDGs’’ (Osman et al., 2017). The framework was prepared to:

> *serve as a guide for countries to conceptualize, review or further develop their national curricula and ensure that education is integral to any strategy to create a resilient generation that will advocate for action and the attainment of the SDGs in a holistic, integrated manner. (Osman et al., 2017)*

The target for the framework is to serve as a guide for countries to review or develop their national curricula to achieve SDGs and is a tool that follows a competency development model; that combines knowledge, skills, values and attitudes. The model aims to realize SDGs, by ensuring that populations have the relevant skills, knowledge, values and attitudes for social, economic and environmental development.

Moreover, the role of education for SD is stated in the curriculum framework that education is crucial for the development of necessary knowledge, skills, values as well as attitudes for sustainable development and global citizens in addition to necessity

for peace and tolerance. Accordingly, the rationality of framework is indicated that the framework will guide countries to address 17 SDGs with their targets via education comprising education including from early childhood to adult through holistic manner. With the help of the framework, learners will engage in their environment, while knowledge and attitude will help them to take decision on their environment and society (Osman et al., 2017).

Moreover, it is aimed at redesigning countries their national curriculums based on framework and achieving SDGs by gaining learners necessary knowledge, attitudes, skills and values for the development of social, environment and economy. Accordingly, there is created as a model for development of competency (knowledge, skills, attitudes and values). These competencies are also required for accomplishment of SDGs targets via education. Therefore, the framework can be efficient in all learnings contexts as non-formal, informal and formal (Osman et al., 2017).

The terms passing during in the framework are described as (Osman et al., 2017):

- → **A number of competencies:** combination of attitudes, knowledge, values and skills acquired as a result of learning
- → **Competence:** general ability of a person
- → **Competency:** learning process as well as accomplishment of learning outcomes
- → **The clusters of learning competences:** acquired knowledge, skills, values and attitudes for each 17 SDGs

According to the framework, expected competencies with learning outcomes from learners in whole is described as in Table 3.2 below.

Table 3.2. *Competencies in the Framework (Osman et al., 2017, p.11)*

Knowledge and understanding	Skills and applications	Values and attitudes
*Understanding of key social, environmental and economic challenges and complexities. *Understanding of local, national and global challenges and complexities *Knowledge to respond to these challenges and complexities *Multiple literacies *Life skills *Understanding of key socio-political challenges and conflicts *Differential and multiscalar understanding *Systems theory and reflexivity	*Analysis *Factfinding *Listening, observing and problem solving *Independent learning and critical thinking *Goal-setting skills *Planning and decision making *Ability to identify and solve problems, and to set goals *Effective communication and social integration skills *Capacity to think independently *Self-reflective and reflective skills	*Sense of purpose and hope *Commitment to justice *Confidence, resilience and adaptability *Openness, respect for diversity *Communication, engagement and integration *Responsible, active, productive and engaged citizens *Duty bearers *Commitment to community engagement for constructive responses to societal issues *Self-esteem, self-understanding and clearer sense of identity

In order to map each SDGs with related the clusters of learning competences from early childhood education to adult education, matrix is used in the curriculum framework as in Table 3.5 as below.

Table 3.3. *Matrixed used in the Framework (Osman et al., 2017, p.12)*

		Knowledge & Understanding	**Skills & Applications**	**Values & Attitudes**
Life course	ECCE	*	*	*
	*Primary Education	*	*	*
	Secondary Education	*	*	*
	TVET	*	*	*
	Tertiary Education	*	*	*
	Adult Education	*	*	*

In accordance with the curriculum framework, SDGs are categorized under three dimensions of Sustainable Development presented in *Figure 3.2*.

1. End poverty in all its forms everywhere
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. Ensure healthy lives and promote well-being for all at all ages
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Achieve gender equality and empower all women and girls
6. Ensure availability and sustainable management of water and sanitation for all
7. Ensure access to affordable, reliable, sustainable and modern energy for all
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10. Reduce inequality within and among countries
11. Make cities and human settlement inclusive, safe, resilient and sustainable
12. Ensure sustainable consumption and production patterns
13. Take urgent action to combat climate change and its impacts
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
    Strengthen the means of implementation and revitalize the global partnership for sustainable development
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

Figure 3.2. SDGs according to three pillars of SD (Health and Education Unit of the Commonwealth Secretariat [HEU], 2016, cited in Osman et al., 2017, p.2)

3.3.2. Rubric Development

The process of developing the most convenient rubric was initiated with a detailed research in the literature considering the purpose of the thesis and the research questions. After the literature review, ‘‘The Curriculum Framework for the SDGs’’ (Osman et al., 2017) was decided to be the base for developing of the rubric. The framework consists of matrixes which contains SDGs, related clusters of learning competences and related learning outcomes for several levels of education (Osman et al., 2017, p.5).

The process of the Rubric development was summarized in *Figure 3.3*. as below:

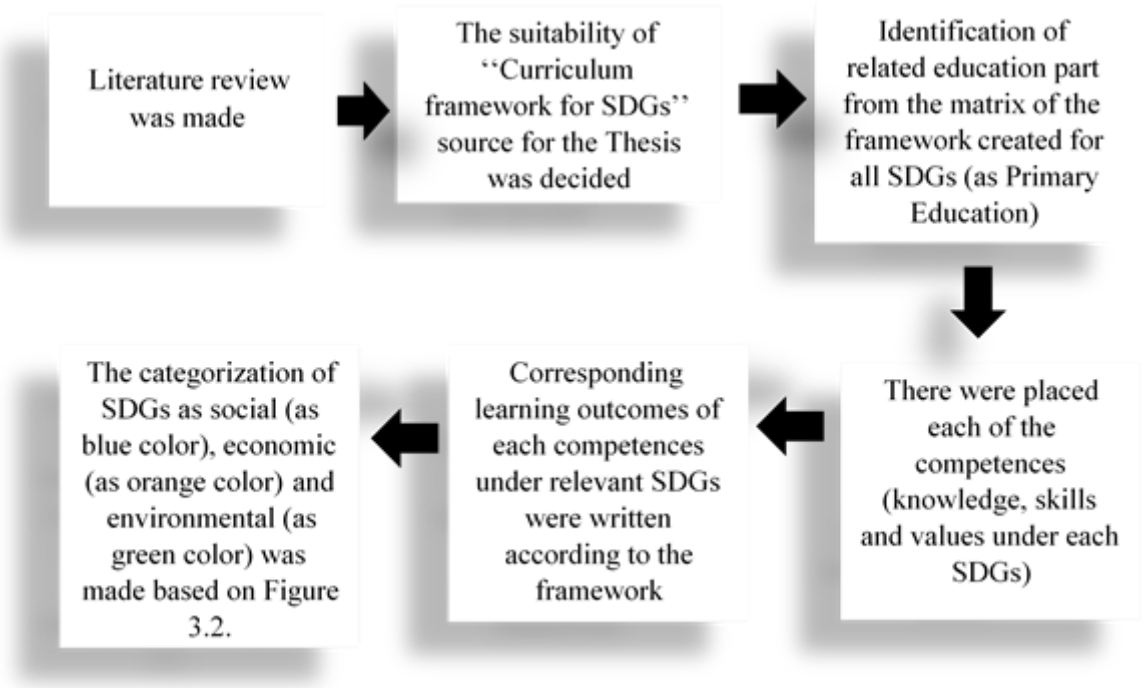

Figure 3.3. The Process of the Rubric Development

To sum up, as presented in Appendix A, the Rubric comprises the phases as:

1. Three pillars of SD (social, economic and environmental) (considered Figure 3.2)
2. Seventeen SDGs,
3. Clusters of learning competencies (relevant skills, knowledge, values and attitudes),
4. Learning outcomes.

During the development of the Rubric, phases in below.

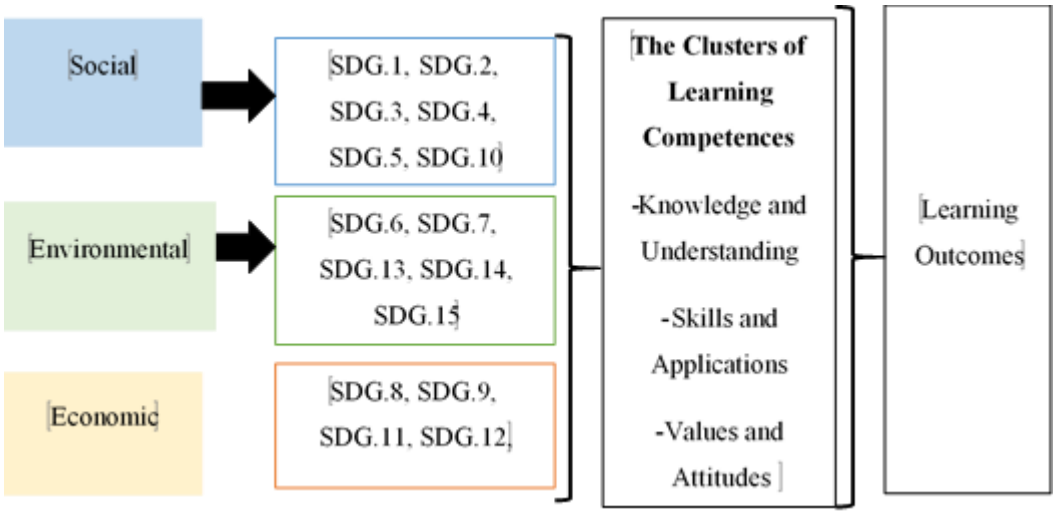

Figure 3.4. The Phases of the Rubric

Therefore, the rubric is based on the identification and description of the competencies (phase 3) that learners should acquire, with an emphasis on the results of learning (phase 4), for implementing the SDGs (phase 2) in the context of 3 pillars of SD (phase 1). Accordingly, the rubric is prepared as a matrix model with corresponding core competencies for 17 SDGs (Appendix A).

Data Analysis Steps

Step 1: Reviewing SDGs

17 Sustainable Development Goals of UN (Sustainable Development Knowledge Platform, n.d.; UN, n.d.; UN, 2015) and relevant explanations have been reviewed as a background for the analysis steps. All summarized UN SDGs with their targets are presented in the table form as in Appendix B.

Step 2: Determination of SDGs related Objectives in 2018 Middle School Science Curriculum Through Content Analysis

In this study, content analysis was conducted to answer the first research question, that is; ‘‘Which objectives in the elementary Science curriculum (2018) for 5-8 grades are related to sustainable development goals?’’. Content analysis as a research technique reveals knowledge of values, beliefs (consciousness or unconsciousness), ideas or attitudes of individual or group (Fraenkel & Wallen, 2006). The source as artifacts can be in the form of especially documents or transcriptions as written. In addition, it can be specified as sources transformed to the text can be evaluated via content analysis (Berg, 2001). To be able to complete a content analysis successfully, there should be successful coding process (Hsieh & Shannon, 2005).

Weber (1990) addressed that through coding in content analysis, the information from the text is categorized into fewer contents. According to Hsieh and Shannon (2005), these categories can be patterns or themes occurring from the source with the analysis. In the line of identified categories, coding scheme is constructed by researcher to analysis of specified contexts. Categorization for information can occur before data analysis corresponding literature, related studies so on or during data analysis (Fraenkel et al., 2012).

Identifying the categories is important for both guiding the analysis and transforming the resulting information into meaningful units at the end of the analysis process.

The content analysis of this study was realized through using the rubric for identifying SDGs, the clusters of learning competences (Knowledge and understanding; Skills and applications; Values and attitudes) and define the objectives in the line with three aspects of SD during the analysis of the objectives in the curriculum. The analysis was made by the researcher, after obtaining the expert opinion, necessary revisions are made to prepare the final version.

Step 3: Exploring Corresponding Contexts from Science Textbooks Through Document Analysis

Through document analysis as one of qualitative research method (Bowen, 2009), physical sources especially written documents can be examined, evaluated and also categorized (Payne & Payne, 2004). ‘‘It yields excerpts, quotations, or entire passages from records, correspondence, official reports and open-ended surveys’’ (Labuschagne, 2003, p.101).

Document analysis was used for this thesis to answer the second research question that is; ‘‘How are SDGs related objectives in Middle School Science Curriculum (2018) reflected in Science Textbooks approved by the Ministry of National Education?’’. In line with the definition of document analysis and the related research question, Science textbooks for 5^{th} – 8^{th} grade levels are analyzed and the results are describing corresponding contents from the textbook for SDGs related objectives.

3.3.3. Data Reporting

In the study, the data sources as Science Curriculum and Science Textbooks (5th to 8th) are in Turkish language. Therefore, all selected objectives related to SDGs and the excerpts from the textbooks are translated to English.

3.4. Trustworthiness

As a term trustworthiness can be defined as that the results of the study can be worthy to focus on or it should be valuable to be taken account (Lincoln & Guba, 1986). Besides, the assessment of trustworthiness in a qualitative study bases on the following

established criteria. These criteria are addressed such as ‘credibility, transferability, confirmability and dependability’ (Lincoln & Guba, 1986). Moreover, these terms are indication of validity and reliability in a qualitative study. Accordingly, they are addressed these terms as such that credibility is related to internal validity, while transferability is corresponding to external validity and generalizability (Lincoln & Guba, 1986). For other terms, dependability reflects to reliability and also confirmability is regarding to objectivity.

3.4.1. Credibility

Credibility that is also passing as ‘‘truth value’’ in the literature can be defined as revealing of whether the results reflects reality or not in what degree or the truthiness of information obtained from research data with correct interpretation of (Lincoln & Guba, 1985). In order to ensure the credibility of the study, the ways are stated as ‘‘prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, referential adequacy and member checking’’ (Lincoln & Guba, 1985, p.301). The strategies for credibility are emphasized in the following studies as well (Pitney, 2004; Shenton, 2004; Flick, 2009; Tracy, 2013; Korstjens & Moser, 2018). In addition to Lincoln and Guba, Shenton (2004) add new strategies for credibility as:

> the adaptation of research methods well, the development of early familiarity with the culture, random sampling, tactics to ensure honesty in informants, iterative questioning, peer scrutiny of the research project, the researcher’s reflective commentary, background, qualifications and experience of investigator, thick description of the phenomenon under scrutiny and examination of previous research findings. (Shenton, 2004, p.64-69)

Among strategies, triangulation one comes forward and taken account for this study. As a credibility technique, the description of triangulation made by Denzin (1989) is

that while moving on triangulation process, there is not used only one methods. Instead of it, multiple methods and investigators are combined in order to eliminate biases in the study. Onwuegbuzie and Leech (2007) indicates that it provides an evidence with the help of ‘‘different sources’’ in addition to Denzin (1989) indicated. This technique is applied with one way. The types of triangulation can be listed such as ‘‘methodological triangulation’’ using of one than more methods in the study, ‘‘investigator triangulation’’ looking at least two researchers to strength the result and ‘‘data triangulation’’ usage of more data resources as at least one (Sim & Sharp, 1998).

For this study, to increase credibility, the steps followed were:

⇒ Applying to data triangulation in the study: the main aim of the research is to introduce how Science curriculum (2018) embed the SDGs in its objectives for elementary education at first. In accordance with this purpose, textbooks are determined as second data sources in order to check how SDGs related objectives are reflected in the textbooks (from 5^{th} to 8^{th}). In this line, two data sources not only the curriculum but also the textbooks lead data triangulation in the study. By doing so, there will be eliminated any deficiencies in the research.

⇒ Furthermore, investigator triangulation is considered so two researcher evaluates the results of the study and in this way, this type of triangulation successfully actualized

3.4.2. Transferability

The definition of term of transferability is figuring out in many studies. It can be very briefly summarized that whether results of a study can be applied to other contexts as well as the subjects or not (Lincoln & Guba; 1985; Bitsch, 2005). Tobin and Begley (2004) state transferability as generalizability. To achieve transferability, the strategies that can be applied by the researcher divided into two. One of them is ‘‘thick description’’ and another one is ‘‘purposeful sampling’’ (Lincoln & Guba, 1985,

p.316; Bitsch, 2005, p.85). And the strategies used in the current study summarized as following:

⇒ **Thick description:** ‘‘enable judgments about how well the research context fits with other contexts, thick descriptive data, i.e. a rich and extensive set of details concerning methodology and context, should be included in the research report’’ (Li, 2004, p.305). In other words, it gives detail information on the study or provides overview to study. And in this study, from beginning to end, it is tried to detail information and descriptions of data sources. To illustrate, the objectives obtained from Science curricula are listed and also regarding clusters of competences and learning outcomes are briefly described based on the rubric. Then, the reflections of the objectives related to SDGs are tried to be analyzed in the specified textbooks by displaying the related parts and pages. In addition, all both the objectives and the related parts from the textbooks are provided so that all readers can understand and evaluate the findings.

⇒ **Purposive sampling:** this type of sampling method is addressed in the section of sampling in the study. In order to remember the sampling method, it can be presented that the selection of individuals, groups etc. depending on the criteria or purpose to find answer the research questions (Teddlie &Yu, 2004). Patton (1990) also mentioned that the selected case should be information rich and the case is selected purposefully. Moreover, there exist many selection strategies for purposive sampling and one of them criterion sampling. In this sampling method, there is determined criterions that are important and predetermined and in this direction the cases meet the criteria are studied (Patton, 1990). Therefore, some criteria are determined for selection of the sample as presented in ‘‘sampling’’ section.

3.4.3. Dependability

Dependability is defined as that the results of the study can be stable or same while performing the study in similar context with alike participants (Bitch, 2005). It is related to repeatability of the study but the findings should be consistent with previous ones. To meet dependability in the study, the strategies passes in the literature. These strategies are ‘‘audit trail, replication logic, step-wise replication, code–recoding, interrater comparisons, and triangulation’’ (Arry et al., 2010, p.502).

As clarified before, there was preferred data triangulation method. In addition to information coming from expert opinion, there was applied inter-reliability and the coefficient for reliability was calculated corresponding formula as addressed by Miles and Huberman (1994) and the agreement was founded as 87%. Moreover, detail information on design, data analysis process and also data of the study were pointed out in related parts of the study.

3.4.4. Confirmability

When turning to confirmability in a study, it is confirming of a result of a study by other researchers to what degree (Lincoln & Guba, 1985; Baxter & Eyles, 1997). The technique used in the study to fulfill the confirmability in the study illustrated as ‘‘audit trial, reflexive journal and triangulation’’ (Guba, 1981, pp. 87-88). Triangulation one was preferred like indicated in previous parts as investigator triangulation. Two researchers analyzed the findings.

3.4.5. Limitations of the Study

The study is composition of qualitative research, case study and content analysis. Therefore, while thinking about the limitations of the study, these methods limitations also should be considered. When considering these information, there is detected some limitations related to study and they are listed as below:

⇒ According to Yin (1984), there can occur bias for the study caused by the researcher who can direct the findings in accordance with his/her views.

During research process, it can raise tendency to go on what expected from the study or the data interpretation so it may occur by me during this process

⇒ One of the issue occurring in these studies is the generalization since there is preferred studying with only one subjects sometimes or in a small number (Tellis, 1997; Zainal, 2007). Correspondingly, it is studied only one subject as the curriculum and then textbooks so the number of the sample is so small and therefore, it is difficult to say that generalization is possible compared to quantitative research due to be case study

⇒ Moreover, Norris (1997) stated one of the bias being able to present in qualitative research that ‘‘the value preferences and commitments of researchers and their knowledge or otherwise of these’’ (p.174). This shows that researcher’s opinions also can affect the results and in this study, there is applied to expert opinion and also two researchers in addition to me so the opinions of the researchers have a role as Norris (1997) indicated.

⇒ The study is limited to just used data so there can be applied to examine as teacher’s opinions on curriculum and lesson plans too.

CHAPTER 4

FINDINGS

Findings of this thesis are going to be presented in 2 main parts; in the first part the answer for the first research question of this thesis on "how sustainable development goals (SDGs) are reflected in Turkish Middle School Science Curriculum (2018)" will be answered through the results of content analysis. In the second part, the research question of this thesis on "how sustainable development goals (SDGs) are reflected in Science textbooks?" will be answered through the results of document analysis of the science textbooks approved by Ministry of National Education.

Reflections of sustainable development goals (SDGs) on the 2018 Middle School Science Curriculum are explored and analyzed for 5, 6, 7, 8th grades in line with the Curriculum Framework for SDGs (Osman et al., 2017). As explained in the Chapter 3, the analysis was based on three clusters of learning competencies: knowledge and understanding; skills and applications and values and attitudes. After each SDG was analyzed for these clusters, related learning outcomes were according to the Framework. Accordingly, the steps followed for answering the research question related to exploring reflections of Sustainable Development Goals (SDGs) in 2018 Middle School Science Curriculum are presented in the *Figure 4.1.* below.

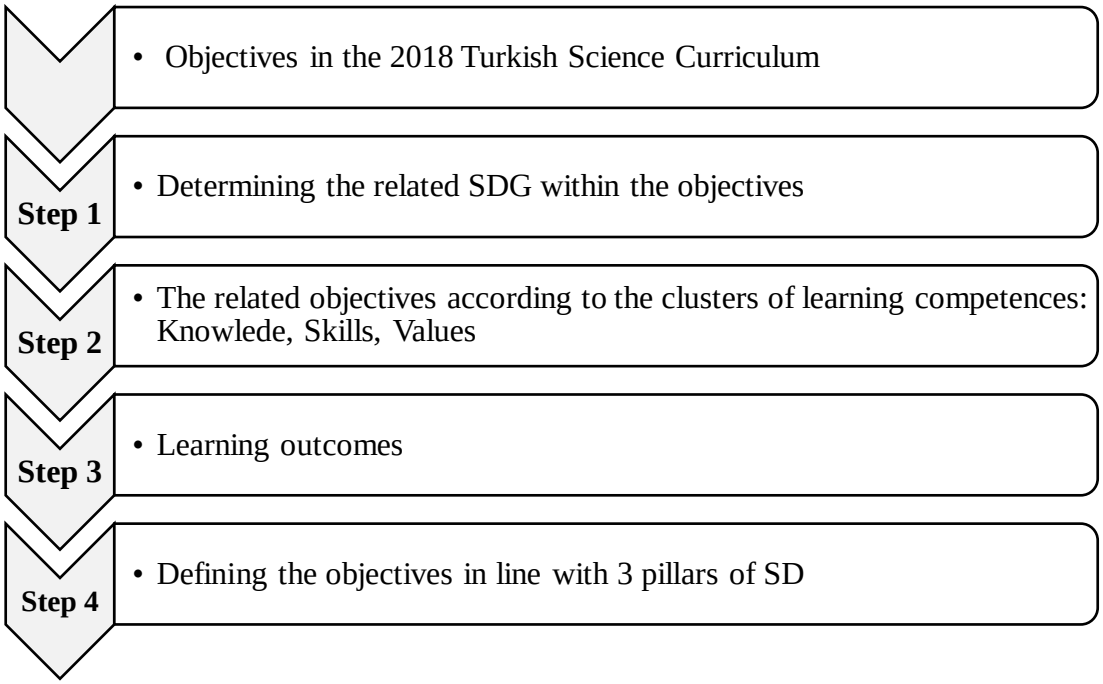

Figure 4.1. The Steps Followed for Analyzing of the 2018 Turkish Science Curriculum

As is presented in the Figure 4.1, exploring learning competencies for each objective in the 2018 Science curriculum was realized through 3 steps as given in the Curriculum Framework for SDGs (Osman et al., 2017):

1. Each objective in the curriculum was evaluated for its relation with SDGs;
2. The clusters of learning competencies (knowledge, skills, values) for the determined SDG were analyzed;
3. Learning outcomes for each competence were determined;
4. SDG related objectives were defined in three dimensions of SD as social, economic and environmental.

Therefore, each step of analysis outlined above was designed to answer a research questions of the thesis (Table 4.1):

Table 4.1. *The Research Questions of the Thesis versus the Steps Set for the Analysis*

Purpose: To explore the how sustainable development goals (SDGs) are reflected in Turkish Middle School Science Curriculum (2018)

Research Questions	Study Steps
1. Which objectives in Middle School Science Curriculum (2018) for 5-8 grades are related to Sustainable Development Goals (SDGs)? 1.1.What are the ratios of the SDGs in determined objectives in 5^{th} to 8^{th} grade Science Curriculums?	Step 1
2. What are the clusters of learning competences (knowledge, skills and values) for the SDGs in Science curriculum for 5-8 grades? 2.1. How the clusters of learning competences (Knowledge, Skills and Values) of SDGs are distributed in the Science Curriculum for grades 5^{th} to 8^{th}?	Step 2
3. What are the learning outcomes for the learning competences for the SDGs in the Science Curriculum for 5-8 grades?	Step 3
4. How is the distribution of the SDG related objectives in three dimensions of SD?	Step 4
5. How is the distribution of the SDGs related objectives according to the total number of objectives in Science Curriculum (2018)?	
6. How is the distribution of SDGs related units and subject areas by grade levels in Science Curriculum (2018) ?	
7. How is the distribution of SDGs related objectives according to grade levels and learning areas in Science Curriculum (2018)?	

The results for the second part, on the other hand, are presented with the following order:

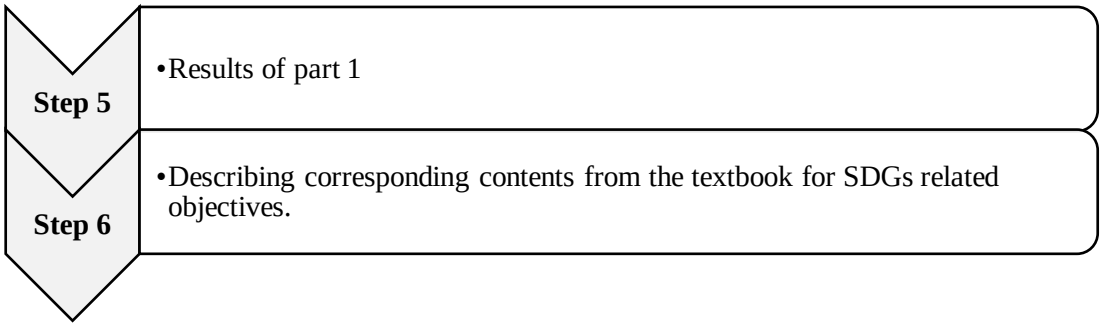

Figure 4.2. The Steps Followed for Analyzing of the Science Textbooks from 5th to 8th Grades

Hence, the research questions of the thesis to be answered for the second part are as follows:

Table 4.2. *The Research Questions Versus the Steps Set for the Analysis*

Purpose: To explore the how sustainable development goals (SDGs) are reflected in Science Textbooks from 5th to 8th grades	
Research Question	**Study Steps**
1. How are SDGs related objectives in Middle School Science Curriculum (2018) reflected in Science Textbooks approved by Ministry of National Education? 1.1.How is the distribution of activities related to SDGs according to the total number of activities in Science textbooks by grades? 1.2.How the distribution of SDGs is related objectives in the parts of Science textbooks by grade levels?	Step 6 5th grade 6th grade 7th grade 8th grade

4.1. SDGs with Relevant Competences in 5th Grade Science Curriculum and Science Textbook

In this part, the data related to the objectives of 5th grade Science Curriculum and Science Textbook are presented separately. Results for investigating the objectives are arranged in such a way to present the objective number and the objective itself for the curriculum, corresponding SDG goal/s and the related competence founded in the science curriculum (Table 4.3). As well, distribution of the SDGs in 5th grade Science Curriculum objectives as well as the distribution of these competences in terms of the clusters of learning competences are presented graphically.

4.1.1. SDGs with Relevant Competences in 5th Grade Science Curriculum

SDGs related objectives in 5th grade Science Curriculum together with corresponding the clusters of learning competences (Knowledge and understanding; Skills and applications; Values and attitudes) and the learning outcomes for the learning competencies are presented in below.

Table 4.3. *SDGs Versus Corresponding Clusters of Learning Competencies with Learning Outcomes in 2018 Science Curriculum for 5th Grade*

SDGs	Clusters of Learning Competencies / Learning Outcomes
G.3- Good health and well-being	**K.1**.Learning to address personal and food hygiene and sanitation, and disease and infection transmission/control
G.4-Quality education	**S.5.**Critical and engaged approach towards learning
G.12-Responsible consumption and production	**K.1**.Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts
G.13- Climate action	**K.1.**Understanding of and preparedness for natural disasters (e.g. floods, tsunamis, earthquakes)

Table 4.3. *Continued*

SDGs	Clusters of Learning Competencies / Learning Outcomes
G.14 –Life below water	**K.1.**Introduction to understanding the role of the ocean (e.g. moderating climate, providing oxygen and food, medicine, energy and minerals) **S1.** Application of critical thinking skills to investigate threatened or endangered species, and conducting surveys or interviews with fishermen and fish processors to develop potential solutions to the challenges faced
G.15- Life on land	**K.1.** Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact **K.2.**Understand the importance of biodiversity and threats to biodiversity, habitat loss; concept of endangered species

(Source: Osman et al., 2017)
G: Goal
K: Knowledge and understanding
S: Skills and applications
V: Values and attitudes

Moreover, SDGs related objectives in 5th grade Science Curriculum and corresponding the clusters of learning competences with learning outcomes are displayed in Table 4.4 below.

Table 4.4. *SDGs Related Objectives Versus Corresponding Clusters of Learning Competencies: Knowledge (K), Skills (S) and Values (V) in the 2018 Science Curriculum for 5th Grade*

SDGs related Objectives	**Competences**							
	**Knowledge						*Skills	
	SDGs/Learning Outcomes							
	G.3. K.1	G.12. K.1	G.13. K.1	G.14. K1	G.15. K.1	G.15. K.2	G.4. S.5	G.14. S.1
6.1.1. Question the importance of biodiversity for natural life				×		×		
6.1.1.a. Gives examples of plants and animals that are endangered or are in danger of extinction in Turkey and in the World						×		×
6.1.2. Discusses the factors threatening biodiversity based on research data						×	×	×
6.2.1. Expresses the importance of interaction between human and environment		×			×			
6.2.1.a. The negative impacts of environmental pollution on human health are mentioned	×				×			

Table 4.4. *Continued*

SDGs related Objectives	Competences							
	**Knowledge						*Skills	
	SDGs/Learning Outcomes							
	G.3. K.1	G.12. K.1	G.13. K.1	G.14. K1	G.15. K.1	G.15. K.2	G.4. S.5	G.14. S.1
6.2.2. Offers proposals for the solution of environmental problems in the near or in Turkey							×	
6.2.3. Makes inferences about environmental problems in the future as a result of human activities		×			×			
6.2.4. Discusses examples of benefits and harm situations in human-environment interaction					×		×	
6.3.1. Explains destructive natural events caused by natural processes			×					
6.3.1.a. Earthquakes, volcanic eruptions, floods, landslides, tornadoes, hurricanes are mentioned without entering the details			×					

Table 4.4. *Continued*

SDGs related Objectives	Competences							
	**Knowledge						*Skills	
	SDGs/Learning Outcomes							
	G.3. K.1	G.12. K.1	G.13. K.1	G.14. K1	G.15. K.1	G.15. K.2	G.4. S.5	G.14. S.1
6.3.2. Expresses ways of protection from destructive natural events			×					

(Source: MoNE, 2018)
G: Goal
****K:** Knowledge and understanding ***S:** Skills and applications
V: *Values and attitudes*

As is presented in Table 4.4, 8 main and 3 sub- objectives in the Turkish Science Curriculum (2018) are related to SDGs.

According to both Table 4.3. and Table 4.4, all the objectives, however, are found in the Chapter 6 of the 5th grade Science Curriculum. As the results of content analysis displayed, 6 out of 17 goals are found as related to the objectives for the 5th grade Science Curriculum. These goals are; G.3 (Good health and well-being), G.4 (Quality education), G.12 (Responsible consumption and production), G.13 (Climate action) and G.14 (Life below water), G.15 (Life on land). Furthermore, the goal for quality education (G.4) corresponds to one cluster of learning competence (skill). In the same manner, those for good health and well-being (G.3), responsible consumption and production (G.12) and climate action (G.13) correspond to one cluster (knowledge); life below water (G14) and life on land (G.15) to one (knowledge).

Therefore, it may be concluded as a result of content analysis that, there are 8 mains with 3 sub-objectives in the 5th grade Science Curriculum that are related to 6 SDGs and all are found in one chapter only; Chapter 6: Human and Environment.

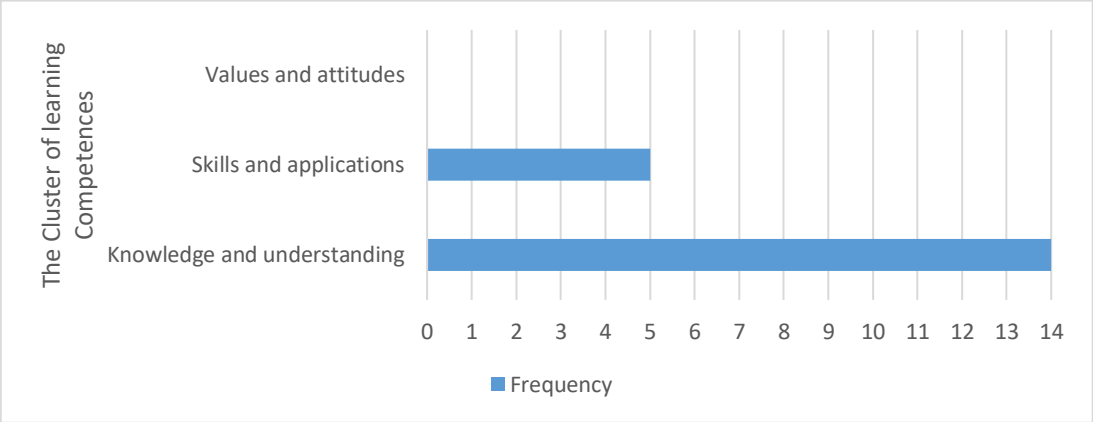

Figure 4.3. The Distribution of Clusters of Learning Competences (Knowledge, Skill and Value) in 5th Grade Science Curriculum

Distribution of Clusters of Learning Competences (Knowledge and understanding; Skills and applications; Values and attitudes) in 5th grade Science Curriculum are presented in *Figure 4.3*. As it is shown in the figure, while the objectives in the curriculum coincide with clusters of learning competencies in the frequency of 19, 5 of these clusters are related to skill and 14 of them are related to knowledge. Yet, there are no clusters found related to value. In summary, knowledge and understanding is the most represented within the clusters of learning competence in the objectives.

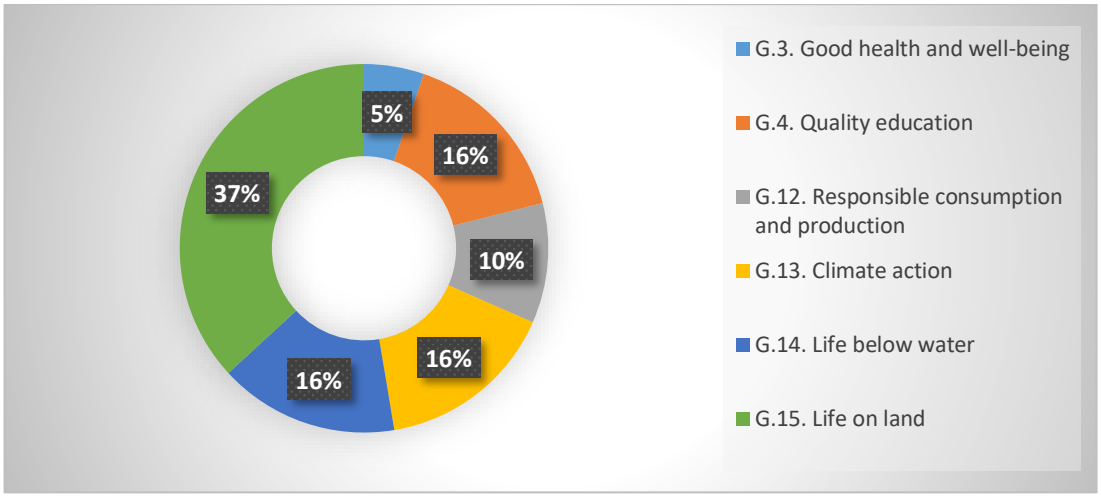

Figure 4.4. Percentage of the SDGs in Determined Objectives in 5th Grade Science Curriculum

As presented in *Figure 4.4*, the 5th grade Science Curriculum coincides with 6 SDGs; "Life on land" (G15) (37%) having the highest percentage of appearance and "Good health and well-being" (G.3) (5%) having the least.

Table 4.5. *The Distribution of the SDG Related Objectives in Three Dimensions of SD for 5th Grade*

	Three Dimensions of SD		
SDG related Objectives	**Social**	**Economic**	**Environmental**
6.1.1. Question the importance of biodiversity for natural life			
6.1.1.a. Gives examples of plants and animals that are endangered or are in danger of extinction in Turkey and in the World			
6.1.2. Discusses the factors threatening biodiversity based on research data			
6.2.1. Expresses the importance of interaction between human and environment			
6.2.1.a. The negative impacts of environmental pollution on human health are mentioned			
6.2.2. Offers proposals for the solution of environmental problems in the near or in Turkey			
6.2.3. Makes inferences about environmental problems in the future as a result of human activities			

Table 4.5. *Continued*

	Three Dimensions of SD		
SDG related Objectives	**Social**	**Economic**	**Environmental**
6.2.4. Discusses examples of benefits and harm situations in human-environment interaction			
6.3.1. Explains destructive natural events caused by natural processes			
6.3.1.a. Earthquakes, volcanic eruptions, floods, landslides, tornadoes, hurricanes are mentioned without entering the details			
6.3.2. Expresses ways of protection from destructive natural events			

The distributions of the objectives in three pillars of SD were determined regarding to the inclusion of SDGs in corresponding objective since the categorization of SDGs for three pillars was made as in methodology part. Accordingly, SDG related objectives are placed in three dimensions of SD (Social, Economic and Environmental) as shown in Table 4.5. According to the table, most of the objectives determined are placed in the environmental dimension, while 4 of the objectives are detected in social and 2 in economic dimension.

4.1.2. SDGs with Relevant Competences in 5th Grade Science Textbook

After the SDG related objectives are investigated in the 2018 Science Curriculum, the step 6 of the thesis is to explore the way the determined objectives are placed in the textbooks. This section, therefore, describes the content of the SDG related objectives in the 5th grade Science Textbook. The results are displayed by describing corresponding contents from the textbook for SDGs related objectives.

Table 4.6. *Objective 5.6.1.1 Versus SDGs with Corresponding Competences*

Objective 5.6.1.1: Question the importance of biodiversity for natural life **Related SDG/s of UN (2015) as:** ‘‘G.14 (Life below water) and G.15 (Life on land)’’
Related Competencies/learning outcomes (Osman et. al, 2017) as: → ‘‘G.14. K.1.-Introduction to understanding the role of the ocean (e.g. moderating climate, providing oxygen and food, medicine, energy and minerals)’’ (p.71). → ‘‘G.15. K.2.-Understands the importance of biodiversity and threats to biodiversity, habitat loss; concept of endangered species’’ (p.75).

(Source: Osman et al., 2017; MoNE, 2018)

As shown in Table 4.6, the objective of ‘‘question the importance of biodiversity for natural life’’ (MoNE, 2018, p.29) is evaluated within three parts of the textbook through an *activity (see p.143)*, a *question (see p.143)*, and a *discussion (see p.144)* (Özkan & Mısırlıoğlu, 2018) sections in 5th grade Science Textbook. Corresponding activity was related to understand species environment around us through research. With the help of question and discussion, students can elaborate the importance of biodiversity It is expected from students to use of their knowledge on biodiversity for evaluating a given context.

When examining the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’ since students will engage in the concept critically.

Accordingly, the content of the objectives, the goals and the textbook are similar and compatible. The subject is related with relationship between biodiversity and nature. Moreover, the competences of skill and values are not used in this case. Moreover, information in the textbook related to the objective is given additionally via ‘‘text’’ by listing the importance of biodiversity *(see p.143)* (Özkan & Mısırlıoğlu, 2018).

Table 4.7. *Objective 5.6.1.1.a Versus SDGs with Corresponding Competences*

Objective 5.6.1.1.a: Gives examples of plants and animals that are endangered or are in danger of extinction in Turkey and in the World **Related SDG/s of UN (2015) as**: ‘‘G.14 (Life below water) and G.15 (Life on land)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.14. S1.- Application of critical thinking skills to investigate threatened or endangered species, and conducting surveys or interviews with fishermen and fish processors to develop potential solutions to the challenges faced’’ (p.71). → ‘‘G.15. K.2.-Understand the importance of biodiversity and threats to biodiversity, habitat loss; concept of endangered species’’ (p.75).

(Source: Osman et al., 2017; MoNE, 2018)

The objective of described in the curriculum as ‘‘gives examples of plants and animals that are endangered or are in danger of extinction in our country and in the world’’ (MoNE, 2018, p.29) as illustrated in Table 4.7 is presented in ‘‘Think and Research’’ *(see p.145)* part of the Science Textbook. As stressed in the objective, students will give examples of endangered species as a result of research related subject (Özkan & Mısırlıoğlu, 2018).

Both the focus of the objective, the goals and the content of the textbook are the same about the endangered species.

The aim of the objective is reflected as described in the content of the textbook. In addition to knowledge about the subject, the competence of skill is also included. For skills, students will approach the context critically to investigate threatened or endangered species (G.14.S1).

Although there are the competences of knowledge and skills, value is not included in this context. Furthermore, the additional information is described in some sections of the textbook such as text and newspaper article by giving examples related to endangered species *(see pp. 145-147)* (Özkan & Mısırlıoğlu, 2018). In learning area

part, students are prepared mentally for this objective at the beginning of unit with help of question.

Table 4.8. *Objective 5.6.1.2 Versus SDGs with Corresponding Competences*

Objective 5.6.1.2: Discusses the factors threatening biodiversity based on research data **Related SDG/s of UN (2015) as:** ‘‘G.4 (Quality education), G.14 (Life below water) and G.15 (Life on land)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.14. S.1-Application of critical thinking skills to investigate threatened or endangered species and conducting surveys or interviews with fishermen and fish processors to develop potential solutions to the challenges faced’’ (p.71). → ‘‘G.15. K.2-Understand the importance of biodiversity and threats to biodiversity, habitat loss; concept of endangered species’’ (p.75).

(Source: Osman et al., 2017; MoNE, 2018)

Table 4.8 provides the excerpts related to the objective of ‘‘discusses the factors threatening biodiversity based on research data’’ (MoNE, 2018, p.29).

The objective is placed in discussion part of the textbook only. Discussion mentioned in the objective is also included in the textbook as expected. There is expected students to discuss the factors which threat the biodiversity *(see p.144)* (Özkan & Mısırlıoğlu, 2018).

Due to discussion method, students will engage the concept within critical approach by engaging (G.4) and the concept will be discussed by using the knowledge of reflected in the goals that is on elaborating the factors on threating biodiversity and applying of the knowledge in this specific issue by using their skill competence. In addition, value competence is not involved for this part. Consequently, the results

point out that the content of the objective, goals and the textbook are same. Moreover, students will gain this content with these two competence types except value one.

In addition, related information is available additionally in other parts of the textbook ‘‘question (in the text)’’ *(see p.147)* and ‘‘texts’’ *(see pp.145-147)* as well and stimulation of thinking the factors affecting biodiversity is provided with question. In the texts, there are listed the factors that threaten biodiversity (Özkan & Mısırlıoğlu, 2018).

Table 4.9. *Objective 5.6.2.1 Versus SDGs with Corresponding Competences*

Objective 5.6.2.1: Expresses the importance of interaction between human and environment **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production) and G.15 (Life on land)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12. K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts (p.63)’’ → ‘‘G.15. K.1-Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact’’ (p.75).

(Source: Osman et al., 2017; MoNE, 2018)

It can be seen from the data in Table 4.9. that there is examined related unit in the textbook and two sections as question and learning are founded related to the objective which is ‘‘expresses the importance of interaction between human and environment’’ (MoNE, 2018, p.29). When analyzing the objective in the textbook, the objective appears in two parts such as ‘‘learning area’’ *(see p.141)* and ‘‘questions (in texts)’’ *(see p.148)* as presented in the table (Özkan & Mısırlıoğlu, 2018). The questions in these parts tend to elaborate the impact of human-environment relationship as

described in the goal (G.15). The aim of the objective is revealed in a way of questions to use only students' knowledge on the context.

Furthermore, there is used just knowledge competence since thinking process is going on through the text with the guidance of questions on human-environment relationship. Other competences (skill and value) are not highlighted for this content. In terms of the content, all sections are relevant and similar, focusing on human and environmental relationships. The content of the textbook reflects on the other hand as addressed in the objective.

Moreover, information is located in the ''text'' by addressing the interaction explicitly *(see p.154)* and evaluated in ''unit assessment question'' via true-false and fill in blank questions *(see p. 163)* additionally to give examples on this interaction between human and nature (Özkan & Mısırlıoğlu, 2018).

Table 4.10. *Objective 5.6.2.1.a Versus SDGs with Corresponding Competences*

Objective 5.6.2.1.a: The negative impacts of environmental pollution on human health are mentioned **Related SDG/s of UN (2015) as:** ''G.3 (Good health and well-being) and G.15 (Life on land)'' **Related Competencies/learning outcomes (Osman et. al, 2017):** → ''G.3.K.1-Learning to address personal and food hygiene and sanitation, and disease and infection transmission/control'' (p.25). → ''G.15.K.1-Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact'' (p.75).

(Source: Osman et al., 2017; MoNE, 2018)

In addition, Table 4.10 summarizes that the objective of ''the negative impacts of environmental pollution on human health are mentioned'' (MoNE, 2018, p.29) can be seen through the ''texts'' *(see pp.149-150)* in the textbook (Özkan & Mısırlıoğlu, 2018)

As understanding from description of the objective, there is not reached any source of information. Instead, direct information on the impact of environmental pollution on human health in text is preferred; and therefore, it remains at the level of knowledge. In other words, skill and value competences are not illustrated for this content. Moreover, air, water and soil pollutions and corresponding diseases such as asthma cholera and allergies. In addition to them, there are included other related diseases as well (Özkan & Mısırlıoğlu, 2018)

When comparing both the objective, texts and the goals, they reflect same information as the results of human impacts on nature and the results effects on human health. When examining related part in textbook, it is not applicable to find additional knowledge related to the objective.

Table 4.11. *Objective 5.6.2.2 Versus SDGs with Corresponding Competences*

Objective 5.6.2.2: Offers proposals for the solution of environmental problems in the near or in Turkey **Related SDG/s of UN (2015) as:** ‘‘G.4 (Quality education)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).

(Source: Osman et al., 2017; MoNE, 2018)

According to Table 4.11, the subject of environmental problems and the solutions for these problems as mentioned in the objective of ‘‘offers proposals for the solution of environmental problems in the near or in our country’’ (MoNE, 2018, p.29) is included in the part of ‘‘activity’’ *(see p.151)* in the textbook (Özkan & Mısırlıoğlu, 2018).

The reflection of the objective in the textbook is pointed out that the subject is approached by an activity-based method to elaborate possible offers for the solution of environmental problems. There are asked question to indicate students the problems and then suggestions for related problems. During the activity, students have an active role with critical and engaged approach for learning (G.4) and the skill competence

will be dominant during this process. Also, there is not given any information on the related to the objective additionally.

Table 4.12. *Objective 5.6.2.3 Versus SDGs with Corresponding Competences*

Objective 5.6.2.3: Makes inferences about environmental problems in the future as a result of human activities **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production) and G.15 (Life on land)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12.K.1- Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63) → ‘‘G.15.K.1-Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact’’ (p.75).

(Source: Osman et al., 2017; MoNE, 2018)

When examining the findings from Table 4.12, ‘‘makes inferences about environmental problems in the future as a result of human activities’’ (MoNE, 2018, p.29) is introduced to ‘‘question (in text)’’ *(see p.153)* and ‘‘think and research’’ *(see p.154)* sections in the textbook (Özkan & Mısırlıoğlu, 2018). Whereas one of them has question, the other section contains research approach in order to make students inferences on the topic. According to the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’ since students will approach the context critically.

In terms of constituting same contents, it can be mentioned that the objective is addressed in the textbook as expecting. Moreover, defined goals are relevant and

observable in both objective and the textbook because there are given impacts on environment as a result of human consumption and production so two goals interested in human- environment interaction. The content of the text involves the responsible consumption and production (G.12) since the main source of wastes and environmental problems is human activities and these problems occur as a result of consumption and production pattern of a society. In the content of this part of the textbook, knowledge competence exists only. Skill and value competences are not indicated for this part. Furthermore, additional information in the textbook related to the objective is stated in the ‘‘text’’ by introducing the environmental problems within paragraph as electronic waste *(see p.154)* (Özkan & Mısırlıoğlu, 2018).

Table 4.13. *Objective 5.6.2.4 Versus SDGs with Corresponding Competences*

Objective 5.6.2.4: Discusses examples of benefits and harm situations in human-environment interaction
Related SDG/s of UN (2015) as: ‘‘G.4 (Quality education) and G.15 (Life on land)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29)
→ ‘‘G.15.K.1-Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact’’ (p.75)

(Source: Osman et al., 2017; MoNE, 2018)

As shown in Table 4.13., there is encountered ‘‘discussion’’ *(see p.155)* part because the objective includes discussion structure on benefit and harm of situation in human-environment interaction (Özkan & Mısırlıoğlu, 2018). The objective is that ‘‘discusses examples of benefits and harm situations in human-environment interaction’’ (MoNE, 2018, p.29). Such case is directly given place in discussion part. In this case, the students were mostly asked to use the existing information but because of a critical approach to the situation G.4 coming forward there. As described in the objective, human-environment interaction is highlighted. Likewise, the topic is revealed in not

only discussion part but also in the goals; in other words, the issue addressed in not only goal but also the objective and textbook are parallel.

The structure of the discussion lead students uses both knowledge and also skill competences like explaining above so it can be inferred that there is given place for both competences predicted before. The content is as addressed in G.15 human-environment interaction and impacts. In addition to targeted part, the information regarding to topic is expressed and evaluated in most of the section of the textbook such as ‘‘think and research’’ *(see p.152)* via observation for pollutant around environment, ‘‘text’’ *(see pp. 148-150 and p.154)* by illustrating pollution types as environmental air etc. explicitly, ‘‘question (in text)’’ by illustrating picture *(see p.153)* and ‘‘unit measurement and evaluation studies’’ *(see pp.163-164)* with question types of true-false, fill in blank and multiple choice to elaborate more on the topic additionally (Özkan & Mısırlıoğlu, 2018).

Table 4.14. *Objective 5.6.3.1 Versus SDGs with Corresponding Competences*

Objective 5.6.3.1: Explains destructive natural events caused by natural processes **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.1-Understanding of and preparedness for natural disasters (e.g. floods, tsunamis, earthquakes)’’ (p.67)

(Source: Osman et al., 2017; MoNE, 2018)

In addition to these, according to findings in Table 4.14, destructive nature events are interpreted in ‘‘what have we learned’’ *(see p.160)* section (Özkan & Mısırlıoğlu, 2018) in the light of the objective that is described as ‘’ explains destructive natural events caused by natural processes’’ (MoNE, 2018, p.29). For the content of the textbook, there is just corresponding information written in diagram as name without

explanation as expected in the objective. While examining G.13 of knowledge content in the rubric, there is given information in destructive events and it is reflected in textbook as well. There is only dominant knowledge competence due to expressing these natural events by using current knowledge without application or acting. Moreover, names of these events are summarized in ‘‘newspaper article’’ *(see p.156)* by informing storm via meteorology report, ‘‘text’’ by illustrating natural events types such as floods, landslides, earthquakes etc. *(see p.156)* in the textbook additionally and knowledge is also assessed in ‘‘unit measurement and evaluation studies’’ (*see p.164)* with multiple choice question (Özkan & Mısırlıoğlu, 2018).

Table 4.15. *Objective 5.6.3.1.a Versus SDGs with Corresponding Competences*

Objective 5.6.3.1.a: Earthquakes, volcanic eruptions, floods, landslides, tornadoes, hurricanes are mentioned without entering the details
Related SDG/s of UN (2015) as: ‘‘G.13 (Climate action)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.13.K.1-Understanding of and preparedness for natural disasters (e.g. floods, tsunamis, earthquakes)’’ (p.67)

(Source: Osman et al., 2017; MoNE, 2018)

Information on earthquakes, volcanic eruptions, floods, landslides, tornadoes etc. are referred in ‘‘figures’’ *(see pp.157-158)* by describing earthquake and volcanic eruption topics briefly and ‘‘texts’’ *(see p.159)* by addressing natural events as floods, landslides, hurricanes and hoses together with their causes and impacts in the textbook without giving detail (Özkan & Mısırlıoğlu, 2018) as indicated in objective like that ‘‘earthquakes, volcanic eruptions, floods, landslides, tornadoes, hurricanes are mentioned without entering the details’’ (MoNE, 2018, p.29) illustrated in Table 4.15.

In fact, information is directly given to students through figures about destructive nature events as stressing in G.13. The content of both objective, text and the goal is similar so it is enough evidence to say that the knowledge competence is embedded

as stressed in the objective for all. There is not observed any additional information for this finding as well.

Table 4.16. *Objective 5.6.3.2 Versus SDGs with Corresponding Competences*

Objective 5.6.3.2: Expresses ways of protection from destructive natural events **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.1-Understanding of and preparedness for natural disasters (e.g. floods, tsunamis, earthquakes)’’ (p.67)

(Source: Osman et al., 2017; MoNE, 2018)

It is seen through Table 4.16 that the expression of protection for destructive events is stated in ‘‘question (in text)’’ *(see p.159)* and also ‘‘think and research’’ *(see p.159)* (Özkan & Mısırlıoğlu, 2018) as expressed in the objective. According to the objective, it is stated that ‘‘expresses ways of protection from destructive natural events’’ (MoNE, 2018, p.29). Based on the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’ since students will engage in the concept critically.

So far, the contents focus on destructive nature events and its protection ways. According to the results from science textbook, the knowledge on destructive events of ‘‘Climate action’’ (G.13) is revealed in related parts in accordance with objective. Besides, there is not indicated any skill and value competences for this situation like in the form of activity etc. As seen from the parts, the same subject is studied in the textbook similar to the objectives and the goal.

While evaluating on the subject is provided with question and research, the additional information on ways of protection is given through ‘‘text’’ *(see p.160)* by listing the ways of protection for the natural events (Özkan & Mısırlıoğlu, 2018).

4.2. SDGs with Relevant Competences in 6th Grade Science Curriculum and Science Textbook

The objectives of 6th grade Science Curriculum and Science Textbook are analyzed and the results are illustrated separately. The findings are presented in accordance with the objective number and the objective itself for the curriculum, corresponding SDG goal/s and the related competence found in the Science Curriculum. Furthermore, both distribution of the SDGs in 6th grade Science Curriculum objectives and distribution of the SDGs in 6th grade Science Curriculum objectives regarding the clusters of learning competences are displayed graphically.

4.2.1. SDGs with Relevant Competences in 6th Grade Science Curriculum

SDGs related objectives in 6th grade Science Curriculum are represented in point of related corresponding the clusters of learning competences (Knowledge and understanding; Skills and applications; Values and attitudes) and the learning outcomes for the learning competencies as shown in below.

Table 4.17. *SDGs Versus Corresponding Clusters of Learning Competencies with Learning Outcomes in 2018 Science Curriculum for 6th Grade*

SDGs	Clusters of Learning Competencies / Learning Outcomes
G.3- Good health and well-being	**K.1**.Learning to address personal and food hygiene and sanitation, and disease and infection transmission/control **K.2.**Understanding healthy eating and nutrition **K.6.**Emergency preparedness, evacuation drills, first aid **K.8.**Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases

Table 4.17. *Continued*

SDGs	Clusters of Learning Competencies / Learning Outcomes
G.4-Quality education	**S.5.**Critical and engaged approach towards learning
G.7- Affordable and clean energy	**K.2**.Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts
G.11- Sustainable cities and communities	**K.1**.The nature and components of cities and our basic needs: food, housing, energy, transport and water
G.12-Responsible consumption and production	**K.1**.Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts
G.13- Climate action	**K.3.**Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production)

(Source: Osman et al., 2017)
G: Goal
K: Knowledge and understanding
S: Skills and applications
V: Values and attitudes

In addition, SDGs related objectives in 6th grade Science Curriculum and corresponding the clusters of learning competences with learning outcomes are displayed in Table 4.18 below.

Table 4.18. *SDGs Related Objectives Versus Corresponding Clusters of Learning Competencies: as Knowledge (K), Skills (S) and Values (V) in the 2018 Science Curriculum for 6th Grade*

SDGs related Objectives	**Competences**								
	**Knowledge								*Skills
	SDGs/Learning Outcomes								
	G.3. K1	G.3. K2	G.3. K6	G.3. K8	G.7. K2	G11. K1	G.12. K1	G.13. K3	G.4. S5
2.3.5.b. Emphasis is made to hygiene that is needed to be considered during blood donation	×								
4.3.2. Determines the selection criteria of heat insulation materials used in buildings						×			
4.3.3. Develops alternative thermal insulation materials						×		×	
4.3.4. Discusses the importance of heat insulation in buildings in terms of family and country economy and effective use of resources						×			×
4.4.1. Classifies fuels as solid, liquid and gas and gives examples of commonly used fuels					×				

Table 4.18. *Continued*

SDGs related Objectives	Competences								
	**Knowledge							*Skills	
	SDGs/Learning Outcomes								
	G.3. K1	G.3. K2	G.3. K6	G.3. K8	G.7. K2	G11. K1	G.12. K1	G.13. K3	G.4. S5
4.4.1.a. It is stated that fossil fuels are limited and they are one of the non- renewable energy sources and the importance of renewable energy sources is emphasized by giving examples					×			×	
4.4.2. Discusses the effects of usage of different types of fuels on human and environment					×		×		×
4.4.3. Research and report on measures to be taken regarding the stove and natural gas poisons			×						×
5.4.3. Explains the importance of sound insulation						×			
5.4.3.a. Technological and architectural applications that are developed for sound insulation are mentioned						×			

Table 4.18. *Continued*

SDGs related Objectives	Competences								
	**Knowledge								*Skills
	SDGs/Learning Outcomes								
	G.3. K1	G.3. K2	G.3. K6	G.3. K8	G.7. K2	G11. K1	G.12. K1	G.13. K3	G.4. S5
6.2.3. Gives examples of defects in sensory organs and technologies used in the removal of these defects				×					
6.2.3.a. Causes of eye defects as myopia, hypermetropia, astigmatism and strabismus without mentioning the treatment methods are described briefly				×					
6.2.4. Discusses measures to be taken to protect the health of sensory organs				×					×
6.3.1. Discuss what needs to be done for the health of the systems based on the research data				×					×
6.3.1.a. System diseases which are the most common diseases in Turkey is mentioned				×					

Table 4.18. *Continued*

SDGs related Objectives	Competences								
	**Knowledge							*Skills	
	SDGs/Learning Outcomes								
	G.3. K1	G.3. K2	G.3. K6	G.3. K8	G.7. K2	G11. K1	G.12. K1	G.13. K3	G.4. S5
6.3.1. b. The harms of unconscious drug use are highlighted		×							
6.3.1. c. The effects of harmful habits such as alcohol and smoking are addressed to human health. Yeşilay is emphasized in the fight against alcohol and smoking		×							
6.3.1.ç. Basic information about first aid is given			×						

(Source: MoNE, 2018)
****K:** Knowledge and understanding ***S:** Skills and applications
*****V:** Values and attitudes

The results of Table 4.18 show that 6th grade Science Curriculum have 10 mains with 8 sub- objectives related to SDGs. These objectives are found in the Chapters 2, 4, 5 and 6. The most of SDG related objectives are in Chapter 6 and Chapter 4, while chapter with the least number of the objective is founded as Chapter 2.

As the results of content analysis displayed, 6 out of 17 goals are identified as related to the objectives for the 6th grade Science Curriculum. To illustrate, these goals are; G.3 (Good health and well-being), G.4 (Quality education), G.7 (Affordable and clean energy), G.11 (Sustainable cities and communities), G.12 (Responsible consumption and production), G.13 (Climate action).

Moreover, there are determined one clusters of learning competence (knowledge) for the goals of good health and well-being (G.3), affordable and clean energy (G.7), sustainable cities and communities (G.12) and climate action (G.13); on the other hand, quality education (G.4) corresponds to one cluster of learning competence (skill).

As a result, 18 objectives in 6th grade Science Curriculum are related to 6 SDGs. These objectives are mostly in Chapter 6: Systems and Their Health in Our Bodies and Chapter 4: Matter and Heat. Chapter 2: Systems in Our Bodies has the least number of the objectives related to SDGs.

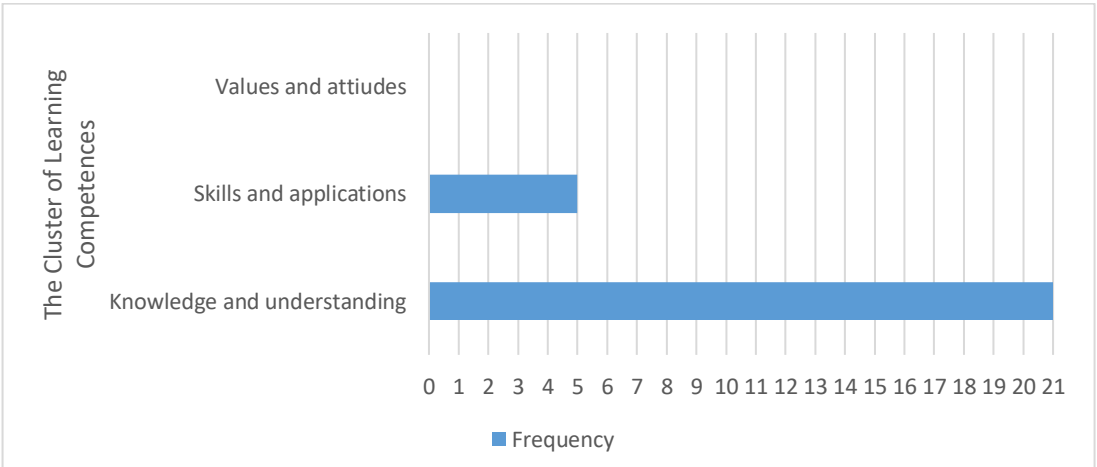

Figure 4.5. The Distribution of Clusters of Learning Competences (Knowledge, Skill and Value) in 6th Grade Science Curriculum

Figure 4.5 illustrates distribution of the clusters of learning competences (Knowledge, Skill and Value) in 6th grade Science Curriculum. According to the figure, the frequency of clusters of learning competencies in the objectives of the curriculum is 26. While 21 of these clusters are correspond to knowledge and understanding, 5 of them are related to skills and applications but there are no clusters found related to values and attitudes one. In conclusion, the most represented within the clusters of learning competence in the objectives is knowledge and understanding.

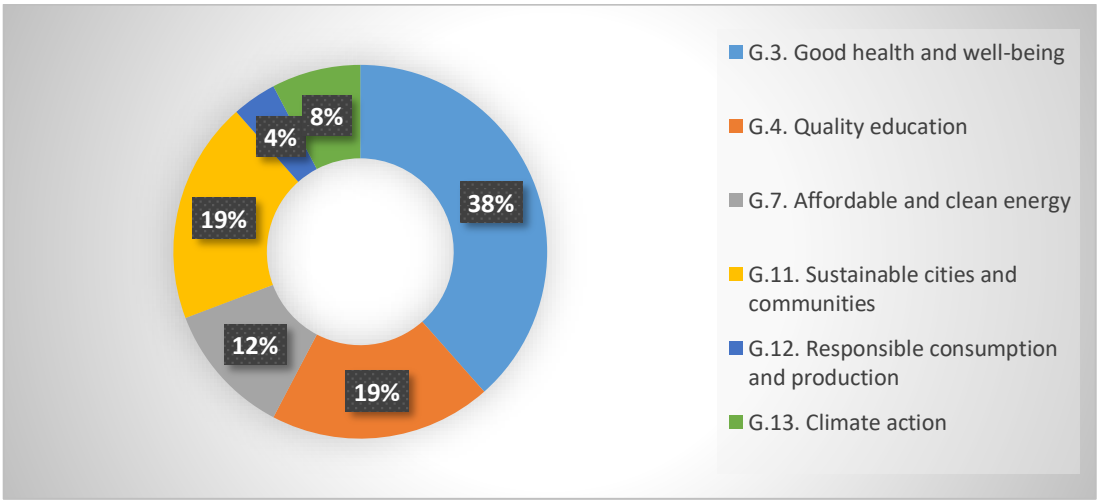

Figure 4.6. Percentage of the SDGs in Determined Objectives in 6th Grade Science Curriculum

Figure 4.6 represents how SDGs found as related to the objectives of the science curriculum are distributed. As represented in the figure, the 6th grade Science Curriculum contains 6 SDGs; G.3 (Good health and well-being) (38%) having the highest percentage of appearance and G.12 (Responsible consumption and production) (4%) having the least.

Table 4.19. *The Distribution of the SDG Related Objectives in Three Dimensions of SD - 6th Grade*

	Three Dimensions of SD		
SDG related objectives	**Social**	**Economic**	**Environmental**
2.3.5.b. Emphasis is made to hygiene that is needed to be considered during blood donation	■		
4.2.2. Determines selection criteria of heat insulation materials used in buildings		■	
4.3.3. Develops alternative thermal insulation materials		■	■
4.3.4. Discusses the importance of heat insulation in buildings in terms of family and country economy and effective use of resources	■	■	
4.4.1. Classifies fuels as solid, liquid and gas and gives examples of commonly used fuels			■
4.4.1. a. It is stated that fossil fuels are limited and they are one of the non- renewable energy sources and the importance of renewable energy sources is emphasized by giving examples			■
4.4.2. Discusses the effects of usage of different types of fuels on human and environment	■	■	■
4.4.3. Research and report on measures to be taken regarding the stove and natural gas poisons	■		

Table 4.19. *Continued*

	Three Dimensions of SD		
SDG related objectives	**Social**	**Economic**	**Environmental**
5.4.3. Explains the importance of sound insulation			
5.4.3.a. Technological and architectural applications that are developed for sound insulation are mentioned			
6.2.3. Gives examples of defects in sensory organs and technologies used in the removal of these defects			
6.2.3.a. Causes of eye defects as myopia, hypermetropia, astigmatism and strabismus without mentioning the treatment methods are described briefly			
6.2.4. Discusses measures to be taken to protect the health of sensory organs			
6.3.1. Discuss what needs to be done for the health of the systems based on the research data			
6.3.1.a. System diseases which are the most common diseases in Turkey is mentioned			

Table 4.19. *Continued*

	Three Dimensions of SD		
SDG related objectives	**Social**	**Economic**	**Environmental**
6.3.1. b. The harms of unconscious drug use are highlighted			
6.3.1. c. The effects of harmful habits such as alcohol and smoking are addressed to human health. Yeşilay is emphasized in the fight against alcohol and smoking			
6.3.1.ç. Basic information about first aid is given			

The distributions of the objectives in three pillars of SD were determined regarding to the inclusion of SDGs in corresponding objective since the categorization of SDGs for three pillars was made as in methodology part. According to Table 4.19, the distribution of SDGs related objectives in three dimensions of SD are displayed. It is apparent from the table that most of the objectives are placed in social dimension. While 4 of them are in environmental one, there is 6 objectives in economic dimension of SD

4.2.2. SDGs with Relevant Competences in 6th Grade Science Textbook

The analysis of which objectives in the Science Curriculum (2018) for 5-8th grades are related to SDGs are made. Afterwards, how SDG related objectives are placed in the textbook is determined as in Step 6. In this section, the content of the SDGs related objectives in the 6th grade Science Textbook are presented. The findings are illustrated describing corresponding contents from the textbook for SDGs related objectives.

Table 4.20. *Objective 6.2.3.5.b Versus SDGs with Corresponding Competences*

Objective 6.2.3.5.b: Emphasis is made to hygiene that is needed to be considered during blood donation **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good health and well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3.K.1-Learning to address personal and food hygiene and sanitation, and disease and infection transmission/control’’ (p.25)

(Sources: Osman et al., 2017; MoNE, 2018)

The results are summarized in Table 4.20. It points out that there is made an emphasis on particularly to be hygiene during donation described in ‘‘text’’ *(see p.64)* as (Çiğdem, Balçık & Karaca, 2018) explained in the objective as ‘‘emphasis is made to hygiene that is needed to be considered during blood donation’’ (MoNE, 2018, p.32).

The content of the text is about that needles and blood donation which all tests are made for diseases are sterile and they are used only one (Çiğdem, Balçık & Karaca, 2018).

All content passing in the objective, text as well as the goal is consistent with each other mainly hygiene since there is addressed the hygiene and infection which are the core concepts of G.3 (Good health and well-being) as illustrated in the table. Also, the knowledge is provided to students directly as expressed in the objective; and therefore, other competences (value and skill) are not indicated for this context due to direct knowledge related to the topic. Furthermore, any additional knowledge on the content is not investigated.

Table 4.21. *Objective 6.4.3.2 Versus SDGs with Corresponding Competences*

Objective 6.4.3.2: Determines the selection criteria of heat insulation materials used in buildings **Related SDG/s of UN (2015) as:** ‘‘G.11 (Sustainable cities and communities)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.11. K.1- The nature and components of cities and our basic needs: food, housing, energy, transport and water’’ (p.58).

(Sources: Osman et al., 2017; MoNE, 2018)

Another objective which is related to SDGs is that ‘‘determines the selection criteria of heat insulation materials used in buildings’’ (MoNE, 2018, p.34).

The findings described in Table 4.21 shows that especially the content is not identified in only one part and the reflection of the related objective is made in the sections of ‘‘question (in text)’’ *(see p.139, p.143 and p144)* by asking material types and criteria of selection these materials for insulation, ‘‘research’’ *(see p.143)* by asking for research to determine heat loss reasons in buildings and ‘‘working time’’ by addressing selection of heat insulation materials for specified regions on home model through answering the reasons of such selection *(see p.147)* (Çiğdem, Balçık & Karaca, 2018).

According to the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’ since students will approach the context critically. During these sections, student will try to decide the selection criteria for heat insulation in houses as expected in the objective like dealing with such concept in the goal of sustainable cities and communities (G.11). In these processes, there is used background information and then this information is used for determination of criteria. According to the content of the text and the objective, it is not applicable for value competences for this part.

In addition, additional information in the textbook related to the objective is found in the sections of the textbook as ‘‘text’’ *(see p.143)* that selection criteria for heat insulation materials are listed, ‘‘table’’ *(see p.144)* which type of materials used in insulation, their properties and place where they are used are described in the table *(see p.144)* and some of these materials are stated in the text *(see p.144)* as well, ‘‘subject evaluation’’ that selection of materials for specific contexts such as house are asked to students through multiple choice questions *(see p.150 and p.151)*, ‘‘what have we learned?’’ by indicating which criteria should be considered for insulation materials *(see p. 158)* and ‘‘unit evaluation’’ which properties of heat insulation materials for buildings is asked via multiple choice question *(see p.162)* (Çiğdem, Balçık & Karaca, 2018). Through these sections, information about the characteristics of the substances is provided.

Table 4.22. *Objective 6.4.3.3 Versus SDGs with Corresponding Competences*

Objective 6.4.3.3: Develops alternative thermal insulation materials **Related SDG/s of UN (2015) as:** ‘‘G.11 (Sustainable cities and communities) and G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.11. K.1 - The nature and components of cities and our basic needs: food, housing, energy, transport and water’’ (p.58). → ‘‘G.13.K.3 - Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production)’’ (p.67).

(Sources: Osman et al., 2017; MoNE, 2018)

As reported by Table 4.22, creating alternative thermal insulation materials are made in the line of ‘‘activity’’ *(see p.145)* to prepare students new insulation material by describing materials and steps followed (Çiğdem, Balçık & Karaca, 2018). The knowledge of insulation is involved in the activity to develop a material. While doing such an activity, the concepts of insulation and energy efficiency in houses arise in

accordance with G.11 (Sustainable cities and communities) and G.13 (Climate action) in the form of knowledge as in the objective of ‘‘develops alternative thermal insulation materials’’ (MoNE, 2018, p.35).

As a result, the objective involves the terms of insulation materials and the developing word. When considering of the process in the activity, it is apparent that creating defined as developing and design is related to insulation like in the goals above. The competence of knowledge also guides students to going on the activity as expected. Due to the reflection of the related objective just in activity part, textbook does not contain any additional knowledge.

Table 4.23. *Objective 6.4.3.4 Versus SDGs with Corresponding Competences*

Objective 6.4.3.4: Discusses the importance of heat insulation in buildings in terms of family and country economy and effective use of resources **Related SDG/s of UN (2015) as:** ‘‘G.4 (Quality education) and G.11 (Sustainable cities and communities)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5 - Critical and engaged approach towards learning’’ (p.29). → ‘‘G.11. K.1 - The nature and components of cities and our basic needs: food, housing, energy, transport and water’’ (p.58).

(Sources: Osman et al., 2017; MoNE, 2018)

The discussion of heat insulation effectiveness on economy, resources and also for society are described in the part of ‘‘discussion’’ *(see p.146)* through investigation of benefits of thermal insulation for buildings in the textbook (Çiğdem, Balçık & Karaca, 2018) as stated in the objective of ‘‘discusses the importance of heat insulation in buildings in terms of family and country economy and effective use of resources’’ (MoNE, 2018, p.35). The objective is reflected in discussion part of the textbook as displayed in Table 4.23.

When examining the content, critical and engaged approach together with knowledge on insulation in houses (as in G.11) is the consistent with both the objective and the textbook. Both skill and knowledge competences are presented during discussion without placing value competence.

Meanwhile, knowledge on this issue is described and evaluated in ‘‘text’’ *(see p.146)* by indicating heat insulation effectiveness on economy, resources and also for society together with illustrating of related insulation materials through picture and ‘‘subject evaluation’’ *(see p. 149)* by asking true-false question to elaborate knowledge on the subject (Çiğdem, Balçık & Karaca, 2018) as additional information. Especially, the contribution to economy of insulation is illustrated additionally in text.

Table 4.24. *Objective 6.4.4.1 Versus SDGS with Corresponding Competences*

Objective 6.4.4.1: Classifies fuels as solid, liquid and gas and gives examples of commonly used fuels **Related SDG/s of UN (2015) as:** ‘‘G.7 (Affordable and clean energy)’’
Related Competencies/learning outcomes (Osman et. al, 2017): → ‘‘G.7.K.2 - Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42).

(Sources: Osman et al., 2017; MoNE, 2018)

Furthermore, there is highlighted in the curriculum that students will be able to ‘‘classify fuels as solid, liquid and gas and gives examples of commonly used fuels’’ (MoNE, 2018, p.34) as in Table 4.24.

On the other hand, for the textbook it is founded that classification of fuels is made with ‘‘question (in text)’’ *(see p.152)* in the textbook. There are not asked directly classification of fuels. Instead, examples for the fuels in daily life are asked (Çiğdem, Balçık & Karaca, 2018).

In the same time, different types of fuels are handled with G.7 (Affordable and clean energy) while answering but the level of the content is particularly in knowledge competence. Overall, similar subjects reflected also in textbook is investigated in the line of the findings.

Apart from these, there is identified and assessed such knowledge additionally in ‘‘text’’ *(see p.153)* that wood and coal fuel types as solid ones are mentioned. In addition, liquid fuels such as fuel-oil and gas fuels as LPG are described as well. For ‘‘what have we learned?’’ *(see p.158)* part, there is given a diagram that shows the classification of fuels with examples. For ‘‘subject evaluation’’ *(see p.159)*, with open ended and true-false question, there asked the type of the specified fuels (Çiğdem, Balçık & Karaca, 2018).

Table 4.25. *Objective 6.4.4.1.a Versus SDGs with Corresponding Competences*

Objective 6.4.4.1.a: It is stated that fossil fuels are limited, and they are one of the non- renewable energy sources and the importance of renewable energy sources is emphasized by giving examples **Related SDG/s of UN (2015) as:** ‘‘G.7 (Affordable and clean energy) and G.13 (Climate action) **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.7. K.2 - Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42). → ‘‘G.13. K.3 - Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production)’’ (p.67).

(Sources: Osman et al., 2017; MoNE, 2018)

As described in the objective of ‘‘it is stated that fossil fuels are limited and they are one of the non- renewable energy sources and the importance of renewable energy sources is emphasized by giving examples’’ (MoNE, 2018, p.35), renewable and non-renewable energy sources and fossil fuels concepts are the scope of the objective.

Based on the objective, it is determined in textbook as summarized in Table 4.25 that renewable and non-renewable energy sources and fossil fuels are explained in text by addressing G.7 (Climate action) and G.13 (Climate action) containing of such concepts.

Corresponding part is determined in ‘‘text’’ by indicating what are non-renewable and renewable sources are stated *(see p.154)* and renewable energy sources such as ‘hydroelectric, solar, geothermal, biomass and wave energies’ are described and illustrated with pictures *(see p.155)* (Çiğdem, Balçık & Karaca, 2018).

Also, the knowledge is directly mentioned. There is given some examples in such resources so it is not applicable to investigate any skill or value competences for this section. In addition to the text, all subjects in the objective, textbook and also the goals are relevant each other.

Besides, among other parts of textbook in related unit, there is presented additional information on the content in ‘‘what have we learned?’’ that renewable and nonrenewable energies are classifies as and then corresponding examples are illustrated under each energy types in diagram *(see p.158),* ‘‘subject evaluation’’ that through fill in blank questions, there are selected words for related sentence which are about fuels *(see p.159)* and also there is asked multiple choice question to find the characteristics of specified energy sources in the pictures *(see p.160)* and ‘‘unit evaluation’’ that one of the renewable energy sources is asked through multiple choice question *(see p.162)* (Çiğdem, Balçık & Karaca, 2018).This information stated in the objective is evaluated and remembered during these sections additionally.

Table 4.26. *Objective 6.4.4.2 Versus SDGs with Corresponding Competences*

Objective 6.4.4.2: Discusses the effects of usage of different types of fuels on human and environment **Related SDG/s of UN (2015) as:** ‘‘G.4 (Quality education), G.7 (Affordable and clean energy) and G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4.S.5-Critical and engaged approach towards learning’’ (p.29) → ‘‘G.7.K.2-Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42) → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63).

(Sources: Osman et al., 2017; MoNE, 2018)

In Table 4.26, the objective of ‘‘discusses the effects of usage of different types of fuels on human and environment’’ (MoNE, 2018, p.35) is presented in ‘‘research’’ *(see p.156)* part that it is expected students to do research on effects of fossil fuels usage effect on environment whereas as stated in the objective (Çiğdem, Balçık & Karaca, 2018). It is expected from students to make discussion on environment to elaborate different types of fuels effects on human and environment.

Both of the objective, the goals (G.7 and G.12) and the text indicate consumption of resources and their impacts as asking students to reveal of the impact of fossil fuels on human and environment. During the research, students will engage in learning critically as expected (G.4). In this part, it can be explained that whereas discussion for the topic is indicated in the objective, it is examined the research part to investigate students the topic.

Furthermore, the information given in the textbook related to the objective is clearly defined in the text *(see p.156)* by mentioning the effects of fuels on human and

environment such as air and environmental pollutions with their impacts additionally as well (Çiğdem, Balçık & Karaca, 2018).

Table 4.27. *Objective 6.4.4.3 Versus Corresponding Competences*

Objective 6.4.4.3: Research and report on measures to be taken regarding the stove and natural gas poisons **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good Health and Well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3. K.6 -Emergency preparedness, evacuation drills, first aid’’ (p.25). → ‘‘G.4. S.5 - Critical and engaged approach towards learning’’ (p.29).

(Sources: Osman et al., 2017; MoNE, 2018)

When Table 4.27 is examined, the objective is as ‘‘research and report on measures to be taken regarding the stove and natural gas poisons’’ (MoNE, 2018, p.35). The research on taking precautions for poisoning is addressed in the research part as expected in the objective. Corresponding content is given in the part of ‘‘research’’ *(see p.156)* (Çiğdem, Balçık & Karaca, 2018). For this context, while the information related to health issue is gained, students will engage the subject through research as well.

Precautions is also defined in the objective and the textbook as mentioned in the goal so it indicates the consistency among the parts. Moreover, information is represented in stated SDGs in knowledge learning competence type since the study restricted with just research that includes information on the specified topic. In addition to this, measures to be taken with regard to poisoning is pointed out in the parts of ‘‘text’’ *(see p.157)* by indicating measures to be taken with regard to stove and natural gas poisoning through listing them and ‘‘what have we learned?’’ *(see p.158)* that precautions against poisoning are listed and also it is assessed in the ‘‘subject evaluation’’ *(see p.159 and p.160)* which the topic of precautions for poisoning is assessed with true-false and multiple choice questions additionally as well (Çiğdem, Balçık & Karaca, 2018).

Table 4.28. *Objective 6.5.4.3 Versus SDGs with Corresponding Competences*

Objective 6.5.4.3: Explains the importance of sound insulation **Related SDG/s of UN (2015) as:** ‘‘G.11 (Sustainable cities and communities)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.11. K.1- The nature and components of cities and our basic needs: food, housing, energy, transport and water’’ (p.58).

(Sources: Osman et al., 2017; MoNE, 2018)

According to Table 4.28, the importance of sound insulation described in the objective as ‘‘explains the importance of sound insulation’’ (MoNE, 2018, p.36) is emphasized in the part of ‘‘working time’’ *(see p.190)* by asking students sound insulation importance for human health by giving examples (Çiğdem, Balçık & Karaca, 2018). Sound insulation concept is met in G.11 (Sustainable cities and communities) since insulation in buildings and its preventable effect on noise for environment will help of understanding cities and building structures in daily life like mentioned in the goal. Moreover, it is displayed as knowledge without referring to other competences (skills or values) due to not referring any action or value related one. In addition to the content related to the objective in textbook, there is not determined any additional information regarding subject.

Table 4.29. *Objective 6.5.4.3.a Versus SDGs with Corresponding Competences*

Objective 6.5.4.3.a: Technological and architectural applications that are developed for sound insulation are mentioned **Related SDG/s of UN (2015) as:** ‘‘G.11 (Sustainable cities and communities)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.11. K.1-The nature and components of cities and our basic needs: food, housing, energy, transport and water’’ (p.58).

(Sources: Osman et al., 2017; MoNE, 2018)

The representation of the applications on for sound insulation is exhibited as passing in the objective of ‘‘technological and architectural applications that are developed for

sound insulation are mentioned'' (MoNE, 2018, p.36) in Table 4.29 in the ''texts'' by mentioning some of the insulation materials such as cotton, sponge etc. with illustrated picture *(see p.185)*. In addition, the importance of sound insulation, the places where the insulation is applied such as cinema and what should be done for the insulation are described as well *(see p.186 and p.187)*. In the parts of ''what have we learned?'', there are presented dome of sound insulation materials *(see p.191)* (Çiğdem, Balçık & Karaca, 2018).

The topic is the same as the previous objective but there is described the sound insulation applications apparently in order to understand technological and architectural structure of buildings and application of sound insulation in these structures (as stated in G.11 in knowledge competence area). From the content of the objective, the text and the goal, they have same topic (one of the basic needs sound insulation). Also, there is not observed additional knowledge.

Table 4.30. *Objective 6.6.2.3 Versus SDGs with Corresponding Competences*

Objective 6.6.2.3: Gives examples of defects in sensory organs and technologies used in the removal of these defects **Related SDG/s of UN (2015) as:** ''G.3 (Good health and well-being)'' **Related Competencies/learning outcomes (Osman et. al, 2017):** → ''G.3. K.8 -Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases'' (p.25).

(Sources: Osman et al., 2017; MoNE, 2018)

The examples of defects in sensory organs and related technologies presented in the objective ''gives examples of defects in sensory organs and technologies used in the removal of these defects'' (MoNE, 2018, p.37) as in Table 4.30 is founded in ''question (in text)'' section by asking sensory organs defects and related technological products used to remedy them *(see p.222)* (Çiğdem, Balçık & Karaca, 2018) as presented in the objective.

Information is obtained through question method by students. Moreover, the content of the objective and the text is related to health as in G.3 (Good health and well-being) as in the form of knowledge competence. In order to evaluate students' knowledge on this health issue like in the goal, it is used question to appear of the examples from the answers of students.

Apart from these, ''subject evaluation'' that eye defect related question as choosing appropriate word from the puzzle is asked and the information of eye defect again and material used for correction of the defect is elaborated with the help of visual through multiple choice question *(see pp.226-227)* and ''working time'' that sensory organs such as nose, eye, ear etc. in the pictures and corresponding diseases are matched and then write under the pictures *(see p. 236)* (Çiğdem, Balçık & Karaca, 2018) parts of the textbook are given place and evaluated the knowledge on the topic additionally.

Table 4.31. *Objective 6.6.2.3.a Versus SDGs with Corresponding Competences*

Objective 6.6.2.3.a: Causes of eye defects as myopia, hypermetropia, astigmatism and strabismus without mentioning the treatment methods are described briefly
Related SDG/s of UN (2015) as: ''G.3 (Good health and well-being)''
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ''G.3. K.8-Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases'' (p.25).

(Sources: Osman et al., 2017; MoNE, 2018)

Furthermore, causes of eye defects as passing in the objective ''causes of eye defects as myopia, hypermetropia, astigmatism and strabismus without mentioning the treatment methods are described briefly'' (MoNE, 2018, p.36) as presented in Table 4.31. The content is reflected briefly in the ''text'' by stating causes of such eye defects *(see p.222)* (Çiğdem, Balçık & Karaca, 2018) as stated in the objective.

According to the finding, defects in eye as health condition subjects is stressed to teach them students like in G.3. Not only the text but also the objective and the goal address the issue of understanding the health condition and diseases. As understanding from the text, knowledge comes forward so it is not possible to observe any other competence (skills or values ones). In addition, there is not additional information related to the topic.

Table 4.32. *Objective 6.6.2.4 Versus SDGs with Corresponding Competences*

Objective 6.6.2.4: Discusses measures to be taken to protect the health of sensory organs **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good health and well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3. K.8-Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases’’ (p.25) → ‘‘G.4. S.5 - Critical and engaged approach towards learning’’ (p.29).

(Sources: Osman et al., 2017; MoNE, 2018)

The discussion of measurement taken for protection health of organs stated in the objective of ‘‘discusses measures to be taken to protect the health of sensory organs’’ (MoNE, 2018, p.37) is reflected in textbook as in the section of ‘‘discussion’’ *(see p.224)* (Çiğdem, Balçık & Karaca, 2018) as exhibited in Table 4.32.

Considering students approach to this discussion, there will occur the skill of critical and engaged learning understanding the way of protection health expected in the goal of good health and well-being (G.3 and G.4). The objective, the content of the text and the goal are parallel on indicating same content (protection of health).

On the other hand, what needs to be done to protect the health of our sensory organs a is expressed in the ‘‘text’’ such as consuming foods rich in vitamin A for eye health *(see pp.224-225)* (Çiğdem, Balçık & Karaca, 2018) as additional knowledge in this case.

Table 4.33. *Objective 6.6.3.1 Versus SDGs with Corresponding Competences*

Objective 6.6.3.1: Discuss what needs to be done for the health of the systems based on the research data **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good health and well-being) and G.4 (Quality education)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3. K.8-Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases’’ (p.25). → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).

(Sources: Osman et al., 2017; MoNE, 2018)

The health of systems and what needs for a healthy system are discussed in the objective of ‘‘discuss what needs to be done for the health of the systems based on the research data’’ (MoNE, 2018, p.37) described in Table 4.33.

The objective is evaluated in the parts of ‘‘question (in text)’’ that what should be done for health of support and movement system is asked *(see p.228),* ‘‘research’’ which what should be done protection health of internal glands *(see p.228),* support and movement system *(see p.230)* and digestive system *(see p.232)* are researched by students and ‘‘discussion’’ that common diseases related to circulatory system and what should be done for its health are asked *(see p.233)* (Çiğdem, Balçık & Karaca, 2018).

Knowledge competence in the scope of health (as in G.3) and skill competence while engaging the learning critically (as in G.4) on issue are determined. The content of the text, the objective and the goal (G.3) emphasizes the health of the systems. As well, there are just included knowledge and skill competence except value one.

Additional information is taken part in the parts of ‘‘texts’’ by indicating ways of protection health of systems *(see p.229, p.230 and p.232)* and assessed in ‘‘unit evaluation’’ that the actions for protections of supports and movement system, the factors affecting circulatory system negatively and the behaviors for protection of

digestive system health are asked through multiple choice questions *(see p.244)* (Çiğdem, Balçık & Karaca, 2018).

Table 4.34. *Objective 6.6.3.1.a Versus SDGs with Corresponding Competences*

Objective 6.6.3.1.a: System diseases which are the most common diseases in Turkey is mentioned **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good health and well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3. K.8- Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases’’ (p.25).

(Sources: Osman et al., 2017; MoNE, 2018)

Regarding the objective which is stressed as ‘‘system diseases which are the most common diseases in Turkey is mentioned’’ (MoNE, 2018, p.37) is presented in Table 34. Through system unit, the systems diseases are defined in ‘‘text’’ that under the titles of health of internal secretion with the diseases such as dwarfism, gigantism, diabetes etc. glands *(see p.229)*, the support and movement system with the diseases such as bone fracture and rheumatism *(see p. 231)*, the digestive system with the diseases as ulcer and diarrhea *(see p.232)*, the circulatory system with the diseases as anemia and cardiovascular diseases *(see p.233)*, the respiratory system with the diseases as pneumonia, flu, lung and throat cancers *(see p.234)* and the excretory system with the disease as kidney failures are described (Çiğdem, Balçık & Karaca, 2018) in the textbook.

The content of excerpted part is also related to diseases and health (as passed in G.3) and in the objective as expected. In addition, information in related part is directly supplied to students as. Furthermore, information is provided just with knowledge without embedding other competences due to not applying knowledge to their life or behave accordingly.

While providing such knowledge, it is evaluated in ‘‘subject evaluation’’ that system diseases are elaborated with true-false questions and there asked also questions that sentences which describe diseases are completed by selecting appropriate word pairs related to system diseases *(see p.241)* and ‘‘working time’’ that system diseases are matched and then these diseases are written under the corresponding system in the picture *(see p.236)* (Çiğdem, Balçık & Karaca, 2018) additionally as well.

Table 4.35. *Objective 6.6.3.1.b Versus SDGs with Corresponding Competences*

Objective 6.6.3.1.b: The harms of unconscious drug use are highlighted **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good health and well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3. K.8- Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases’’ (p.25).

(Sources: Osman et al., 2017; MoNE, 2018)

In addition, it is indicated the harms of unconscious of drug usage pointed out in the objective of ‘‘the harms of unconscious drug use are highlighted’’ (MoNE, 2018, p.37) as presented in Table 4.35 is determined in the ‘‘text’’ that unconscious drug use such as antibiotics with their impacts as disrupt the immune system etc. and what should be done for conscious drug consumption are mentioned *(see p.237)* (Çiğdem, Balçık & Karaca, 2018) in the part of the textbook.

For this content, the health issue is stated as in the objective and G.3 (Good health and well-being). Information is provided in the direct knowledge format in the textbook. From the objective to textbook and also the goal focus on healthy nutrition. While going on the same content, it shows that the content does not involve not only skill but also value competences.

Apart from these knowledge, it is additionally evaluated in ‘‘subject evaluation’’ that when regarding the information in the visual related to drug usage, it is asked to which

statement is wrong through multiple choice question *(see p.242)* (Çiğdem, Balçık & Karaca, 2018).

Table 4.36. *Objective 6.6.3.1.c Versus SDGs with Corresponding Competences*

Objective 6.6.3.1.c: The effects of harmful habits such as alcohol and smoking are addressed to human health. Yeşilay is emphasized in the fight against alcohol and smoking **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good health and well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3. K.8- Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases’’(p.25).

(Sources: Osman et al., 2017; MoNE, 2018)

The objective is determined as ‘‘the effects of harmful habits such as alcohol and smoking are addressed to human health. Yeşilay is emphasized in the fight against alcohol and smoking’’ (MoNE, 2018, p.37) as indicated in Table 4.36. The effects of harmful habits are briefly highlighted in the ‘‘text’’ part *(see p.238)* (Çiğdem, Balçık & Karaca, 2018) as stated in the objective.

Due to the reflection of the knowledge on health conditions, it can be stated that the competence is in goal of health and well-being (G.3) in knowledge competence area as in not only the objective but also the content of the textbook. Besides, both skill and value competences are not detected for this content because of emphasizing the knowledge on issue instead of taking action or behaving accordingly. Furthermore, additional information is not presented there for this case.

Table 4.37. *Objective 6.6.3.1.ç Versus SDGs with Corresponding Competences*

Objective 6.6.3.1.ç: Basic information about first aid is given **Related SDG/s:** ‘‘G.3 (Good health and well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3. K.8- Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases’’ (p.25).

(Sources: Osman et al., 2017; MoNE, 2018)

As indicated at Table 4.37, the objective is ‘‘basic information about first aid is given’’ (MoNE, 2018, p.37). Accordingly, basic information on first aid is given by indicating accurate first aid, first-aid related concepts as first –aider, first aid certificates and first aid services and there is given visual to shows the sequences for application first aid in the ‘‘text’’ section *(see p.238)* (Çiğdem, Balçık & Karaca, 2018).

What is placed in these sections (objective and the textbook) is as similar as the goal detected. Moreover, the content is transmitted to students in the way of knowledge competence except skills and values one.

Also, information is additionally reflected in questions in ‘‘subject evaluation’’ by asking incorrect option during applying first aid to an injured person with multiple choice question *(see p.242)* (Çiğdem, Balçık & Karaca, 2018).

4.3. SDGs with Relevant Competences in 7th Grade Science Curriculum and Science Textbook

The objectives of 7th grade Science Curriculum and Science Textbook are investigated and the findings are provided in separate parts by indicating the objective number and the objective itself for the curriculum, corresponding SDG goal/s and the related competence found in the Science Curriculum. Accordingly, distribution of the SDGs in 7th grade Science Curriculum objectives in addition to the distribution of these competences in terms of the clusters of learning competences are illustrated graphically.

4.3.1. SDGs with Relevant Competences in 7th Grade Science Curriculum

7th grade SDGs related objectives in Science Curriculum are shown related regarding the clusters of learning competences (Knowledge and understanding; Skills and applications; Values and attitudes) and the learning outcomes for the learning competencies as indicated in Table 4.38. Moreover, SDGs related objectives in 7th grade Science Curriculum and corresponding the clusters of learning competences with learning outcomes are displayed in Table 4.39 below.

Table 4.38. *SDGs Versus Corresponding Clusters of Learning Competencies with Learning Outcomes in 2018 Science Curriculum for 7th Grade*

SDGs	Clusters of Learning Competencies / Learning Outcomes
G.3- Good health and well-being	**K.10**.Learning about mental and emotional health, and sexual and reproductive health and rights **S.4.**Ability to identify positive and negative influences, analyses risks, and make informed decisions
G.4-Quality education	**S.5.**Critical and engaged approach towards learning
G.7-Affordable and clean energy	**K.2.**Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts
G.9-Industry, innovation and infrastructure	**K.3.**Understanding the economic, environmental and social benefits and challenges of different types of infrastructure and industry
G.12-Responsible consumption and production	**K.1**.Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts **K.2**.Further understanding of the '4 Rs' **S.1**.Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes) **S.2**.Participating in recycling, composting and other environmental schemes **V.2**.Adoption of non-wasteful behaviors (e.g. reduce packaging, use compost, seek environmentally friendly options) **V.3.**Awareness of environmental/health risks, and benefits of safe disposal
G.13- Climate action	**K.3.**Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production)

(Source: Osman et al., 2017)

G: Goal

K: Knowledge and understanding **S:** Skills and applications

V: Values and attitudes

Table 4.39. *SDGs Related Objectives Versus Corresponding Clusters of Learning Competencies: as Knowledge (K), Skills (S) and Values (V) in the 2018 Science Curriculum for 7th Grade*

SDGs related Objectives	**Competences**											
	**Knowledge						*Skills				***Values	
	SDGs/Learning Outcomes											
	G.3. K10	G.7. K2	G.9 .K3	G.12. K1	G12. K2	G.13. K3	G.3. S4	G.4. S5	G.12. S1	G.12. S2	G.12. V2	G.12. V3
4.5.1.Distinguishes recyclable and non-recyclable materials in domestic waste				×	×				×			
4.5.2.Designs projects for the recycling of domestic solid and liquid wastes								×		×		
4.5.3.Queries for efficient use of recycling resources				×					×			
4.5.3.a.The contribution of recycling plants to the economy is emphasized			×		×							
4.5.4.Takes care of waste management in the vicinity				×				×			×	×
4.5.4.b.it is reminded that it should not be contacted with medical waste				×								

Table 4.39. *Continued*

SDGs related Objectives	Competences											
	**Knowledge						*Skills				***Values	
	SDGs/Learning Outcomes											
	G.3.K10	G.7.K2	G.9.K3	G.12.K1	G12.K2	G.13.K3	G.3.S4	G.4.S5	G.12.S1	G.12.S2	G.12.V2	G.12.V3
4.5.5.Develops project to deliver reusable items to those who need					×			×		×		
5.1.4.Gives examples of the innovative applications of solar energy in everyday life and technology		×				×						
5.1.4.a. The importance of solar energy is emphasized in terms of effective usage of resources		×		×								
5.1.5.Dscusses ideas about how to use solar energy in the future		×						×				

Table 4.39. *Continued*

SDGs related Objectives	Competences											
	**Knowledge						*Skills				***Values	
	SDGs/Learning Outcomes											
	G.3.K10	G.7.K2	G.9.K3	G.12.K1	G12.K2	G.13.K3	G.3.S4	G.4.S5	G.12.S1	G.12.S2	G.12.V2	G.12.V3
5.3.3.a.It is mentioned that glass wastes which be left in forest areas can cause fire risk				×								
6.1.1.c.Importance of hygiene in reproductive system health is highlighted	×											
6.1.3.Discusses the precautions to be taken for the healthy development of the embryo based on research data							×	×				

(Source: MoNE, 2018)
****K:** Knowledge and understanding ***S:** Skills and applications
*****V:** Values and attitudes

As displayed in Table 4.39, the number of SDGs related objectives in the Science Curriculum are 8 mains objectives and 5 sub-objectives. While most of the objective are referred in Chapter 4, Chapter 6 has the least SDG related objectives. The results of the study reveals that 6 out of 17 goals are determined as related to the objectives for the 7th grade Science Curriculum. These goals are; Good health and well-being (G.3), Quality education (G.4), Affordable and clean energy (G.7), Industry, innovation and infrastructure (G.9), Responsible consumption and production (G.12) and Climate action (G.13).

Moreover, G.7 (Affordable and clean energy), G.9 (Industry, innovation and infrastructure) and G.13 (Climate action) just contain one clusters of learning competence (knowledge). Likewise, G.4 (Quality education) includes only one competence (skill). While G.3 (Good health and well-being) address both skills and values competences, G.12 (Responsible consumption and production) consists of all competences (knowledge, skill and value).

In brief, content analysis shows that there are 8 main objectives with 5 sub- ones in the 7th grade Science Curriculum related to 6 SDGs. These objectives are mostly represented in Chapter 4 as ‘‘Pure Substances and Mixtures’’. On the other hand, the least referred chapter is Chapter 6 as ‘‘Reproduction, growth and development in living organisms’’.

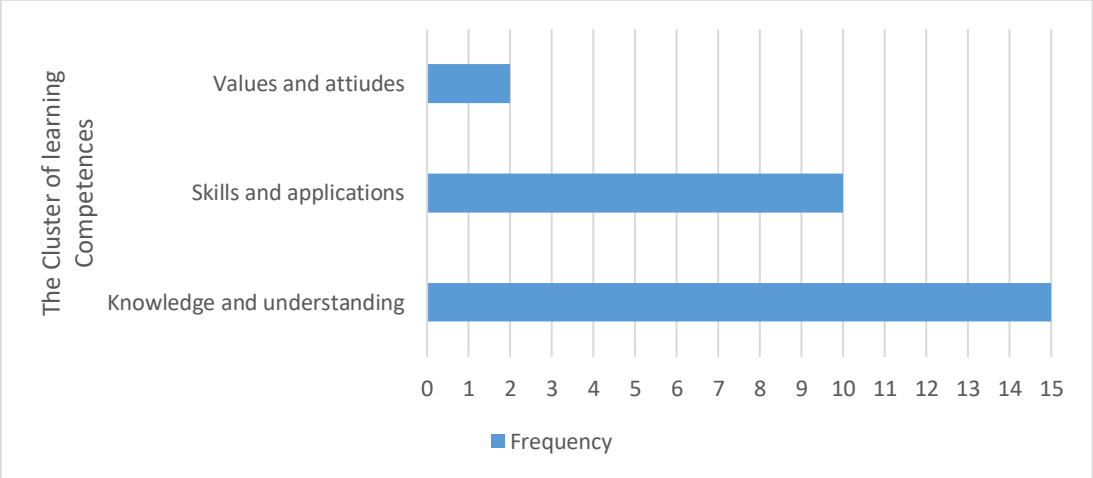

Figure 4.7. The Distribution of Clusters of Learning Competences (Knowledge, Skill and Value) in 7th Grade Science Curriculum

In *Figure 4.7*, Distribution of Clusters of Learning Competences (Knowledge, Skill and Value) in 7th grade Science curriculum is illustrated. According to the figure, there is founded 27 clusters of learning competences in the curriculum; 10 of these clusters are related to skill and 15 of them are related to knowledge; on the other hand, value related competence consists of just 2 of the competences in the curriculum. To conclude, knowledge and understanding (f=15) is the most represented, whereas value competence is the least referred within the clusters of learning competence in the objectives.

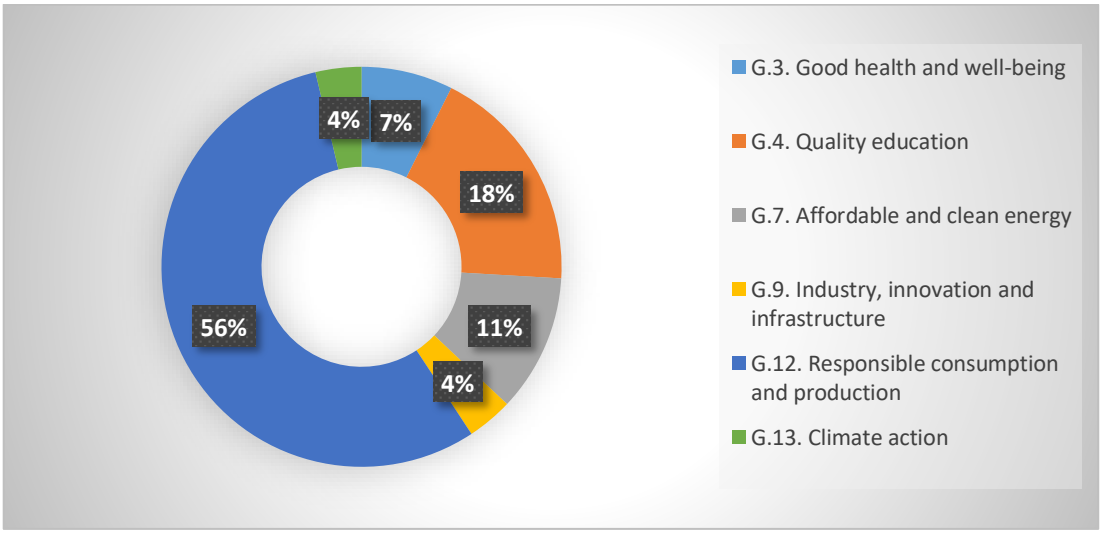

Figure 4.8. Percentage of the SDGs in Determined Objectives in 7th Grade Science Curriculum

Furthermore, *Figure 4.8* presents that the 7th grade Science curriculum involves 6 SDGs; "Responsible consumption and production" (G12) (56%) having the highest percentage of appearance, while "Climate action" (G.13) (4%) and "Industry, innovation and infrastructure'' (G.9) having the least.

Table 4.40. *The Distribution of the SDG Related Objectives in Three Dimensions of SD – 7th Grade*

	Three Dimensions of SD		
SDG related Objectives	**Social**	**Economic**	**Environmental**
4.5.1. Distinguishes recyclable and non-recyclable materials in domestic waste			
4.5.2. Designs projects for the recycling of domestic solid and liquid wastes			
4.5.3. Queries for efficient use of recycling resources			
4.5.3.a. The contribution of recycling plants to the economy is emphasized			
4.5.4. Takes care of waste management in the vicinity			
4.5.4.b. It is reminded that it should not come into contact with medical waste			
4.5.5. Develops projects to deliver reusable items to those in need			

Table 4.40. *Continued*

	Three Dimensions of SD		
SDG related Objectives	**Social**	**Economic**	**Environmental**
5.1.4. Gives examples of the innovative applications of solar energy in everyday life and technology			
5.1.4. a. The importance of solar energy is emphasized in terms of effective use of resources			
5.1.5. Discusses ideas about how to use solar energy in the future			
5.3.3. a. It is mentioned that glass wastes which left in forest areas can cause fire risk			
6.1.1.c. Importance of hygiene in reproductive system health is highlighted			
6.1.3. Discusses the precautions to be taken for the healthy development of the embryo based on research data			

The distributions of the objectives in three pillars of SD were determined regarding to the inclusion of SDGs in corresponding objective since the categorization of SDGs for three pillars was made as in methodology part. As shown in Table 4.40, SDG related objectives are presented in three dimensions of SD (Social, Economic and Environmental). At least one dimension is related to the objectives. Most of the objectives are in the economic dimension. 6 of them are in social dimension. On the other hand, there are 3 of them in environmental dimension.

4.3.2. SDGs with Relevant Competences in 7th Grade Science Textbook

After the analysis of the objectives in the 2018 Science Curriculum in terms of related to SDG and inclusion of the clusters the learning competences (Knowledge and understanding; Skills and applications; Values and attitudes), how SDG related objectives is placed in the textbook is investigated as in Step 6. In this section, the content of the SDG related objectives in the 7th grade Science Textbook are displayed. The results are displayed by describing corresponding contents from the textbook for SDGs related objectives.

Table 4.41. *Objective 7.4.5.1 Versus SDGs with Corresponding Competences*

Objective 7.4.5.1: Distinguishes recyclable and non-recyclable materials in domestic waste **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63). → ‘‘G.12.K.2-Further understanding of the ‘4 Rs’’ (p.63). → ‘‘G.12.S.1-Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes)’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

To distinguish recyclable and non-recyclable materials in domestic wastes as described in the objective of ‘‘distinguishes recyclable and non-recyclable materials in domestic waste’’ (MoNE, 2018, p.43) as in Table 4.41 is displayed in the ‘‘question (in text)’’ that non-recyclable materials illustrated via table such as car, plastic bottles etc. *(see p.113)* are presented and then other non-recyclable materials are asked *(see p.114)* and ‘‘activity’’ which observation of trashes in house for a week is requested from students and then it is asked to students to classify these trashes as recyclable

and non-recyclable by writing these information in specified table *(see p.112)* (Gezer, 2018) are the parts where the objective is reflected. The content of the related parts in the textbook is related the domestic waste and consumption as involved in two different knowledge competences. In this case, students will use both knowledge and skill competences to distinguish materials since in order to able to distinguish such materials in terms of recyclable or non-recyclables, the knowledge of recycling is necessary firstly (G.12.K1); and then, students will use their knowledge in this issue to their life (G.12.K.2).

While applying knowledge about recycling in domestic waste, they will make analysis and then decide the separation of the wastes (G.12.S.1). Students will perform what is expected from the objective in the textbook in the guidance of the goal. Additionally, ‘‘text’’ that metals, plastics, glassless etc. as domestic waste are mentioned as recyclable ones in addition to indication of frying oil, cable, battery, gum etc. through illustrated visual of these materials *(see p.112)*, ‘‘apply what we learned’’ that it is expected to give examples on recyclable materials from students *(see p.116)* and ‘‘unit evaluation’’ that there are multiple choice question which is about non-recyclable materials *(see p.112)* and question related to matching of sentence that is about recycling with corresponding terms *(see p.118)* (Gezer, 2018) sections present the knowledge by directly giving information. The knowledge is assed in these sections.

Table 4.42. *Objective 7.4.5.2 Versus SDGs with Corresponding Competences*

Objective 7.4.5.2: Designs projects for the recycling of domestic solid and liquid wastes
Related SDG/s of UN (2015) as: ‘‘G.4 (Quality education) and G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).
→ ‘‘G.12. S.2-Participating in recycling, composting and other environmental schemes’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

As the results pointed out in Table 4.42, the project is made for recycling of domestic and liquid wastes as expected from the objective of ‘‘designs projects for the recycling of domestic solid and liquid wastes’’ (MoNE, 2018, p.43) in the Science Curriculum. Moreover, the objective is addressed in the part of ‘‘activity’’ that there are created two groups that first group has the project title of ‘Recycling of Domestic Solid Waste’ and second group has the project title of ‘Recycling of Household Liquid Wastes’. Later, students made research on the projects and then present *(see p.114)* (Gezer ,2018) in the Science Textbook. In this part of the textbook, solid and liquid wastes are evaluated. During project students will participate the activity related to wastes with critical and engaged approach (G.4.S.5). Via this project, they will participate recycling related an activity (G.12.S.2). For this case, students will use skill competence to understand recycling different perspective. Also, students will apply the knowledge of recycling for the specific situation. As seen from the content of the objective, related competences and the content of the textbook are relevant each other. Furthermore, there is not obtained any additional knowledge related to the concept.

Table 4.43. *Objective 7.4.5.3 Versus SDGs with Corresponding Competences*

Objective 7.4.5.3: Queries for efficient use of recycling resources **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63) → ‘‘G.12.S.1-Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes)’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

According to Table 4.43, the query for efficient use of recycling resources stressed in the objective of ‘‘queries for efficient use of recycling resources’’ (MoNE, 2018, p.43)

is placed in the ‘‘text’’ that benefits of recycling such as energy conservation, prevention of environmental, air and water pollutions etc. are mentioned *(see p.114)* (Gezer, 2018). Through massage passed in text, students will question the benefits of the recycling. While doing so, they will use their background knowledge on topic to evaluate. Because of relating the topic to recycling and consumption, it can be stated that the text is directly regarding to knowledge as indicated in the clusters of competences. The skill competence is on the other hand not applicable for the competence of S.1 (G.12) since the objective at first reflects the skills of analyzing and querying of efficient usage of resources (as in G.12.S.1). The results show that the objective is achieved with just direct knowledge via text in the textbook; in other words, the objective is given only through knowledge competence level in the textbook. The focused topic is also the same in both the objective, textbook and the goal. In addition to the objective, the additional information is not addressed in this content.

Table 4.44. *Objective 7.4.5.3.a Versus SDGs with Corresponding Competences*

Objective 7.4.5.3.a: The contribution of recycling plants to the economy is emphasized
Related SDG/s of UN (2015) as: ‘‘G.9 (Industry, innovation and infrastructure) and G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.9. K.3-Understanding the economic, environmental and social benefits and challenges of different types of infrastructure and industry’’ (p.51).
→ ‘‘G.12. K.2-Further understanding of the ‘4 Rs’’(p.63).

(Source: Osman et al., 2017; MoNE, 2018)

The knowledge of the contribution of recycling plants to economy is displayed in Table 4.44 with related the objective of ‘‘the contribution of recycling plants to the economy is emphasized’’ (MoNE, 2018, p.43). Contribution of recycling plants to the economy is presented within the part of ‘‘text’’ that the objective is mentioned as it is

in this part and recycling, providing job opportunities are mentioned as contributor factors for economy *(see p.115)* (Gezer, 2018). Also, the knowledge is provided with the understanding issue without acting or behaving accordingly. The content bases on both economy, recycling and plants so it can be inferred that the objective is related to understanding the economic benefits of plants (as in G.9) and understanding the different perspective of the recycling as economy (as in G.12). Regarding to the content of the objective, textbook and the goals, both of them indicate same issue (recycling plants and the economy). Furthermore, the information is assessed in ‘‘apply what we learned’’ that contribution of recycling to the country's economy is asked in this part through open ended question *(see p.116)* (Gezer, 2018) in textbook additionally.

Table 4.45. *Objective 7.4.5.4 Versus SDGs with Corresponding Competences*

Objective 7.4.5.4: Takes care of waste management in the vicinity
Related SDG/s: ‘‘G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).
→ ‘‘G.12. K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63).
→ ‘‘G.12. V.2-Adoption of non-wasteful behaviors (e.g. reduce packaging, use compost, seek environmentally friendly options)’’ (p.63).
→ ‘‘G.12. V.3-Awareness of environmental/health risks, and benefits of safe disposal’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

There can be understand from the objective of ‘‘taking care of waste management in the vicinity’’ (MoNE, 2018, p.43) that students will be in action to apply their knowledge on consumption and production as summarized in Table 4.45.

The objective is reflected in the textbook by introducing just information in the part of ‘‘text’’ that classification of materials before disposing is recommended and taking care of waste control is highlighted *(see p.115)* (Gezer, 2018). As described in the content of the objective, the main target is to have students' knowledge in this subject and then apply it to their daily life as indicated in text. Therefore, there is not found any activity or project for applying the stated knowledge in the objective; and therefore, there is presented the content of the objective in the textbook just in the form of knowledge competence except value and skill competences. The same content (waste management) is stressed in not only in the objective and textbook but also in the goal. Moreover, there is also not defined any additional information as well.

Table 4.46. *Objective 7.4.5.4.b Versus SDGs with Corresponding Competences*

Objective 7.4.5.4.b: It is reminded that it should not come into contact with medical waste
Related SDG/s of UN (2015) as: ‘‘G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

Apart from this, the reminding of not coming into contact with medical waste emphasis on the objective of ‘‘it is reminded that it should not come into contact with medical waste’’ (MoNE, 2018, p.43) as stated in Table 4.46 is illustrated in the ‘‘text’’ that transportation of medical waste is described by avoiding from medical waste, using orange color container that includes the emblem with on the black color phrase that attract attention to medical waste *(see p.115)* (Gezer, 2018). The impacts of consumption and production on environment and health is provided in the form of knowledge competence. Indeed, consistent contents in the objective, textbook and the

goal reveal that the target of the objective is achieved as expected as in the textbook. Due to direct information, there is just found knowledge competence. Additionally, the information is assessed with question in ‘‘apply what we learned’’ that the reason of not contacting of waste is asked with open ended question *(see p.116)* (Gezer, 2018) in the textbook.

Table 4.47. *Objective 7.4.5.5 Versus SDGs with Corresponding Competences*

Objective 7.4.5.5: Develops projects to deliver reusable items to those in need **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.12. K.2-Further understanding of the ‘4 Rs’’ (p.63). → ‘‘G.12. S.2-Participating in recycling, composting and other environmental schemes’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

As Table 4.47 summarizes that the project on delivering reusable items to those in needs stated in the objective such that ‘‘develops projects to deliver reusable items to those in need’’ (MoNE, 2018, p.43) is presented in the part of ‘‘activity’’ that there is made an aid campaign related to delivery of goods to people who need and students cooperate with friends during this campaign *(see p.115)* (Gezer, 2018) in the textbook. The activity includes competence not only knowledge but also skill competence. Through the project of delivery of reusable items to needs, students will understand particularly reuse aspects of 4 Rs. They will also participate such recycling activity with the help of this project. During the project, there will be used knowledge (G.12.K.2) and skill (G.12.S.2) competences for the issue of reusable items. Through the project, students will engage in the project critically as well (G.4). From the objective and the textbook to the goal, the content is the same. Moreover, there cannot be founded any related additional information for this part.

Table 4.48. *Objective 7.5.1.4 Versus SDGs with Corresponding Competences*

Objective 7.5.1.4: Gives examples of the innovative applications of solar energy in everyday life and technology **Related SDG/s of UN (2015) as:** ‘‘G.7 (Affordable and clean energy) and G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.7.K.2-Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42). → ‘‘G.13. K.3-Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production)’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

Apart from those, the innovative applications of solar energy applications in daily life examples identified in the objective of ‘‘gives examples of the innovative applications of solar energy in everyday life and technology’’ (MoNE, 2018, p.44) as summarized in Table 4.48 are mentioned through the ‘‘activity’’ that the importance of efficient use of solar energy and its usage areas are researched by students *(see p.131)* (Gezer, 2018) in the textbook with help of the research. The content is also reflected in discussion part so students will engage in the context critically; and therefore, when examining the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’. With the help of the objective, students will have an information on one of form of energy (identified in G.7) and indirectly climate action (G.13) as identified climate change and energy relation. In addition to the objective, the content of the textbook and related goals emphasizes solar energy as type of energy form. On the other side, there is not included any skill and value competences except knowledge since there is expected students to just give examples related to the topic without applying or behaving related issue. In addition, the information is defined through

question in ‘‘unit evaluation’’ that there is asked question that solar energy and technological tool related sentence is matched with corresponding term *(see p.151)* (Gezer, 2018) additionally.

Table 4.49. *Objective 7.5.1.4.a Versus SDGs with Corresponding Competences*

Objective 7.5.1.4.a: The importance of solar energy is emphasized in terms of effective use of resources
Related SDG/s of UN (2015) as: ‘‘G.7 (Affordable and clean energy) and G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.7.K.2-Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42).
→ ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

In Table 4.49, the importance of solar energy that is emphasized in terms of effective use of resources passing in the objective of ‘‘the importance of solar energy is emphasized in terms of effective use of resources’’ (MoNE, 2018, p.44) is exhibited in the ‘‘text’’ that the way of benefit from solar energy is described by illustrating the examples of as description of solar panel system and solar cookers and also production of electricity *(see p.131)* (Gezer, 2018). Moreover, consumption of resources as main subject of both the goals, the objective and the textbook; in other words, the content of them are consistent. All this information is obtained through knowledge not with skill or value in this case since the of concept solar energy consumption in the objective is stated directly to students. Particularly, there is not founded extra information about the content.

Table 4.50. *Objective 7.5.1.5 Versus SDGs with Corresponding Competences*

Objective 7.5.1.5: Discusses ideas about how to use solar energy in the future **Related SDG/s of UN (2015) as:** ‘‘G.4 (Quality education) and G.7 (Affordable and clean energy) **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.7.K.2-Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42).

(Source: Osman et al., 2017; MoNE, 2018)

The objective in the curriculum as discussing ıdeas about how to use solar energy in the future explained trough the objective of ‘‘discusses ideas about how to use solar energy in the future’’ (MoNE, 2018, p.44) is examined in related part of the book presented in Table 4.50. According to the findings, it is reflected in the part of ‘‘discussion (in the text)’’ *(see p.131)* (Gezer, 2018) as stressed in the objective.

The objective is directly displayed in textbook. Students approach to concept within critical and engaged learning (G.4). The focus of the discussion is on the usage of the solar energy as indicated in the goal of G.7 (K.2). This shows that both of the goal, objective and the textbook reflects the similar content. Due to critical engaging and usage of the knowledge related issue, there are identified only knowledge and skill competence. Moreover, there is not provided any additional information to students in this part.

Table 4.51. *Objective 7.5.3.3.a Versus SDGs with Corresponding Competences*

Objective 7.5.3.3.a: It is mentioned that glass wastes which left in forest areas can cause fire risk
Related SDG/s of UN (2015) as: ‘‘G.12 (Responsible consumption and production)
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

As reported in Table 4.51, the objective which is ‘‘it is mentioned that glass wastes which left in forest areas can cause fire risk’’ (MoNE, 2018, p.44) is addressed in the related part of the textbook in the ‘‘text’’ that the news related to fire in the forests due to leaving of a piece of glasses that behaves as convex lenses is mentioned and it is suggested to not leaving of glasses to prevent fires in forests *(see p.146)* (Gezer, 2018). The effect of these wastes is highlighted like as indicated in G.12. The knowledge competence comes forward on the topic. Skill or value competence is not included in this time because of direct information without any application or acting related issue. For the content, the objective, textbook and the goal highlight the same topic (consumption effects). In the part of the information given in the textbook related to the objective the knowledge is assessed in ‘‘unit evaluation’’ that the reason of fire risk in forest due to leaving of glass wastes is asked with open ended question *(see p.152)* (Gezer, 2018) additionally.

Table 4.52. *Objective 7.6.1.1.c Versus SDGs with Corresponding Competences*

Objective 7.6.1.1.c: Importance of hygiene in reproductive system health is highlighted **Related SDG/s of UN (2015) as:** ‘‘G.3 (Good health and well-being)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.3.K.10-Learning about mental and emotional health, and sexual and reproductive health and rights’’ (p.25).

(Source: Osman et al., 2017; MoNE, 2018)

As Table 4.52 points out, the importance of hygiene in reproductive system health concept which is the scope of the objective of ‘‘importance of hygiene in reproductive system health is highlighted’’ (MoNE, 2018, p.45) is highlighted in ‘‘text’’ that what should be done after going to toilet is described by giving examples such as drying of related area, wearing of cotton underwear etc. *(see p.161)* (Gezer, 2018) without detail. Moreover, the hygiene and system health are the concepts that are mentioned in in the goal of G.3.

The findings arise the parallelism on the contents from objective to textbook. While displaying knowledge, there is not added any activity etc. that stimulate action of students or appearing of values so there is just indicated knowledge competence since the information is directly provided to students. There is not illustrated any additional knowledge there as well.

Table 4.53. *Objective 7.6.1.3 Versus SDGs with Corresponding Competences*

Objective 7.6.1.3: Discusses the precautions to be taken for the healthy development of the embryo based on research data
Related SDG/s of UN (2015) as: ‘‘G.3 (Good health and well-being) and G.4 (Quality education)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.3.S.4-Ability to identify positive and negative influences, analyses risks, and make informed decisions’’ (p.25).
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).

(Source: Osman et al., 2017; MoNE, 2018)

As in Table 4.53, students discuss the precautions to be taken for the healthy development of the embryo during activity based on research data as aiming at the objective of ‘‘discusses the precautions to be taken for the healthy development of the embryo based on research data’’ (MoNE, 2018, p.45). The objective is addressed in the part of ‘‘activity’’ that while the main focus of the activity is as what should mother candidates pay attention to, information related to pregnancy process is collected by also illustrating pregnancy picture from the resources and then it is expected to preparation a poster *(see p.163)* (Gezer, 2018) in the textbook. Consequently, there is analyzed the knowledge on health issue as in G.3 (Good health and well-being) with engaged learning as in G.4 (Quality education). When examining the content of the objective, the goals and the textbook, all of them address as expected from the objective. In addition, students engage in learning with critical approach and decision making so skill competence is dominant for this achievement. On the other hand, these precautions are directly indicated in the ‘‘text’’ that what should be paid attention by mother candidates during pregnancy is mentioned by indicating as consuming adequate nutrition, exercises, avoiding harmful habits and radiation etc. *(see p.164)* (Gezer, 2018) in addition to research additionally.

4.4. SDGs with Relevant Competences in 8th Grade Science Curriculum and Science Textbooks

This part represents the data related to the objectives of 8th grade Science Curriculum and Science Textbook separately. The findings for investigating the objectives are arranged in such a way to display the objective number and the objective itself for the curriculum, corresponding SDG goal/s and the related competence founded in the science curriculum. Moreover, both distribution of the SDGs in 8th grade Science Curriculum objectives and distribution of the SDGs in 8th grade Science Curriculum objectives regarding the clusters of learning competences are displayed graphically.

4.4.1. SDGs with Relevant Competences in 8th Grade Science Curriculum

SDGs related objectives in 8th grade Science Curriculum are represented in accordance with corresponding the clusters of learning competences (Knowledge and understanding; Skills and applications; Values and attitudes) and the learning outcomes for the learning competencies as presented in Table 4.54 by describing corresponding contents from the textbook for SDGs related objectives. Moreover, SDGs related objectives in 8th grade Science Curriculum and corresponding the clusters of learning competences with learning outcomes are displayed in Table 4.55 below.

Table 4.54. *SDGs Versus Corresponding Clusters of Learning Competencies with Learning Outcomes in 2018 Science Curriculum for 8th Grade*

SDGs	Clusters of Learning Competencies / Learning Outcomes
G.3- Good health and well-being	**K.6**.Emergency preparedness, evacuation drills, first aid **S.1.**Application of understanding to real life, such as personal hygiene and sanitation, and healthy living (e.g. food choices and exercise) **S.4.**Ability to identify positive and negative influences, analyses risks, and make informed decisions

Table 4.54. *Continued*

SDGs	Clusters of Learning Competencies / Learning Outcomes
G.4-Quality education	**S.5.**Critical and engaged approach towards learning
G.7-Affordable and clean energy	**K.1**.Basic concepts of energy and consumptive uses (e.g. powering cars) **K.2.**Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts **S.2**.Identification and practice of actions and choices for sustainable and safe living **V.2**.Commitment to energy conservation **V.4.**Consumptive behavioral change
G.8-Decent work and economic growth	**K.2.**Jobs in the school, community, etc.
G.9- Industry, innovation and infrastructure	**K.2.** Concepts of sustainability, industry, economic development, human well-being **K.3.** Understanding the economic, environmental and social benefits and challenges of different types of infrastructure and industry
G.12-Responsible consumption and production	**K.1**.Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts **K.2.**Further understanding of the '4 Rs' **K.7.**Calculate and compare Ecological Footprints

Table 4.54. *Continued*

SDGs	Clusters of Learning Competencies / Learning Outcomes
	S.1. Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes) **S.2**.Participating in recycling, composting and other environmental schemes **V.1**.Appreciation of the need to reduce harm, of impact and of finite resources. **V.5**.Consumer awareness and commitment to sustainable choices
G.13- Climate action	**K.2**.Basic understanding of climate science (e.g. carbon cycles, greenhouse gas effects) and physical impacts (e.g. sea-level rise, extreme weather) **K.3**.Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production) **K.5.**Concepts of climate mitigation and adaptation, resilience, sustainable development **S.2**.Ability to describe the causes and effects of climate change **S.3**.Understand and distinguish climate change impact in relation to self/context
G.15- Life on land	**K.1.** Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact

(Source: Osman et al., 2017)
G: Goal
K: Knowledge and understanding
S: Skills and applications
V: Values and attitudes

For Table 4.55, combination of two tables indicate one table through such as p.148 to 147 due to restricted region.

Table 4.55. *SDGs Related Objectives Versus Corresponding Clusters of Learning Competencies: as Knowledge (K), Skills (S) and Values (V) in the 2018 Science Curriculum for 8th Grade*

Competences															
				*Skills								***Values			
SDGs/Learning Outcomes															
G.13. K2	G.13. K3	G.13. K5	G.15. K1	G.3. S1	G.3. S4	G.4. S5	G.7. S2	G.12. S1	G.12. S2	G.13. S2	G.13. S3	G.7. V2	G.7. V4	G.12. V1	G.12. V5
×															
×															
				×	×										
								×							

Table 4.55. *Continued*

SDGs related Objectives	Competences								
	**Knowledge								
	SDGs/Learning Outcomes								
	G.3. K6	G.7. K1	G.7. K2	G.8. K2	G.9. K2	G.9. K3	G.12. K1	G.12. K2	G.12. K7
1.2.1.Explain the difference between climate and weather events									
1.2.2.States that climate science (climatology) is a branch of Science and expert working in this field is called as climatologist									
4.4.6.Take necessary precautions regarding the hazards that may occur during the use of acids and bases as cleaning materials	×								
4.4.7.Offers solutions for the prevention of acid rain							×		
4.4.7.a.Causes and consequences of the formation of acid rains is referred							×		

Table 4.55. *Continued*

Competences															
				*Skills								***Values			
SDGs/Learning Outcomes															
G.13. K2	G.13. K3	G.13. K5	G.15. K1	G.3. S1	G.3. S4	G.4. S5	G.7. S2	G.12. S1	G.12. S2	G.13. S2	G.13. S3	G.7. V2	G.7. V4	G.12. V1	G.12. V5
						×									
						×									
×															
×															
						×				×					

Table 4.55. *Continued*

SDGs related Objectives	Competences								
	**Knowledge								
	SDGs/Learning Outcomes								
	G.3. K6	G.7. K1	G.7. K2	G.8. K2	G.9. K2	G.9. K3	G.12. K1	G.12. K2	G.12. K7
4.6.1.Researches the development of chemical industry in Turkey from past to present					×	×			
4.6.1.b.The process of the Turkish chemical industry is mentioned by giving a few important examples of imported and exported chemical products					×	×			
4.6.2.Investigates the professions in the chemical industry and offers suggestions on new professions in the future				×					
6.3.1.Explain substance cycles by showing them on the diagram									
6.3.2.Question the importance of substance cycles for life									
6.3.3.Discusses the causes and possible consequences of global climate change									

Table 4.55. *Continued*

Competences															
				*Skills								***Values			
SDGs/Learning Outcomes															
G.13. K2	G.13. K3	G.13. K5	G.15. K1	G.3. S1	G.3. S4	G.4. S5	G.7. S2	G.12. S1	G.12. S2	G.13. S2	G.13. S3	G.7. V2	G.7. V4	G.12. V1	G.12. V5
×															
	×										×				
			×												
		×													

Table 4.55. *Continued*

SDGs related Objectives	Competences								
	**Knowledge								
	SDGs/Learning Outcomes								
	G.3. K6	G.7. K1	G.7. K2	G.8. K2	G.9. K2	G.9. K3	G.12. K1	G.12. K2	G.12. K7
6.3.3.a.The greenhouse effect is described									
6.3.3.b.In the context of global climate change, the effects of environmental problems on the future of the world and human life are questioned									
6.3.3.c.The predictions about how environmental problems can have an impact on the future of the world are asked to express through artistic means									
6.3.3.ç.The calculation of the ecological footprint (using safe cities such as extension as edu, org and mil) is provided to students									×
6.3.3.d.Measures taken by world countries to prevent global climate change (e.g. Kyoto Protocol) are addressed									

Table 4.55. *Continued*

Competences															
				*Skills								***Values			
SDGs/Learning Outcomes															
G.13. K2	G.13. K3	G.13. K5	G.15. K1	G.3. S1	G.3. S4	G.4. S5	G.7. S2	G.12. S1	G.12. S2	G.13. S2	G.13. S3	G.7. V2	G.7. V4	G.12. V1	G.12. V5
						×								×	
						×			×						
								×							
								×							

Table 4.55. *Continued*

SDGs related Objectives	Competences								
	**Knowledge								
	SDGs/Learning Outcomes								
	G.3. K6	G.7. K1	G.7. K2	G.8. K2	G.9. K2	G.9. K3	G.12. K1	G.12. K2	G.12. K7
6.4.1.Takes care to be efficient in the use of resources							×		
6.4.2. Designs projects for efficient use of resources									
6.4.3.Explains the importance of separation of solid wastes for recycling							×		
6.4.4.Offers solution proposals using research data on the contribution of recycling to the country's economy							×	×	
6.4.5.Provides solution suggestions by specifying the possible encountered problems in the future if resources are not used efficiently							×		

Table 4.55. *Continued*

Competences															
				*Skills								***Values			
SDGs/Learning Outcomes															
G.13. K2	G.13. K3	G.13. K5	G.15. K1	G.3. S1	G.3. S4	G.4. S5	G.7. S2	G.12. S1	G.12. S2	G.13. S2	G.13. S3	G.7. V2	G.7. V4	G.12. V1	G.12. V5
							×								
						×	×								

Table 4.55. *Continued*

SDGs related Objectives	Competences								
	**Knowledge								
	SDGs/Learning Outcomes								
	G.3. K6	G.7. K1	G.7. K2	G.8. K2	G.9. K2	G.9. K3	G.12. K1	G.12. K2	G.12. K7
7.3.1.Gives examples of applications in which electric energy is transformed into heat, light, and motion		×							
7.3.3.Explains how electrical energy is generated in power plants			×						
7.3.3.a.Power plants such as hydroelectric, thermal, wind, geothermal, and nuclear are mentioned			×						
7.3.4.Generates ideas on the advantages and disadvantages of power plants			×						
7.3.4.a.They are asked to produce ideas for evaluating power plants in terms of benefit-loss and risks and to defend them			×						

Table 4.55. *Continued*

Competences															
				*Skills								***Values			
SDGs/Learning Outcomes															
G.13. K2	G.13. K3	G.13. K5	G.15. K1	G.3. S1	G.3. S4	G.4. S5	G.7. S2	G.12. S1	G.12. S2	G.13. S2	G.13. S3	G.7. V2	G.7. V4	G.12. V1	G.12. V5
						×						×			
						×						×	×		×
						×						×	×		×

Table 4.55. *Continued*

SDGs related Objectives	Competences								
	**Knowledge								
	SDGs/Learning Outcomes								
	G.3. K6	G.7. K1	G.7. K2	G.8. K2	G.9. K2	G.9. K3	G.12. K1	G.12. K2	G.12. K7
7.3.5.Discusses the importance of conscious and efficient use of electrical energy in terms of family, and country economy							×		
7.3.6.Pays attention to energy efficient use at homes									
7.3.6.a.Long term studies to reduce the electricity bills are asked to do from students and the process is monitored									

(Source: MoNE, 2018)
****K:** Knowledge and understanding ***S:** Skills and applications
*****V:** Values and attitudes

It can be seen from the data in Table 4.55 that there are 19 main and 10 sub- objectives are related to SDGs in the Science curriculum. The objectives identified in the table are found in the Chapters 1, 4, 6 and 7 of the 8th grade Science curriculum. The most of SDG related objectives are founded in Chapter 6, the chapter containing the least SDG related objective is determined as Chapter 1.

According to the results of content analysis, 8 out of 17 goals are founded as related to the objectives for the 8th grade Science Curriculum. These goals are; G.3 (Good health and well-being), G.4 (Quality education), G.7 (Affordable and clean energy), G.8 (Decent work and economic growth), G.9 (Industry, innovation and infrastructure), G.12 (Responsible consumption and production), G.13 (Climate action) and G.15 (Life on land).

Accordingly, there are determined one clusters of learning competence (knowledge) for the goals of decent work and economic growth (G.8), industry, innovation and infrastructure (G.9) and life on land (G.15); on the other hand, quality education (G.4) corresponds to one cluster of learning competence (skill). Good health and well-being (G.3) and climate action (G.13) have two clusters of competences (knowledge and skill), while affordable and clean energy (G.7) and responsible consumption and production (G.12) involve all learning competences (knowledge, skills and values).

To sum up, 29 objectives in 8th grade Science Curriculum are related to 8 SDGs. Most of the objectives are founded in the Chapter 6: Energy Transformations and Environmental Science, while there is determined the least number of the objectives related to SDGs in Chapter 1: Seasons and Climate.

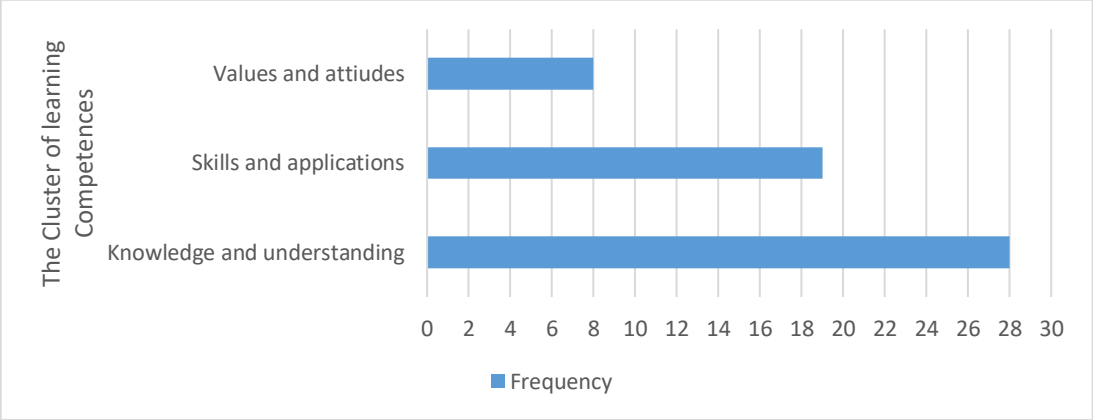

Figure 4.9. The Distribution of Clusters of Learning Competences (Knowledge, Skill and Value) in 8th Grade Science Curriculum

Figure 4.9 presents the distribution of the clusters of learning competences (Knowledge, Skill and Value) in 8th grade Science Curriculum. As the figure shows, frequency of clusters of learning competencies in the objectives of the curriculum is 55. 28 of these clusters are correspond to knowledge and understanding, 19 of them are related to skills and applications. There are also founded 8 of them related to values and attitudes one. In conclusion, the most indicated within the clusters of learning competence in the objectives is knowledge and understanding.

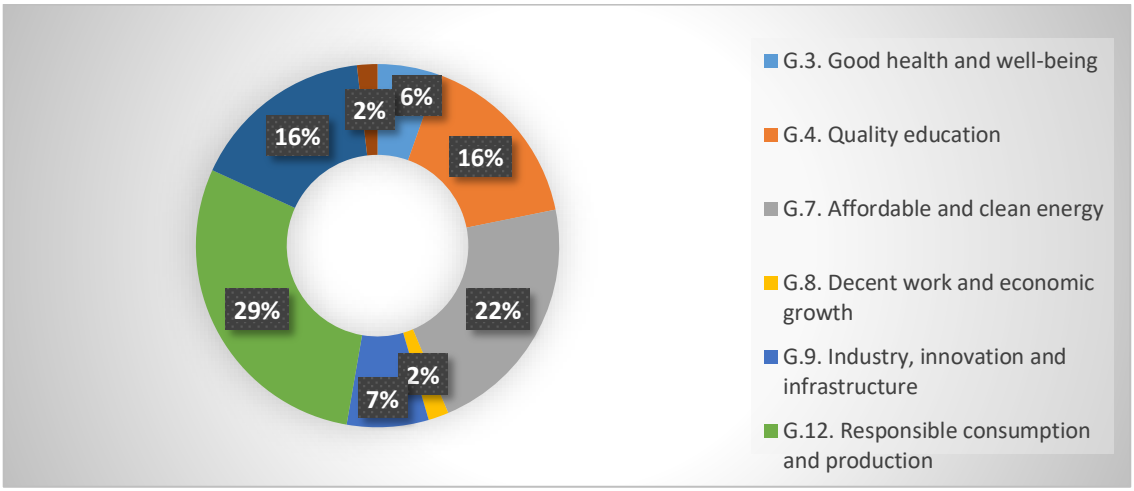

Figure 4.10. Percentage of the SDGs in Determined Objectives in 8th Grade Science Curriculum

Figure 4.10 illustrates how SDGs found as related to the objectives of the science curriculum are distributed. The results reveal that the 8th grade Science Curriculum contains 8 SDGs; G.12 (Responsible consumption and production) (29%) having the highest percentage of appearance and G.9 (Industry, innovation and infrastructure) (2%) and G.15 (Life on land) (2%) having the least.

Table 4.56. *The Distribution of the SDG Related Objectives in Three Dimensions of SD – 8th Grade*

	Three Dimensions of SD		
SDG related Objectives	**Social**	**Economic**	**Environmental**
1.2.1. Explain the difference between climate and weather events			
1.2.2. States that climate science (climatology) is a branch of Science and experts working in this field are called climatologist			
4.4.6. Take necessary precautions regarding the hazards that may occur during the use of acids and bases as cleaning materials			
4.4.7. Offers solutions for the prevention of acid rain			

Table 4.56. *Continued*

	Three Dimensions of SD		
SDG related Objectives	**Social**	**Economic**	**Environmental**
4.4.7.a. Causes and consequences of the formation of acid rains is referred			
4.6.1. Researches the development of chemical industry in Turkey from past to present			
4.6.1.b. The process of the Turkish chemical industry is mentioned by giving a few important examples of imported and exported chemical products			
4.6.2. Investigates the professions in the chemical industry and offers suggestions on new professions in the future			
6.3.1. Explains substance cycles by showing them on the diagram			
6.3.2. Question the importance of substance cycles in terms of life			
6.3.3. Discusses the causes and possible consequences of global climate change			
6.3.3.a. The greenhouse effect is described			
6.3.3.b. In the context of global climate change, the effects of environmental problems on the future of the world and human life are questioned			

Table 4.56. *Continued*

SDG related Objectives	Three Dimensions of SD		
	Social	**Economic**	**Environmental**
6.3.3.c. The predictions about how environmental problems can have an impact on the future of the world are asked to express through artistic means			
6.3.3.ç. The calculation of the ecological footprint (using safe sites such as extension edu, org and mil) is provided to students			
6.3.3.d. Measures taken by world countries to prevent global climate change (e.g. the Kyoto Protocol) are addressed			
6.4.1. Takes care to be efficient in the use of resources			
6.4.2. Designs projects for efficient use of resources			
6.4.3. Explains the importance of separation of solid wastes for recycling			
6.4.4. Offers solution proposals using research data on the contribution of recycling to the country's economy			
6.4.5. Provides solution suggestions by specifying the possible encountered problems in the future if resources are not used efficiently			

Table 4.56. *Continued*

	Three Dimensions of SD		
SDG related Objectives	**Social**	**Economic**	**Environmental**
7.3.1. Gives examples of applications in which electric energy is transformed into heat, light and motion energy			
7.3.3. Explains how electrical energy is generated in power plants			
7.3.3.a. Power plants such as hydroelectric, thermal, wind, geothermal and nuclear are mentioned			
7.3.4. Generates ideas on the advantages and disadvantages of power plants			
7.3.4.a. They are asked to produce ideas for evaluating power plants in terms of benefit-loss and risks and to defend them			
7.3.5. Discusses the importance of conscious and efficient use of electrical energy in terms of family and country economy			
7.3.6. Pays attention to energy-efficient use at homes			
7.3.6.a. Long-term studies to reduce the electricity bills of the students are asked to do and the process is monitored			

The distributions of the objectives in three pillars of SD were determined regarding to the inclusion of SDGs in corresponding objective since the categorization of SDGs for three pillars was made as in methodology part. As shown in Table 4.56, the distribution of SDG related objectives in three dimensions of SD (Social, Economic and Environmental) are presented. From the table, it is apparent that at least one dimension is related to the objectives. Most of the objectives are in the environmental dimension. While 10 of them are in social dimension of SD. On the other hand, there are found 14 objectives in economic dimension.

4.4.2. SDGs with Relevant Competences in 8th Grade Science Textbook

In line with investigation of the SDG related objectives in the 2018 Science Curriculum, how SDG related objectives are reflected in the textbook is analyzed as in Step 6. This section therefore, describes the content of the SDG related objectives in the 8th grade Science Textbook. The results are displayed by describing corresponding contents from the textbook for SDGs related objectives.

Table 4.57. *Objective 8.1.2.1 Versus SDGs with Corresponding Competences*

Objective 8.1.2.1: Explain the difference between climate and weather events **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.2-Basic understanding of climate science (e.g. carbon cycles, greenhouse gas effects) and physical impacts (e.g. sea-level rise, extreme weather)’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

The data derived from 8th grade Science Textbook reveals that explanation of difference between climate and weather events as in the objective of ‘‘explain the difference between climate and weather events’’ (MoNE, 2018, p.47) presented in Table 4.57 is reflected in ‘‘unit assessment questions’’ that it is expected to explain

the difference between climate and weather events *(see p.33)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) part of the textbook in the form of question.

As describing in the content in this part, the topic is related with climate science and its physical impacts as corresponding the cluster of the competence. Correspondingly, it is apparent that both objective, textbook and even if the goal approaches the content with similar way. Moreover, the question related part evaluates knowledge background of students not skill or value.

Also, direct information related to difference of two terms is given via ‘‘table’’ *(see p.31)* additionally and also the difference is also elaborated in ‘‘end of chapter assessment’’ that there is given matching of words as weather events and climate with appropriate sentences *(see p.32)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

Table 4.58. *Objective 8.1.2.2 Versus SDGs with Corresponding Competences*

Objective 8.1.2.2: States that climate science (climatology) is a branch of Science and experts working in this field are called climatologist
Related SDG/s of UN (2015) as: ‘‘G.13 (Climate action)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.13.K.2-Basic understanding of climate science (e.g. carbon cycles, greenhouse gas effects) and physical impacts (e.g. sea-level rise, extreme weather)’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

In Table 4.58, the stating of that climate science is a branch of Science and experts working in this field are called climatologist obviously stated in the objective of ‘‘states that climate science (climatology) is a branch of Science and experts working in this field are called climatologist’’ (MoNE, 2018, p.47) is not founded as stated in the objective; however, the statement is passing in ‘‘unit assessment question’’ that what explore climate science is given through true false question and the terms of

climate and climate scientist are asked via fill in blank questions *(see p.33)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

In this part, there is asking the name of the climate science and climatologist in the statements. Likewise, the scope of the content depends on climate science and its physical impacts alike in the following cluster of the competence.

There is assessed the knowledge of these terms in this section *(see p.33)*. The structure of text is arranged for addressing the knowledge competence except others. On the whole, although the objective is not reflected in the textbook as expected, it is stated through fill-in blank question.

Additionally, the expected terms are identified in the ‘‘text’’ that climate, climatology and climatologist terms are described there *(see p.30)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) before unit assessment question part.

Table 4.59. *Objective 8.4.4.6 Versus SDG s with Corresponding Competences*

Objective 8.4.4.6: Take necessary precautions regarding the hazards that may occur during the use of acids and bases as cleaning materials
Related SDG/s of UN (2015) as: ‘‘G.3 (Good health and well-being)
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.3.K.6-Emergency preparedness, evacuation drills, first aid’’ (p.25).
→ ‘‘G.3. S.1-Application of understanding to real life, such as personal hygiene and sanitation, and healthy living (e.g. food choices and exercise)’’ (p.25).
→ ‘‘G.3. S.4-Ability to identify positive and negative influences, analyses risks, and make informed decisions’’ (p.25).

(Source: Osman et al., 2017; MoNE, 2018)

In Table 4.59, the related objective for this content is stated as ‘‘take necessary precautions regarding the hazards that may occur during the use of acids and bases as cleaning materials’’ (MoNE, 2018, p.50). From the sentence, it is expected an action

from students related issue; and therefore, both knowledge and skill competence is considered for this objective before textbook analysis.

According to the findings, it is founded that the content is described in the ‘‘text’’ that precautions for cleaning products as detergents or spirit salt due to their contamination of acid and bases by wearing gloves, masks etc. and also their impacts are mentioned. Moreover, the meaning of the signs on these products are described via visuals *(see pp.117-118)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

Accordingly, there is expecting students behave as stressing in the objective after reading the text so any skill competence or action are not determined. There is just indicated the knowledge competence about health in textbook as defined in the following clusters of competences. Above all, additional knowledge related to concept is not displayed for this part. To conclude, the expected and the founded competences are completely different except the knowledge competence.

Table 4.60. *Objective 8.4.4.7 Versus SDGs with Corresponding Competences*

Objective 8.4.4.7: Offers solutions for the prevention of acid rain **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63). → ‘‘G.12. S.1-Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes)’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

It is seen that students offer solutions for the prevention of acid rain indicated in the objective of ‘‘offers solutions for the prevention of acid rain’’ (MoNE, 2018, p.50) as

shown in Table 4.60 is presented in ‘‘it is your turn’’ *(see p.119)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as stated in the objective.

In this part, there is pointing out all solutions for the problem. While doing so, students will use both skill and knowledge competences. When considering the content of the formation of acid rain, it is mostly related with consumption and production concepts as in G.12. This indicates that both the objective, the goal and the content of the textbook refers the same content. Regarding the competences, students will use the knowledge of acid rain formation and its effect on environment while analyzing its risks for informed decision making.

Particularly, all solutions for acid rains are indicated in the ‘‘text’’ that some of the things for both protections of the natural environment and minimization of the impact of acid rain are listed *(see p.119)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) additionally by listing them.

Table 4.61. *Objective 8.4.4.7.a Versus SDGs with Corresponding Competences*

Objective 8.4.4.7.a: Causes and consequences of the formation of acid rains is referred
Related SDG/s of UN (2015) as: ‘‘G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

As Table 4.61 shows, causes and the consequences of the formation of acid rains described in the objective of ‘‘causes and consequences of the formation of acid rains is referred’’ (MoNE, 2018, p.50) is reflected through the ‘‘text’’ that the formation of acid rain due to reaction of water vapor with some gases coming from consumption

of fossil fuels via visual and its impacts on such as environment and human made buildings are mentioned *(see pp.118-119)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) without detail. The subject involves the concept of the acid rain that relates to consumption and production like expressing in the cluster of competence.

The objective and the goal as well as the content of the textbook indicate the topic of acid rain consequences in accordance with consumption impact. Due to the provided direct information to students, it can be stated that there is just stresses knowledge competence. Besides, it is not founded any additional information related to the subject in the textbook.

Table 4.62. *Objective 8.4.6.1 Versus SDGs with Corresponding Competences*

Objective 8.4.6.1: Researches the development of chemical industry in Turkey from past to present
Related SDG/s of UN (2015) as: ‘‘G.9 (Industry, innovation and infrastructure)
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).
→ ‘‘G.9. K.2-Concepts of sustainability, industry, economic development, human well-being’’ (p.51).
→ ‘‘G.9. K.3-Understanding the economic, environmental and social benefits and challenges of different types of infrastructure and industry’’ (p.51).

(Source: Osman et al., 2017; MoNE, 2018)

According to the results of Table 4.62, the objective indicated as ‘‘researches the development of chemical industry in Turkey from past to present’’ (MoNE, 2018, p.51) is presented in ‘‘let’s investigate –discuss’’ *(see p.137)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as described in the objective in 8th grade Science textbook. The focus of the content is understanding the structure of the industry as highlighted in the competences. Consequently, the goal, the objective and the textbook point out same topic particularly ‘‘industry’’. Furthermore, while understanding the issue, the corresponding knowledge is used to answer by students so it can be derived that there

is included just knowledge competence. Through research, students will engage in the subject critically as well (G.4).

In fact, the development of the industry is written in the ‘‘text’’ that industrialization plan, types of industries and where these industries are by illustrating with dates are mentioned *(see p.138)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) additionally from past to know.

Table 4.63. *Objective 8.4.6.1.b Versus SDGs with Corresponding Competences*

Objective 8.4.6.1.b: The process of the Turkish chemical industry is mentioned by giving a few important examples of imported and exported chemical products **Related SDG/s of UN (2015) as:** ‘‘G.9 (Industry, innovation and infrastructure) **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.9. K.2-Concepts of sustainability, industry, economic development, human well-being’’ (p.51). → ‘‘G.9. K.3-Understanding the economic, environmental and social benefits and challenges of different types of infrastructure and industry’’ (p.51).

(Source: Osman et al., 2017; MoNE, 2018)

The next finding is as reported by Table 4.63 that the process of the Turkish chemical industry is mentioned by giving a few important examples of imported and exported chemical products that is passing in the objective like that ‘‘the process of the Turkish chemical industry is mentioned by giving a few important examples of imported and exported chemical products’’ (MoNE, 2018, p.51) is reflected in ‘‘text’’ that 2015-2017 export-import information is provided. Also, export and import products are listed by presenting them in tables. Moreover, comparison of these products by years are mentioned *(see pp.139-140)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

As well, industry related topic is handled in both the objective, the goal and the content of the textbook. Moreover, the knowledge competence comes forward in related part

of the textbook on account of indication of related topic to students via direct information. There is also not involved any additional knowledge for this part.

Table 4.64. *Objective 8.4.6.2 Versus SDGs with Corresponding Competences*

Objective 8.4.6.2: Investigates the professions in the chemical industry and offers suggestions on new professions in the future
Related SDG/s of UN (2015) as: ‘‘G.8 (Decent work and economic growth)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).
→ ‘‘G.8. K.2-Jobs in the school, community, etc.’’ (p.46).

(Source: Osman et al., 2017; MoNE, 2018)

Furthermore, ‘‘students investigate the professions in the chemical industry and offers suggestions on new professions in the future’’ highlighted in the objective (MoNE, 2018, p.51) as illustrated in Table 4.64 is displayed in ‘‘it is your turn’’ *(see p.142)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as stated in the objective. Through research, students will engage in the subject critically as well (G.4).

Because of relating with profession, it can be addressed in the competence. In addition to the objective, the textbook and the goal stress similar context as professions; and therefore, it presents only knowledge competence on stating related professions instead of applying or behaving.

Moreover, some related professions are illustrated in the ‘‘text’’ that the professions of ‘mining, petroleum, chemical, food, agricultural engineers etc. are given examples *(see p.141)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) in the textbook additionally.

Table 4.65. *Objective 8.6.3.1 Versus SDGs with Corresponding Competences*

Objective 8.6.3.1: Explains substance cycles by showing them on the diagram **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.2-Basic understanding of climate science (e.g. carbon cycles, greenhouse gas effects) and physical impacts (e.g. sea-level rise, extreme weather)’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

The explanations of substance cycles by showing them on the diagram (as in the objective) (MoNE, 2018, p.52) as in Table 4.65 is not represented in the textbook. On the contrary, figures and explanations related to the substance cycles are exhibited through ‘‘figures’’ that there are given the description of water *(see p.187),* oxygen *(see p.188),* carbon *(see p.189)* and nitrogen *(see p.190)* cycles (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

From the content, it can be inferred that students will show and explain the cycles by showing them from the textbook. Furthermore, it is corresponding to climate science (carbon cycles etc.) as addressing in the competence.

In addition, understanding of climate related science is presented in the objective and the goal as well as the textbook. While explaining and showing the cycles, there is used knowledge competence just for this case because students will background knowledge to understand and then explain the concepts so it is not applicable not only skills and applications but also values and attitudes.

Also, additional knowledge in content is observed in the ‘‘text’’ that water *(see p.187*), oxygen *(see p.188),* carbon and nitrogen *(see p.189)* cycles are described (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

Table 4.66. *Objective 8.6.3.2 Versus SDGs with Corresponding Competences*

Objective 8.6.3.2: Question the importance of substance cycles in terms of life **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.2-Basic understanding of climate science (e.g. carbon cycles, greenhouse gas effects) and physical impacts (e.g. sea-level rise, extreme weather)’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

In the following parts in Table 4.66, the importance of substance cycles in terms of life stated in the objective as ‘‘question the importance of substance cycles in terms of life’’ (MoNE, 2018, p.52) is presented in both ‘‘question (in text)’’ *(see p.190)* as stated in the objective and ‘‘it is your turn’’ through discussion *(see p.190)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

Students answer the question by using knowledge competence and also the content of the question contain climate science concept like in the competence. Moreover, students will engage in the subject critically. When examining the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’. The importance of substance cycles that is mentioned in the G.13 as climate science is described in not only the objective and the goal but also the content of the textbook. In order to question the importance, the cycles, students will understand the climate related concept and apply knowledge to understand the importance of it. Therefore, value competence is not founded for this subject. The corresponding additional information is also given place in ‘‘text’’ that there are given examples of failures of carbon and nitrogen cycles and their impacts *(see p.190)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) to show the connections of each elements in the cycles to students.

Table 4.67. *Objective 8.6.3.3 Versus SDGs with Corresponding Competences*

Objective 8.6.3.3: Discusses the causes and possible consequences of global climate change **Related SDG/s of UN (2015) as:** ‘‘G.4 (Quality education) and G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.13. S.2. Ability to describe the causes and effects of climate change’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

In the light of the related objective as ‘‘discusses the causes and possible consequences of global climate change’’ (MoNE, 2018), p.52), the reflection of this objective in textbook is examined and there is not founded any related part in 8th grade Science Textbook as described in Table 4.67.

However, the information indicated in the textbook related to the objective is addressed in ‘‘text’’ that while causes are connected to human activities, the results are mentioned as melting of glaciers, floods, landslides, extinction of polar bears because of melting glaciers etc. *(see p. 192)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as knowledge.

Table 4.68. *Objective 8.6.3.3.a Versus SDGs with Corresponding Competences*

Objective 8.6.3.3.a: The greenhouse effect is described **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.2-Basic understanding of climate science (e.g. carbon cycles, greenhouse gas effects) and physical impacts (e.g. sea-level rise, extreme weather)’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

The greenhouse effect is described through the ‘‘text’’ that greenhouse gases and their effects, greenhouse effect and its importance are described *(see p.191*) (Aytaç, Türker, Bozkaya & Üçüncü, 2018) very briefly that includes in the objective of ‘‘the greenhouse effect is described’’ (MoNE, 2018, p.52) as presented in Table 4.68. The knowledge that is covered in this part is one of the main concept of climate action (G.13).

Greenhouse subject is the focus of the objective, the goal and the textbook as in the table. Because of in knowledge form, there is not stressed any skill and value competences as well. Also, additional information related to the topic is not provided for this part.

Table 4.69. *Objective 8.6.3.3.b Versus SDGs with Corresponding Competences*

Objective 8.6.3.3.b: In the context of global climate change, the effects of environmental problems on the future of the world and human life are questioned **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action) **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.3-Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production)’’ (p.67). → ‘‘G.13.S.3-Understand and distinguish climate change impact in relation to self/context ‘’(p.67).

(Source: Osman et al., 2017; MoNE, 2018)

In the textbook, the context of global climate change, the effects of environmental problems on the future of the world and human life are questioned like in the objective (MoNE, 2018, p.52) in ‘‘it is your turn’’ *(see p.192)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as indicated in the objective shown in Table 4.69. The concepts of global climate change embedded in as climate action goal (G.13).

Due to passing the concept of climate change in the objective, the textbook and the goal, it can be stated that all of them reflects the same content. Moreover, while

elaborating the issue, there is used both skill and knowledge competences illustrated in the objective part since students will apply their knowledge on climate impacts while understanding the concepts of climate concept. In addition, additional knowledge is not included in this part of the textbook.

Table 4.70. *Objective 8.6.3.3.c Versus SDGs with Corresponding Competences*

Objective 8.6.3.3.c: The predictions about how environmental problems can have an impact on the future of the world are asked to express through artistic means **Related SDG/s of UN (2015) as:** ‘‘G.15 (Life on land)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.15.K.1-Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact’’ (p.75).

(Source: Osman et al., 2017; MoNE, 2018)

The objective which is ‘‘the predictions about how environmental problems can have an impact on the future of the world are asked to express through artistic means’’ (MoNE, 2018, p.53) is reflected in the ‘‘it is your turn’’ *(see p.192)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as mentioned in the objective by asking question as presented in Table 4.70.

Both the goal, the objective and the textbook involves same concept that is the environment and the consequences of environment related issue. Understanding of the environmental impacts is just in knowledge level without any application or acting accordingly. Moreover, there is not needed any additional information for the content.

Table 4.71. *Objective 8.6.3.3.ç Versus SDGs with Corresponding Competences*

Objective 8.6.3.3.ç: The calculation of the ecological footprint (using safe sites such as extension edu, org and mil) is provided to students **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12. K.7.Calculate and compare Ecological Footprints’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

The calculation of the ecological footprint (using safe sites as extension edu, org and mil) placed in as same as in the objective (MoNE, 2018, p.53) is provided students like in Table 4.71 in ‘‘science, technology and life’’ that there is given the link of pdf document and also there are provided questions for calculations of food, goods and services, shelter and transportation footprints *(see p.193)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018). It is expected to have students’ knowledge on ecological footprint calculation as passing in (G.12).

Directly calculation of footprints is stated in the objective, the goal in addition to the textbook. Hence, the calculation based activity is related to knowledge competence since there is no action or value ones related content. Moreover, three is not included any additional information.

Table 4.72. *Objective 8.6.3.3.d Versus SDGs with Corresponding Competences*

Objective 8.6.3.3.d: Measures taken by world countries to prevent global climate change (e.g. the Kyoto Protocol) are addressed **Related SDG/s of UN (2015) as:** ‘‘G.13 (Climate action)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.13.K.5-Concepts of climate mitigation and adaptation, resilience, sustainable development’’ (p.67).

(Source: Osman et al., 2017; MoNE, 2018)

Measures taken by world countries to prevent global climate change (e.g. Kyoto Protocol) described in the objective (MoNE, 2018, p.53) in Table 4.72 are addressed through the ‘‘text’’ that description of Kyoto Protocol as including measures against global warming is provided and some of suggestions to prevent global warming are listed such as not using of deodorant and perfumes, using of filters etc. *(see p.194)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

According to findings, the knowledge of measurement for climate change and Kyoto Protocol are emphasized and addressed. Besides, there is not any activity or action to stimulate skill competences. The source of information bases on climate change as indicated in G.13 (Climate action). The scope of the context in the objective, the textbook and the goal is on the measurement taken by countries for climate change. Particularly, knowledge of climate adaptation and mitigation will be used for this context without acting or behaving accordingly. In addition, it is not applicable to find any additional relevant information on topic.

Table 4.73. *Objective 8.6.4.1 Versus SDGs with Corresponding Competences*

Objective 8.6.4.1: Takes care to be efficient in the use of resources **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63). → ‘‘G.12. V.1-Appreciation of the need to reduce harm, of impact and of finite resources’’ (p.)

(Source: Osman et al., 2017; MoNE, 2018)

According to Table 4.73, targeted in the objective as ‘‘takes care to be efficient in the use of resources’’ (MoNE, 2018, p.53) is not founded from the textbook; however, it

is considered that students behave according to the objective after reading ‘‘text’’ that sustainable development definition is given and it is described as a way of prevention of these problems as depletion of resources, pollutions and extinctions etc. *(see p.197)* and in ‘‘science, technology and life’’ that a news is presented related to discovery of prevention of water waste *(see p.197)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

At the beginning of the analysis of the textbook, knowledge, skill and value competences are expected when considering the objective. As a result, there is founded just text and knowledge competence as indicated in the competence.

Through the reading, students will understand the efficient use of resources; and then, they will behave by considering this efficiency. Besides, there is not reflected any corresponding knowledge additionally in the textbook.

Table 4.74. *Objective 8.6.4.2 Versus SDGs with Corresponding Competences*

Objective 8.6.4.2: Designs projects for efficient use of resources **Related SDG/s of UN (2015) as:** ‘‘**G.12** (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.12.S.2-Participating in recycling, composting and other environmental schemes’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

The excerpt that derived from the textbook about designing projects for efficient use of resources mentioned in the objective of ‘‘designs projects for efficient use of resources’’ (MoNE, 2018, p.53) as presented in Table 4.74 is stressed in ‘‘science, engineering and entrepreneurship applications’’ that it is expected to prepare a project or campaign for saving of resources *(see p.197)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) in the textbook. Moreover, it is expected students to participate in environmental schemes as emphasized in the competence.

It is asked students to prepare a design on the resource usage which is reflected as in the textbook and the goal. Especially, skill competence is dominant for this case since students will be active during this environmental scheme. They will engage critically in this process (G.4). In addition, additional information in the textbook related to the objective is not illustrated in the textbook.

Table 4.75. *Objective 8.6.4.3 Versus SDGs with Corresponding Competences*

Objective 8.6.4.3: Explains the importance of separation of solid wastes for recycling **Related SDG/s of UN (2015) as:** ‘‘**G.12** (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63). → ‘‘G.12. S.1-Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes)’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

Following Table 4.75 presents that ‘‘the importance of separation of solid wastes for recycling’’ (MoNE, 2018, p.53) is reflected in ‘‘question (in text)’’ *(see p.198)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as stated in the objective.

Students will have a knowledge on solid wastes while distinguishing of them with the help of knowledge and skill competences defined in the competences. The objective, the goal and the textbook points out the same topic as ‘‘consumption and recycling’’. While the objective stress understanding of recycling and consumption, it motivates students to distinguish and analyze the types of waste. Furthermore, additional information is not supplied to students in textbook.

Table 4.76. *Objective 8.6.4.4 Versus SDGs with Corresponding Competences*

Objective 8.6.4.4: Offers solution proposals using research data on the contribution of recycling to the country's economy **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63). → ‘‘G.12. K.2-Further understanding of the ‘4 Rs’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

The objective of ‘‘offering solution proposals using research data on the contribution of recycling to country’s economy’’ (MoNE, 2018, p.53) as pointing out in Table 4.76. is reflected in ‘‘let’s investigate- discuss’’ that contribution of recycling to the country's economy is expected to be researched and then there is wanted to be made discussion based on specified data related to recycling *(see p.198)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018). When examining the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’.

During discussion, students will understand consumption and recycling further like stated in the competences. Correspondingly, the issue of contribution of recycling is mentioned similarly in both the textbook, the goal and the objective as well. Aside from the knowledge, skill or on the recycling; and also, there is not indicated value related acting from students.

Furthermore, the relevant information is emphasized in the ‘‘text’’ that reusable of solid wastes and its contribution to economy are indicated *(see p.199)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) additionally.

Table 4.77. *Objective 8.6.4.5 Versus SDGs with Corresponding Competences*

Objective 8.6.4.5: Provides solution suggestions by specifying the possible encountered problems in the future if resources are not used efficiently **Related SDG/s of UN (2015) as:** ‘‘G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.12.K.1-Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63). → ‘‘G.12. S.1-Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes)’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

Through unit assessment section, students ‘‘provides solution suggestions by specifying the possible encountered problems in the future if resources are not used efficiently (MoNE, 2018, p.53) as stated in Table 4.77 is founded explicitly via a reading in ‘‘unit assessment’’ that a reading as story that a girl has a dream and she see her in capsule and Earth as non-livable place. Running out of resources, extinction of creatures is also used to describe situation of Earth in dream. In the question, suggestions for prevention of these problems are asked *(see p.202)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

The concept of efficient usage of resources is the main subject reviewed in the competences. While providing solutions, students will understand and distinguish consumer impact and also importance of consumption as indicated in both the goal and the textbook. In this way, skill and knowledge competences will be active during this process.

Also, the additional corresponding information is analyzed and founded in the following sections such as ‘‘text’’ that precautions for saving water and energy are mentioned such as not pouring of oils to water, purification of water, using of energy saving bulb etc. *(see p.200)*, ‘‘end of chapter assessment’’ that it is expected to

explanation of importance of saving resources *(see p.202),* and ‘‘unit assessment’’ that news related to water scarcity is given and then there is expected to discussion of importance of saving resources *(see p.201)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

Table 4.78. *Objective 8.7.3.1 Versus SDGs with Corresponding Competences*

Objective 8.7.3.1: Gives examples of applications in which electric energy is transformed into heat, light and motion energy
Related SDG/s of UN (2015) as: ‘‘G.7 (Affordable and clean energy)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.7. K.1-Basic concepts of energy and consumptive uses (e.g. powering cars)’’ (p.42).

(Source: Osman et al., 2017; MoNE, 2018)

The objective of ‘‘gives examples of applications in which electric energy is transformed into heat, light and motion energy’’ (MoNE, 2018, p.54) addressed in Table 4.78 is provided through ‘‘preparatory work’’ that the change of electricity into other types of energy is asked *(see p.223)* as stated in the objective and ‘‘end of chapter assessment’’ that how transformation of electrical energy into motion, light and heat energies are asked *(see p.224)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

The scope of the content depends on understanding consumptive uses of energy described in the competence. Not only the objective and the goal but also the textbook emphasizes the same content (energy consumption). The questions also direct students use knowledge competence related the concept of energy because students will use background knowledge to provide example to the issue.

Furthermore, ‘‘text’’ that some examples of applications that there is turning of electrical energy into heat energy are given such as oven, heaters, stoves etc. and how turning of electrical energy into heat energy is also described with illustrating pictures *(see p.224).* Moreover, there is mentioned converting of electrical energy into light

one such as bulb, traffic lights etc. and transformation of energy in these applications are stated *(see p.227).* Finally, conservation of electrical energy into motion one is mentioned such as mixer, drill etc. and again these energy transformations in the application is described *(see p.228)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) in the textbook have information related to the objective additionally as identified below.

Table 4.79. *Objective 8.7.3.3 Versus SDGs with Corresponding Competences*

Objective 8.7.3.3: Explains how electrical energy is generated in power plants
Related SDG/s of UN (2015) as: ‘‘G.7 (Affordable and clean energy)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.7.K.2-Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42).

(Source: Osman et al., 2017; MoNE, 2018)

The objective that ‘‘explaining how electrical energy is generated in power plant’’ (MoNE, 2018, p.54) as summarized in Table 4.79 is presented in ‘‘let’s research-discuss’’ *(see p.229)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as stated in the objective through research. When examining the objective, it may be not understood discussion of the subject. In corresponding part of the textbook, the subject is evaluated through discussion and research, so there is also included the goal with competence of (Osman et al., 2017, p.29) as ‘‘G.4 (Quality education) as the competence of S.5: Critical and engaged approach toward learning’’.

The explanation of energy production is asked as research and the information is related to one of energy production as power plant mentioned in G.7. Generation of energy in power plant is illustrated in both the objective, the textbook and the goal. Accordingly, explanation of generation of energy is provided with knowledge without acting or behaving. In other words, explanation of the concept is necessary for this

achievement with the help of knowledge competence. Also, there is not identified any additional information related to objective in the textbook.

Table 4.80. *Objective 8.7.3.3.a Versus SDGs with Corresponding Competences*

Objective 8.7.3.3.a: Power plants such as hydroelectric, thermal, wind, geothermal and nuclear are mentioned
Related SDG/s of UN (2015) as: ‘‘G.7 (Affordable and clean energy)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.7. K.2-Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42).

(Source: Osman et al., 2017; MoNE, 2018)

According to Table 4.80, power plants such as hydroelectric, thermal, wind, geothermal and nuclear one as indicated in the objective of ‘‘power plants such as hydroelectric, thermal, wind, geothermal and nuclear are mentioned’’ (MoNE, 2018, p.54) is addressed under the **‘‘**texts’’ that the definition of power plant is provided and then how energy is produced in these plants are described by indicating mechanisms of them by indicating the role of turbines in this process *(see pp.229-230)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

All knowledge are the different forms of energy production as the scope of G.7 (Affordable and clean energy). When comparing the content of the objective, the textbook and the goal, they present similar content. In this case, students will gain this knowledge through the texts by using knowledge competence only since knowledge of different forms of energy production is mentioned directly. In this part, additional, information is also not located in the textbook additionally.

Table 4.81. *Objective 8.7.3.4 Versus SDGs with Corresponding Competences*

Objective 8.7.3.4: Generates ideas on the advantages and disadvantages of power plants **Related SDG/s of UN (2015) as:** ‘‘G.7 (Affordable and clean energy)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.7. S.2. Identification and practice of actions and choices for sustainable and safe living’’ (p.42) → ‘‘G.7. K.2.Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42).

(Source: Osman et al., 2017; MoNE, 2018)

There is not founded any information about the objective of ‘‘generating ıdeas on the advantages and disadvantages of power plants’’ (MoNE, 2018, p.54) stated in Table 4.81 is not reflected in the textbook. Moreover, there exist only additional knowledge related to the objective is reflected in the ‘‘text’’ that the advantages are described in terms of cost for production, reliable, clean and also disadvantages are mentioned in terms of river life and high cost for hydroelectric power plants *(see p.231)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

Table 4.82. *Objective 8.7.3.4.a Versus SDGs with Corresponding Competences*

Objective 8.7.3.4.a: They are asked to produce ideas for evaluating power plants in terms of benefit-loss and risks and to defend them **Related SDG/s of UN (2015) as:** ‘‘G.7 (Affordable and clean energy) **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.7.K.2-Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts’’ (p.42) → ‘‘G.7. S.2-Identification and practice of actions and choices for sustainable and safe living’’ (p.42).

(Source: Osman et al., 2017; MoNE, 2018)

Table 4.82 shows that students are asked to produce ıdeas for evaluating power plants in terms of benefit-loss and risks and to defend them as illustrated in the objective of ‘‘they are asked to produce ideas for evaluating power plants in terms of benefit-loss and risks and to defend them’’ (MoNE,2018, p.54). The content is addressed in ‘‘it’s your turn’’ that the evaluation of benefit-risks of power plants is made through 6 thinking hats technique that each hats have corresponding colors and there is so created 6 groups. Moreover, both meaning of colors and colors of hats are provided together with description of what should be done under these colorful hats *(see p.231)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018). Through this activity in it’s your turn part, students will ıdentify and decide actions for sustainable living in terms of energy production displayed in the competences. During evaluating benefits-risks, students will engage critically in this process (G.4). Power plant as a type of energy production is the same subject of the objective, the goal and the textbook. During activity, benefit-loss of this type of energy production is asked to students. For this situation, students will use the knowledge of this energy production and then apply this knowledge to identify benefits or loss of this production type. Moreover, there is not stressed additional information related to the objective for this case.

Table 4.83. *Objective 8.7.3.5 Versus SDGs with Corresponding Competences*

Objective 8.7.3.5: Discusses the importance of conscious and efficient use of electrical energy in terms of family and country economy
Related SDG/s of UN (2015) as: ‘‘G.4 (Quality education), G.7 (Affordable and clean energy) and G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).
→ ‘‘G.7. V.2-Commitment to energy conservation’’ (p.42).
→ ‘‘G.12. K.1.Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

Table 4.83 introduces content related to ‘‘discussion on the importance of conscious and efficient use of electrical energy in terms of family and country economy’’ as presented in the objective (MoNE, 2018, p.54). Students will describe their knowledge with the help of discussion method in ‘‘let’s investigate-discuss’’ *(see p.231)* as stated in the objective and open-ended question in ‘‘end of chapter assessment’’ *(see p.234)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as stated in the objective.

In these sections, students will use both knowledge, skill and value competences with commitment to energy conservation (G.7), critical and engaged learning (G.4) with the knowledge of consumption (G.12).

From the objective the textbook, the content in these part is the same. During discussion, students will use all the clusters of competences (knowledge, skill and value). Besides, the additional knowledge is not expressed in the textbook.

Table 4.84. *Objective 8.7.3.6 Versus SDGs with Corresponding Competences*

Objective 8.7.3.6: Pays attention to energy-efficient use at homes **Related SDG/s of UN (2015) as:** ‘‘G.7 (Affordable and clean energy) and G.12 (Responsible consumption and production)’’ **Related Competencies/learning outcomes (Osman et. al, 2017):** → ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29). → ‘‘G.7. V.2-Commitment to energy conservation’’ (p.42). → ‘‘G.7. V.4-Consumptive behavioral change’’ (p.42). → ‘‘G.12. V.5-Consumer awareness and commitment to sustainable choices’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

Table 4.84 presents that the analysis of the objective as ‘‘pays attention to energy efficient use at homes’’ (MoNE, 2018, p.54) reveals that there are not any value competences as expected at the beginning from the objective. After examination of the content from the textbook, it shows that students will gain this value after reading

text. In other words, the content is given in the ‘‘text’’ that some of requirements for using electrical energy efficiently are listed such as using A class device, energy saving bulbs and also switching of computers and televisions when not used etc. *(see p.232)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018).

In this part of the textbook, there is included just knowledge competence on energy. Therefore, decided the clusters of competence (G.4, G.7 and G.12) shows inconsistency as a result of the analysis.

Moreover, the information is assessed in ‘‘unit assessment’’ that false behavior related to usage of electric devices is asked through multiple choice question *(see p.237)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) additionally.

Table 4.85. *Objective 8.7.3.6.a Versus SDGs with Corresponding Competences*

Objective 8.7.3.6.a: Long-term studies to reduce the electricity bills of the students are asked to do and the process is monitored
Related SDG/s of UN (2015) as: ‘‘G.7 (Affordable and clean energy) and G.12 (Responsible consumption and production)’’
Related Competencies/learning outcomes (Osman et. al, 2017):
→ ‘‘G.4. S.5-Critical and engaged approach towards learning’’ (p.29).
→ ‘‘G.7. V.2-Commitment to energy conservation’’ (p.42).
→ ‘‘G.7. V.4-Consumptive behavioral change’’ (p.42).
→ ‘‘G.12. V.5-Consumer awareness and commitment to sustainable choices’’ (p.63).

(Source: Osman et al., 2017; MoNE, 2018)

The objective of ‘‘long term studies to reduce the electricity bills of the students are asked to do and the process is monitored’’ (MoNE, 2018, p.54) as presented in Table 4.85 is displayed in ‘‘it’s your turn’’ *(see p.233)* (Aytaç, Türker, Bozkaya & Üçüncü, 2018) as stated in the objective in the textbook. As a citizen, they will use approach the consumption with value competence (G.12) by giving value on energy conservation (G.7). Moreover, they will approach the concept critically and evaluate

the process as well (G.4). As a result, it is possible to ıdentify just value competences. There students will participate this process actively and their behavior will shape as a result of this activity. Moreover, the objective, the textbook and the goal indicates same content for this context. Besides, there is not presented any knowledge additionally from the textbook.

On the whole, as G.3 (Good health and well-being), G.4 (Quality education), G.12 (Responsible consumption and production) and G.13 (Climate action) are the common goals in all grades. On the other hand, there are not determined the goals of UN (2015) as G.1 (No poverty), G.2 (Zero Hunger), G.5 (Gender equality), G.6 (Clean water and sanitation), G.10 (Reduced inequalities), G.16 (Peace, justice and strong institutions) and G.17 (Partnership for the goals) in the curriculum and textbooks.

4.5. Comparisons of Findings Related to SDGs Related Objectives and Science Textbooks by Grade Levels

In this section, there are provided comparisons of SDGs related objectives in terms of total number of objectives, chapters, subject areas, clusters of learning competences are provided. Afterwards, comparison of SDGs related objectives in the parts of the Science Textbooks is presented for each grade levels.

4.5.1. Distribution of SDGs Related Objectives According to the Total Number of Objectives in the Science Curriculum

This section presents the comparison of the SDG related objectives according to the total number of objectives in the Science curriculum. The distribution of the objectives in terms of grade levels is given in Table 4.86.

Table 4.86. *Distribution of the SDG Related According to the Total Number of Objectives in 2018 Science Curriculum*

Grade levels	Total Number of Objectives	*SDGs Related Objectives	
		f	%
5th	36	8	22
6th	59	10	17
7th	67	8	12
8th	61	19	31
Total	223	45	20

***** There is shown the total number of the main objectives in the curriculum which are SDGs related ones

According to the results of Table 4.86, there are 36 objectives in 5th grade Science Curriculum. 8 of them (22%) are related to SDGs. For 6th grade level, there are founded 10 out of 59 objectives (17%) are related. Moreover, 7th grade level includes SDGs related objectives of 8 out of 67 (12%). Finally, there is determined 19 objectives (out of 61) related to SDGs in 8th grade Science curriculum. Accordingly, there are a total number of 223 objectives in Science curriculum which 45 of them are corresponding to SDGs (20%).

To sum up, objectives related to SDGs are available at all grade levels. In the Science Curriculum, the number of objectives related to SDGs is small considering the total number of objectives. While the most of SDGs related objectives are in the 8th grade, the least of them are founded in the 5th grade.

4.5.2. Comparison of SDGs Related Objectives and Chapters by Grade Levels in 2018 Science Curriculum

When Table 4.87 is examined, objectives related to SDGs is presented in accordance with the chapters, and grade levels. The findings are provided by indicating chapters, grades, SDGs related objectives and subjects.

Table 4.87. *Distribution of SDGs Related Objectives and Chapters by Grade Levels in 2018 Science Curriculum*

Grades	Chapters	Chapter Names	Subject numbers /Subject headings	SDGs related Objectives
5th Grade	6	Human and Environment	1.Biodiversity	*F5.6.1.1. F5.6.1.1. a F5.6.1.2
			2.Human and environmental relations	F5.6.2.1 F5.6.2.1. a F5.6.2.2. F5.6.2.3 F5.6.2.3 F5.6.2.4
			Destructive Nature Events	F5.6.3.1 F5.6.3.1. a F5.6.3.2
6th Grade	2	The Systems in Our Body	3.Circulatory system	F6.2.3.5.b
	4	Matter and Heat	3.Matter and heat	F6.4.3.2 F6.4.3.3 F6.4.3.4
			4.Fuels	F6.4.4.1 F6.4.4.1.a F6.4.4.2 F6.4.4.3
	5	Sound and its features	4.Interaction of sound with matter	F6.5.4.3 F6.5.4.3.a
	6	Systems in our bodies and its health	2.Sensory organs	F6.6.2.3 F6.2.3.a F6.6.2.4
			3.Health of systems	F.6.6.3.1 F6.6.3.1.a F6.6.3.1.b F6.6.3.1.c F6.6.3.1.ç

Table 4.87. *Continued*

Grades	Chapters	Chapter Names	Subject numbers /Subject headings	SDGs related Objectives
7th Grade	4	Pure Substances and Mixtures	5.Household waste and recycling	F7.4.5.1 F7.4.5.2 F7.4.5.3 F7.4.5.3.a F7.4.5.4 F7.4.5.4.b F7.4.5.5
	5	Interaction of Light with Matter	1.Absorption of light	F7.5.1.4 F7.5.1.4. a F7.5.1.5
			3. Refraction of light and lenses	F7.5.3.3
	6	Reproduction, Growth and Development in Living Things	1.Reproduction, growth and development in humans	F7.6.1.1.c F7.6.1.3
8th Grade	1	Seasons and Climate	2.Climate and air movements	F8.1.2.1 F8.1.2.2
	4	Substance and Industry	4.Acids and bases	F8.4.4.6 F.8.4.4.7 F8.4.4.7.a
			6.Chemical industry in Turkey	F8.4.6.1. F8.4.6.1. b F8.4.6.2
	6	Energy Transformations and Environmental Science	3.Matter cycles and environmental problems	F8.6.3.1 F8.6.3.2 F8.6.3.3 F8.6.3.3. a F8.6.3.3. b F8.6.3.3.c F8.6.3.3. ç F8.6.3.3. d

Table 4.87. *Continued*

Grades	Chapters	Chapter Names	Subject numbers /Subject headings	SDGs related Objectives
			4. Sustainable development	F8.6.4.1 F8.6.4.2 F8.6.4.3 F8.6.4.4 F8.6.4.5
	7	Electrical Charges and Electrical Energy	3.Electrical energy transformation	F8.7.3.1. F8.7.3.3 F8.7.3.3. a F8.7.3.4 F8.7.3.4. a F8.7.3.5. F8.7.3.6 F8.7.3.6.a

*** F:** This letter is used in the curriculum to describe course code

In conclusion, the findings show that most of the SDGs related units are determined in 6th and 8th grades. For 5th grade, there is founded in only Chapter 6: Human and Environment. While there are indicated most of the objectives in both Chapter 4: Matter and Heat and Chapter 6: Systems in our bodies and its health in 6th grade, it is determined that most of the objectives are determined in Chapter 4: Pure Substances and Mixtures in 7th grade level. Most of the objectives in 8th grade level is addressed in Chapter 6: Energy Transformations and Environmental Science. It may be inferred that most of the objectives are in Chapter 4 and 6.

4.5.3. Comparison of SDGs Related Objectives According to Grade Levels and Subject Areas in 2018 Science Curriculum

In this part, the distribution of the SDGs related objectives according to grade levels and subject areas in Science curriculum is shown. Science Curriculum (2018) consists

of four subject areas; ‘‘Earth and Universe’’, ‘‘Living Things and Life’’, ‘‘Physical Events’’ and ‘‘Matter and its nature’’. The findings are illustrated in Table 4.88.

Table 4.88. *Distribution of SDGs Related Objectives According to Grade Levels and Subject Areas in 2018 Science Curriculum*

Grades	**Subject Areas**							
	Earth and Universe		**Living Things and Life**		**Physical Events**		**Matter and its Nature**	
	Total number of objectives	SDGs related objectives	Total number of objective	SDGs related objectives	Total number of objectives	SDGs related objectives	Total number of objective	SDGs related objectives
	f	f	f	f	f	f	f	f
5th	7	-	9	8	14	-	6	-
6th	5	-	22	4	19	1	13	6
7th	10	-	15	2	26	3	16	5
8th	3	2	25	8	16	5	17	4
Total	25	2	68	22	75	9	52	15

In the subject area of ‘‘Earth and Universe’’, there exists 25 objectives founded in the curriculum. Only at the 8th grade level includes the SDGs related objectives in this subject area which is 2 out of 3 objectives. For ‘‘Living Things and Life’’ subject area, all grade levels involve the objectives related to SDGs in this subject area. Also, 22 out of 68 objectives are corresponding to SDGs. Most of the SDGs related objectives are founded in 5th and 8th grades, while the grade with the least the objectives is 7th grade.

In addition, ‘‘Physical Events’’ subject area consists of 9 out of 75 objectives related to SDGs. All grade levels have the objectives related to SDGs except 5th grade. 8th grade also includes these objectives (5 out of 16) more compared to other grade levels, whereas 6th grade contains the least.

For the subject area of ‘‘Matter and its Nature’’, 15 out of 52 objectives are determined corresponding to SDGs. Apart from 5th grade, other grades include these objectives which the most of them are in 6th grade, while the least of them are in 8th grade levels.

In conclusion, ‘‘Matter and its Nature’’ and ‘‘Physical Events’’ subject areas do not contain the objectives related to SDGs in 5th grade. However, 8th grade is the only grade level which includes the objectives. Most of the objectives are indicated in ‘‘Living Things and Life’’ subject area.

4.5.4. Comparison of SDGs Related Objectives in Terms of Clusters of Learning Competences by Grades

In this part, the distribution of the Knowledge, Skills and Values competences in the Science Curriculum by grade levels are shown. The results are visualized graphically as in *Figure 4.11*.

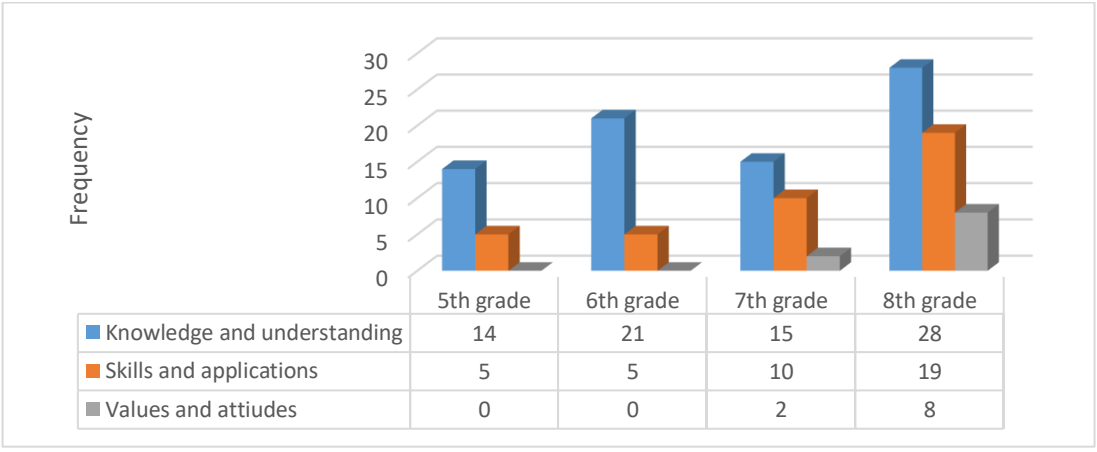

Figure 4.11. The Distribution of the Clusters of Learning Competences as Knowledge, Skills and Values by Grades

From the table, it can be seen that knowledge competence is referred mostly in 8th grade (f=28), while the grade that involves the least competence is 5th grade level (f=14). For skill competence, there is founded skill competence more in 8th grade (f=19), whereas 6th grade level includes the least skill competence (f=5). On the other hand, value competence is determined in only both 7th and 8th grades in the favor of 8th grade level (f=8). On the whole, knowledge competence is dominant in each grades compared other competences.

4.5.5. Comparison of Activities Related to SDGs According to the Total Number of Activities in Science Textbooks by Grades

The comparison of activities related to SDGs according to the total number of activities in Science textbooks by grade levels are given as presented in Table 4.89. The activities in the table are determined considering the pars defined as ‘‘Activity’’. Regarding to these parts, SDGs related activities are presented as below.

Table 4.89. *Distribution of Activities in Science Textbooks Related to SDGs According to the Total Number of Activities and SDGs Related Objectives*

Grade Levels	**Total Number of Activities**	**The Number of SDGs Related Activities**		**SDGs Related Objectives**
	f	**f**	**%**	
5th	34	2	5.9	F5.6.1.1 F5.6.2.2
6th	41	1	2.4	F6.4.3.3
7th	51	5	9.8	F7.4.5.1 F7.4.5.2 F7.4.5.5 F7.5.1.4 F7.6.1.3
8th	25	-	-	-
Total	151	8	5.3	

As indicated in the table, the activities are given in Chapter 6 in 5th grade level. While there is given the activity in Chapter 4 only in 6th grade, the activities in 7th grade level are founded in Chapters 4, 5 and 6.

Moreover, the number of activities related to SDGs reaches the highest level in 7th grade level (f=5, 9.8%). The number of activity is found to be the least at 6th grade (f=1, 2.4%); however, there is not determined any SDGs related activity in 8th grade level. To summarize, it may be inferred that there are not enough number of activities in all grades compared to total number of activities in each grade levels.

4.5.6. Comparison of SDGs Related Objectives in the Parts of the Science Textbooks by Grade Levels

The aim of this section is to present in which part of Science textbooks SDGs related objectives are reflected. Correspondingly, all SDGs related objectives that are reflected to the textbooks are indicated one by one and then the related parts are determined. The data derived from the results are tabulated in the following tables according to grade levels. Moreover, each objective is shown with without grade level number.

Table 4.90. *Distribution of SDGs Related Objectives in the Parts of 5th Grade Science Textbook*

	Science Textbook Parts												
Objectives	Learning area	Questions (in Text)	Do you know?	Activity	Discussion (in Text)	What have we learned?	Discussion	Science, engineering and	Unit measurement and	Text	Figures	Think and Research	News article
6.1.1		×		×	×								
6.1.1.a												×	
6.1.2							×						
6.2.1	×	×											
6.2.1.a										×			
6.2.2				×									
6.2.3		×										×	
6.2.4							×						
6.3.1						×							
6.3.1.a										×	×		
6.3.2		×										×	

Table 4.90 provides an overview of founded excerpts location in the 5th grade Science Textbook. The textbook consists of 13 parts. When examining the findings, it reveals that all of the objectives are founded at least one of the part of the textbook. The most stated part in the textbook is ‘‘Questions (in Text)’’, while the least referred parts are founded as ‘‘Learning area’’, ‘‘Discussion (in Text)’’, ‘‘What have we learned?’’ and ‘‘Figures’’. On the other hand, four parts in the textbook do not include any SDG related excerpts in which the parts of are; ‘‘Do you know?’’, ‘‘Science, engineering and entrepreneurship applications’’, ‘‘Unit measurement and evaluation studies’’ and ‘‘News article’’ for each grade levels.

Table 4.91. *Distribution of SDGs Related Objectives in the Parts of 6th Grade Science Textbook*

	Science Textbook Parts																	
Objectives	Questions (in Text)	Discussion (in Text)	Figure	Text	Do you know these things?	Let’s do the activity	Working Time	What have we learned?	Subject evaluation	Lets remember	Unit evaluation	Research	Science, engineering and	Lets do experiment	Science, life and technology	Example	Discussion	Let's do what
2.3.5. b				×														
4.3.2	×						×					×						
4.3.3						×												
4.3.4																	×	

Table 4.91. *Continued*

Objectives	Science Textbook Parts																	
	Questions (in Text)	Discussion (in Text)	Figure	Text	Do you know these things?	Let's do the activity	Working Time	What have we learned?	Subject evaluation	Let's remember	Unit evaluation	Research	Science, engineering and	Let's do experiment	Science, life and technology	Example	Discussion	Let's do what
4.4.1	×																	
4.4.1.a				×														
4.4.2												×						
4.4.3												×						
5.4.3							×											
5.4.3.a				×				×										
6.2.3	×																	
6.2.3.a				×														
6.2.4		×																
6.3.1	×											×					×	
6.3.1.a				×														
6.3.1.b				×														

Table 4.91. *Continued*

Objectives	Science Textbook Parts																	
	Questions (in Text)	Discussion (in Text)	Figure	Text	Do you know these things?	Let's do the activity	Working Time	What have we learned?	Subject evaluation	Let's remember	Unit evaluation	Research	Science, engineering and	Let's do experiment	Science, life and technology	Example	Discussion	Let's do what
6.6.3.1.c				×														
6.3.1.ç				×														

In 6th grade level, there is detected some parts that involve SDGs related excerpts as summarized in Table 4.91. 6th grade textbook involves 18 parts in total. In the line of the findings, all of the objectives are founded at least one of the part of the textbook. The most indicated part in the textbook is ''Text'', whereas the least referred parts are determined as ''Discussion (in Text)'', ''Let's do the activity'' and ''What have we learned?''. However, 10 parts in the textbook do not involve any SDG related objectives.

Table 4.92. *Distribution of SDGs Related Objectives in the Parts of 7th Grade Science Textbook*

	Science Textbook Parts																
	Science workshop																
Objectives	Discussion (in Text)	What do we remember?	Questions in text	Course preparation	Text	*do activity	*do experiment	*design a vehicle	*make poster	* do research	Figure	Let's apply what we've learned	For Curious ones	Review of the unit	Unit evaluation	Researching	Let's do together
4.5.1			×			×											
4.5.2						×											
4.5.3					×												
4.5.3.a					×												
4.5.4					×												

Table 4.92. *Continued*

	Science Textbook Parts																
	Science workshop																
Objectives	Discussion (in Text)	What do we remember?	Questions in text	Course preparation	Text	*do activity	*do experiment	*design a vehicle	*make poster	* do research	Figure	Let's apply what we've learned	For Curious ones	Review of the unit	Unit evaluation	Researching	Let's do together
4.5.4.b					×												
4.5.5						×											
5.1.4										×							
5.1.4.a					×												
5.1.5	×																
5.3.3.a					×												
6.1.1.c					×												
6.1.3									×								

*It shows corresponding parts in the Science Workshop

As can be seen from Table 4.92, the objectives related to SDGs are shown by indicating related parts from 7th grade Science textbook. There are founded 17 parts in the textbook. The results show that all of the objectives are part in at least one of the part of the textbook. Moreover, the most of the objectives are reflected in the part of ‘‘Text’’. On the other hand, there is determined the parts which include the least of the objectives related to SDGs are as ‘‘Discussion (in Text)’’, ‘‘Questions in text’’, ‘‘make poster’’ and ‘‘do research’’. Furthermore, 11 parts in the textbook do not contain the objectives related to SDGs at all.

Table 4.93. *Distribution of SDGs Related Objectives in the Parts of 8th Grade Science Textbook*

	Science Textbook parts												
Objectives	Are you ready for the unit?	Let's Research-Discuss	Preparatory works	Activity	Text	Questions in text	Figures	Science, technology, and life	Do you know these things?	End Of Chapter Assessment	Unit Assessment Questions	It is your turn	Science, engineering and entrepreneurship
1.2.1											×		
1.2.2											×		
4.4.6					×								
4.4.7												×	
4.4.7.a					×								
4.6.1		×											

Table 4.93. *Continued*

Objectives	Science Textbook parts												
	Are you ready for the unit?	Let's Research-Discuss	Preparatory works	Activity	Text	Questions in text	Figures	Science, technology, and life	Do you know these things?	End Of Chapter Assessment	Unit Assessment Questions	It is your turn	Science, engineering and entrepreneurship applications
4.6.1.b					×								
4.6.2												×	
6.3.1							×						
6.3.2						×						×	
6.3.3													
6.3.3.a					×								
6.3.3.b												×	
6.3.3.c												×	
6.3.3.ç								×					
6.3.3.d					×								
6.4.1					×			×					
6.4.2													×

Table 4.93. *Continued*

Objectives	Science Textbook parts												
	Are you ready for the unit?	Let's Research-Discuss	Preparatory works	Activity	Text	Questions in text	Figures	Science, technology, and ...	Do you know these things?	End Of Chapter Assessment	Unit Assessment Questions	It is your turn	Science, engineering and entrepreneurship
6.4.3						×							
6.4.4		×											
6.4.5											×		
7.3.1			×							×			
7.3.3		×											

To understand the parts that reflect the SDGs related objectives in the 8th grade Science textbook, the findings obtained from the textbook is illustrated in Table 4.93. For 8th grade Science textbook, there are determined 13 parts in the textbook. Also, the results reveals that all of the objectives are indicated in at least one of the part of the textbook except 2 objectives since both objectives are not reflected in the textbook. In addition, there founded the most of the objectives in the part of ‘‘Text’’, while the least referred parts are as ‘‘Preparatory works’’, ‘‘Figures’’ and ‘‘Science, engineering and entrepreneurship applications’’. Also, three parts in the textbook do not contain the objectives related to SDGs as ‘‘Are you ready for the unit?’’, ‘‘Activity’’ and ‘‘Do you know these things?’’.

CHAPTER 5

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

In this chapter, discussion and conclusion in accordance with main findings are presented. Afterwards, educational implications and recommendations for further studies are provided in the last section.

The current study as a qualitative case study reveals how Sustainable Development Goals (SDGs) considering SDGs relevant competences (Knowledge and understanding; Skills and applications; Values and attitudes) are addressed in Middle School Science Curriculum (2018) and Science Textbooks (from 5th to 8th grades) through content analysis and document analysis.

5.1. SDGs with Related Competences in 2018 Curriculum

This section presents discussions and conclusions related to SDGs and corresponding competences in 2018 Science Curriculum. For first section, it is mentioned which SDGs are reflected in the curriculum. For second section, corresponding competences in the curriculum are presented.

5.1.1. SDGs in 2018 Middle School Science Curriculum

When the objectives related to SDGs were analyzed, it was found that the number of SDGs related main objectives was very low compared to the total of the main objective in the curriculum (45 out of 223 (20%)). Similar results are also indicated in the previous studies.

As for example taking Tanrıverdi's (2009) study, objectives and general objectives of the Turkish Primary School Curriculums (2005) did not reflect Education for Sustainable Development content. The author used the framework of Sustainable

Development Strategy developed by European Union Commission in her study and the framework consisted of 7 key priorities.

Kaya and Tomal (2011), on the other hand, analyzed Social Sciences education program in terms of Sustainable Development and it was expressed that although the program was prepared to provide Sustainable Development education, there were shortcomings. Similarly, Yalçınkaya (2013) stated that the ESD content in the Primary School Social Studies Curriculum, was far from reflecting the major targets.

Therefore, it may be inferred that, although ESD, SD and SDGs have been emphasized in the Turkish Science and Social Studies curriculums beginning from 2013, the attempts may not be sufficient to fulfill the requirements given in the literature, frameworks and rubrics. In other words, these concepts are embedded in the curriculum to some extent.

The results can also be summarized as that the number of SDGs related objectives may not enough in the curriculum considering to the total number of the objectives in the curriculum. By embedding more SDGs in the curriculum, it may result inclusion of in the more SD related issues or concepts in the curriculums. Also, students may have a knowledge on global or local problems more and they produce solutions for these challenges as future citizens in the society.

Furthermore, it has been shown as a result of this thesis that, Science Curriculum for all grade levels contain SDGs related objectives; most of them in the 8^{th} grade Science Curriculum and the least, in 5^{th} grade. It is also investigated that, as the grade level increases, there is an increase in the number of SD/ESD/SDG related objectives. Consequently, it may be indicated that SDGs related objectives are not distributed evenly based on grade levels.

This finding is similar with the study conducted by Demirbaş (2011). The author investigated the Geography Curriculum in terms of SD from 9^{th} to 12^{th} grades. The results showed that most of the SD related objectives were placed in 11^{th} and 12^{th} grade levels.

Nguyen (2019) investigated geography textbooks from ESD perspectives through the question of how SD issues are integrated and related competences are reflected in the textbooks regarding to relevant competence in the light of 17 SDGs by UNESCO. The author evaluated the objectives under cognitive, socio-emotional and behavioral headings. The findings figured out that most of the SD related topics were found in 12th grade Geography Textbook, while a few of them were reflected in 6th grade.

Based on these studies, one may drive a conclusion that there is a tendency to inclusion of SD related issues in higher grade levels. The reason of the inclusion of SD in higher grades may be that students cognitive level or ability found the final shape through age so understanding issues can be abstract for students in early ages.

Another reason could be that due to overcrowding of the curriculum with other subjects, it is not possible the integration of such concept. Especially, exams such high school entrance exam or university entrance exam cover the basic topics from biology, physics, chemistry etc. Therefore, it can create an incline that these subjects can make priority to learn. Also, such integration of these concepts can be also coincidence.

Accordingly, integration of these objectives across all grade levels evenly can be recommended for teaching of the concepts at all grade levels in the curriculum as a whole.

Moreover, SDGs related objectives were examined in the Science Curriculum based on a chapter in the thesis. The results show that some of chapters includes SDG related objectives. Based on the findings, it may be indicated that most of the SDGs related objectives are founded in the chapters of Chapter 4 and Chapter 6 that involve the subjects related to matter and human-environment relations.

Moreover, the objectives are referred in 5th grade only in Chapter 6: Human and Environment. Similar result was also founded in the study of Türkmen et al. (2018). It was determined that the objectives of chemistry curriculum in 10th grade were placed in only one unit.

It may be evaluated that the objectives are not distributed equally across all chapters for each grade levels. Therefore, this situation may cause the accumulation of SDGs related issues in specified chapters. It can be resulted in understanding SD as separate concepts from other topics and it can decrease the importance of the concept from student perspective. As a result, the number of the chapters related to SDGs may not be convenient for an effective ESD. Therefore, it can be suggested that the objectives related to SDGs can be integrated in all chapters by infusing these issues into other topics in the curriculum, so SD concept can be understood not a separated topic. Instead, the connection of this topic with other ones can be seen via this integration.

For the subject areas in the Science curriculum, most of the objectives are addressed in the subject area of ''Living Things and Life'' and then ''Matter and Its Nature'' in the curriculum. For the subject area of ''Earth and Universe'', there is pointed out the objectives related to SDGs only in 8th grade level.

It may be concluded that all subject areas in the curriculum do not covers SDGs related objectives and these objectives are accumulated in just two learning areas. Such conclusion may also be result of accumulation of the objectives in specified chapters since each chapter is corresponding to a subject area. In accordance with these result, it may be mentioned that the curriculum focuses more on matter and environmental issues regarding to SDGs. Accordingly, it can be recommended that SDG related objectives should be embedded across all learning areas for each grade levels as in the chapters.

In addition, the average of 6 out of 17 SDGs is determined across grade levels and most of SDGs are founded in 8th grade level. Regarding the number of the goals in the literature, it can be stressed that the number of the goals in the curriculum is not enough to achieve all the goals of SD; and therefore, all SDGs may be included in the curriculum by covering all global and local issues.

Moreover, G.8 (Decent work and economic growth) was founded only in 8th grade. Work related issues may be provided students in higher grade since students in this grade level may begin to determine their career and choose their future jobs. Therefore, the goal may be included in this grade level to present jobs or working environments to students and students can be informed about this issues in early ages as well.

Furthermore, considering the most state goals in the curriculum, it can be interpreted that while there are more focused on the issues of environment and health in lower grades, consumption and production sustainably is more reflected in 7th and 8th grades. Accordingly, it may be concluded that, students are oriented to from health and environment topics to the consumption through grades.

In terms of SDGs in the curriculum, it can be mentioned that SDGs as health, quality education sustainable consumption and production and climate change are reflected in all grades. However, poverty, hunger, clean water, sanitation, inequalities, peace, justice, partnerships are not reflected in the curriculum.

According to the findings of Nguyen (2019), it was founded that themes related to SD were founded in all textbooks. Mostly emphasized one were identified as ‘‘life on land’’ and ‘‘water related topics’’ following with ‘‘sustainable cities and communities, good health and well-being, decent work and economic growth, reduced inequality, climate action and partnership for goals’’ (p.6). On the other hand, one of the goal that was not included in the textbooks was indicated as ‘‘quality education’’.

Ateş (2019) stated that Science curriculum (2018) does not contain UN goals (2015) of ‘‘affordable and clean energy, reduced inequalities, decent work and economic growth, quality education, industry, innovation and infrastructure, life below water, gender equality, clean water and sanitation, no poverty, peace and justice, partnerships for the goals’’.

The goals of UN (2015) as ‘‘gender equality, clean water and sanitation, no poverty, peace and justice, partnerships for the goals’’ are not founded in the current study.

Other goals in the study of Ateş (2019) were determined in the current study for Science curriculum (2018). The difference in the findings can be due to usage of different framework but the goals are the same goals taken reference in the current study. Moreover, specified missing goals in the curriculum should be taken part in the curriculum.

One of the reason can also be that the content of the textbooks was prepared based on both local and global needs. In other words, if the problems such as work, health or migration exist in a country, it is possible to see these problems in the textbooks too. In addition, the goals of both reduced inequalities and partnerships for the goals were not founded in the current study. With respect to these findings, integration of other SDGs related issues in the curriculum can be recommended in order to educate citizens who have can see a problem from different perspectives.

Furthermore, the issues in the objectives related to SDGs in the Science Curriculum can be summarized as ‘‘biodiversity, endangered species, factors threatening biodiversity, human-environment relationship, environmental pollution-health relationship, environmental problems and solutions, future environmental problems, destructive natural events and the way protection, heat insulation, fuels, sound insulation, poisoning, diseases and defects, health of organs, usage of drugs and first aid, recycling, waste and waste management, hygiene, solar energy, climate science, acid rain, chemical industry, substance cycles, climate change, greenhouse effect, footprint, efficient use of resources, recycling, electric energy, power plants and energy efficiency’’.

It can be mentioned that issues can be categorized around the main topics as energy, health, environment, industry, insulation, waste and climate. It can be concluded that there were included most of SDGs issues in the Science Curriculum.

Türkmen et al. (2018) stated that ‘‘Greenhouse effect, global warming, harmful effects of fossil fuel consumption, ozone layer depletion, threats to biodiversity, and environmental pollution’’ were as the dominant concepts in the curriculum.

Ateş (2019) also conducted the study of examination of Science curriculum based on education for sustainable development from 3rd to 8th grade levels considering to 17 Sustainable Development Goals. The findings reveal that for 5th grade level, the issues in the curriculum were stated as ‘‘factors causing environmental problems, biodiversity, extinct and endangered organisms and what needs to be done to preserve this species, sensitivity to environmental problems and presenting solutions for the problems’’ (p.110). The subjects were stated as ‘‘Biodiversity’’ and ‘‘Human environment relationship’’. For 6th grade, it was expected from students to learn the issue of human health and protection of health in the main subject of ‘‘Health of systems’’. For 7th grade level, the issues were addressed as ‘‘recycling, reuse, the control of domestic waste in terms of solid and liquid’’.SD was emphasized in the subject of ‘‘Domestic waste and recycling’’. Finally, for 8th grade level, environmental problems and proposals for these problems in the subjects of ‘‘Substance cycles and environmental problems’’ and Sustainable Development’’ were highlighted in the curriculum. Moreover, there were founded similar issues in the current study as well.

When comparing the study of Türkmen et al. (2018) and the current study, it can be stated that except ozone layer depletion other topics are also common in the current study. The reason may be that specified topics are faced especially in recent years. Therefore, there may be given priority for these issues in the curriculum.

On the other hand, regarding to the study of Tanrıverdi (2009) that was conducted based on the 7 key priorities as ‘‘climate change and clean energy, sustainable transportation, sustainable consumption and production, public health threats, protection and management of natural resources, social integration, population and migration and the fight against global hunger’’ (p.91). It was founded that ‘‘1) climate change, 2) social integration, population and migration, 3) the fight against global hunger, 4) public health threats and 5) sustainable transport’’ (p.100) were reflected not all or given too little space in the curriculums.

According to the study of Yalçınkaya (2013), primary social studies curriculum was analyzed based on the ESD themes of UNESCO. It was founded that ‘‘gender equality, HIV/AIDS, climate change, rural development, sustainable urbanization’’ (p.225) were not included in the program.

According to the findings of both Yalçınkaya (2013) except climate change concept and Tanrıverdi (2009), similar results were also determined in the current study. This may infer that there exist shortcomings for embedding the concepts of ‘‘sustainable transportation and social integration, population and migration, hunger, gender equality, HIV/AIDS, climate change, rural development, sustainable urbanization’’. Therefore, regarding the results of the thesis, specified issues also should be involved in the curriculum.

Accordingly, it can be drawn conclusion that based on previous studies (e.g. Tanrıverdi (2009); Yalçınkaya, 2013), Science curriculum (2018) covers many SDGs related topics. Moreover, specified missing goals in the curriculum should be taken part in the curriculum.

5.1.2. SDGs Related Competences in 2018 Science Curriculum

Regarding to the clusters of learning competences (Knowledge and understanding; Skills and applications; Values and attitudes), knowledge and understanding competence is reflected more in all grades.

In addition, values and attitudes competence was just reflected in not only in 7^{th} grade but also in 8^{th} grade, in the favor of 8^{th} grade. On the other hand, all competences are addressed just in 8^{th} grade.

Similar result was founded in the study of Tanrıverdi (2009), there were founded the objectives mostly included knowledge and attitude in primary school curriculum objectives and these objectives were not sufficient for skill, value and understanding.

According to the results of the thesis, it may be concluded that the curriculum is more knowledge based oriented. Besides, students gain skills related to SDGs through

curriculum. However, value competence is just provided in higher grade levels. Therefore, the embedding of not only knowledge and skills but also values in the curriculum from an early age can be suggested since students can learn or imitate from his/her surroundings especially in early ages and then individual can have his/her own knowledge, skill and value.

Moreover, such inclusion is also important due to educating individuals to be ready for present or future challenges of global word. Therefore, students should be educated with all competences from early age too.

Regarding to the SDGs in the curriculums, all goals in 5th grade levels include knowledge competence except G.4 (Quality education) included skill competence and G.14 (Life below water) included both knowledge and skill ones. For 6th grade, all goals cover just knowledge competence except G.4 (Quality education). For 7th and 8th grades, there were founded similar competence for G.4 (Quality education) included as skill competence, G.3(Good health and well-being) as knowledge and skill and G.12(Responsible consumption and production) included all competences. In addition, there was determined G.7 (Affordable and clean energy) covers all learning competence in 8th grade as well. Other competences in both 7th and 8th grades contain knowledge competence too.

Considering the findings, it can be evaluated that skill competence especially was determined in the curriculum due to the goal of ‘‘quality education’’ (G.4). For 8th grade, there were founded two competences which include all competences so this can increase the possibility of more value related objectives. Moreover, there were determined all competences in 7th and 8th grades so it may result in educating students all competence in higher grades.

Tanrıverdi (2009) founded that for climate change and clean energy topic, the subject was reflected in some units. Also they are addressed through knowledge and understanding without skill, attitude and value. The referred topics related to energy are solar and geothermal energy types only. For sustainable consumption and

production, there was not founded any subject or units in the curriculum corresponding topic. Recognition of environmental problems and environmental awareness are determined in related objectives for sustainable consumption and production. Most of these objectives were sufficient to provide skill, attitude and value. Moreover, when examined the issues that threaten public health topic in the curriculums, the findings were stated that general health concepts are covered. Cleaning of food and keeping the environment clean issues are addressed through knowledge without skill, attitude and value. For fighting global hunger topic, there was not determined any subject, unit or objectives related issue in the curriculums.

The result of the current study presents similar results corresponding to competences. Science curriculum (2018) covers mostly knowledge competence. It can be pointed out that knowledge based education can result in memorization-oriented education. Therefore, the number of the subjects related to SDGs should be increased in the curriculum based on these findings since all these issues are connected each other like a puzzle. Furthermore, ESD is pertinent to value due to its role of in the relationship human and environment as well as development of human (UNESCO, 2009).

It was also mentioned that there exists literature on how ESD should be learned or thought in terms of knowledge, skills and values. More attention to value is provided especially. The prominent idea is necessity of value education for sustainable societies and prepare individuals who can make changes (De Kraker, Lansu & Dam-Mieras, 2007).

Moreover, there was paid attention to values especially in 2018 Science curriculum of MoNE and the importance of the values were highlighted. When considering the significance of values in ESD, all competences should be integrated together. It may be recommended that investigation- discussions based on sustainable development goals, activities that are related to daily life problems especially including problem based approach by offering solutions problems (as in the objective of 7.3.6. a in 8th grade Science Curriculum (2018)), designing projects specified problems or the

reflections for videos, stories or cases can be provided in science education to emerge of specifically value competence.

Moreover, Keleş (2015) conducted study on development an activity on creative drama for teaching of issues corresponding to sustainability. It was stated that ın the study, students could be able to understand opinions as well as values on sustainable consumption from their perspectives. Keleş (2015) also stated that, engaging of students in not only debates but also discussion can be helpful for values thinking by teachers. Therefore, both creative drama, discussions and debates also can be recommended for inclusion of especially value competences.

Competences may impact each other; for example, knowledge on SD or SDGs may influence the attitudes of students towards these concepts. Therefore, it is worthy to investigate the connection among these competences as well.

In conclusion, ‘‘the importance of curriculums comes forward in order to educate individuals who aware of global issues, able to read developments, innovative working for nature, creative, have critical thinking skills and have the knowledge and skills to fulfill the responsibility of global citizenship’’ (Bulut & Çakmak, 2018, p.2681). Therefore, in order to achieve sustainable development goals, individuals who can reach sustainable development targets. Accordingly, there should be created common programs and related lessons (Yapıcı, 2003).

5.1.3. The Reflection of Three Dimensions of SD in 2018 Science Curriculum

The objectives related to SDGs are categorized based on three dimensions of SD as environmental, economic or social. The categorization was made according to the source from Health and Education Unit of the Commonwealth Secretariat [HEU] (2016, cited in Osman et al., 2017) in the framework.

The results for each grade levels show that the most addressed sustainable development dimension one was founded as environmental dimension. According to

the findings, all dimensions of SD were determined in the objectives related SDGs of 2018 Science Curriculum. Although environmental dimension of SD is dominant in the Science Curriculum, all grade levels include remarkable number of the objectives related to economic and social dimensions in the curriculum.

According to the study of Yalçınkaya (2013), the dimension of environmental of ESD was not sufficient in the program due to a few number of results on both awareness on disasters and natural resources. Moreover, the study on the investigation of the objectives of the secondary school chemistry curriculum, on the other hand, show that environmental dimension of SD was dominant among chemistry objectives (Türkmen et al., 2018). Moreover, the study of Nguyen (2019) shows that economic and social dimensions of SD were neglected in the textbooks, while more emphasized was made to the environmental dimension. In addition, Ateş (2019) mentioned that environmental related topics were placed more in Science curriculum (2018) as environmental awareness, human nature relationship, air pollution and climate change etc.

Actually, it was not surprising that environmental dimension is dominant in overall. It is surprising that all dimensions are reflected in the curriculum for all grades. The result can be interpreted as that the reflection of all three dimensions in 2018 Science curriculum is notable for achieving of SD from all perspectives as social, economic and environmental.

Considering the results of (Yalçınkaya, 2013; Türkmen et al., 2018; Nguyen, 2019; Ateş, 2019), it can be inferred that environment related issues are generally in the focus of the curriculum recently. Similar result was also founded in the current study as well.

Alkış (2008) also emphasized the increasing number research related environmental education and the popularity of issue in Turkey. Besides, SD generally was thought as that it covers environment related issues without social or economic one so this

situation can direct the focus to the environmental concepts. In current time, people give more emphasis to environmental issues due to happening changes on both environment and climate significantly (Rosyidatun, 2017). This situation may cause the embedding more environment related issues more.

In conclusion, 2018 Science curriculum was designed for reflection of SD from all perspectives (social, economic or environmental) as stressed in the literature. Sustainable Development is a three-dimensional approach. Therefore, all dimensions must operate together (Bulut & Çakmak, 2018).

The inclusion of three aspects of SD is also so important since when considering development from social perspective, it is not related only with economy since it should include the needs of future generations and nature; and therefore, sustainable development is based on three pillars (Demirbaş, 2011). Accordingly, sustainable development should be reflected in all context based on these pillars regarding their importance for SD.

5.2. SDGs with Related Competences in Science Textbooks

Analysis process consists of 3 steps in the study. Firstly, determination of SDGs related objectives in 2018 Science curriculum together with corresponding competences and learning outcomes. The second step is the identification of related parts from Science textbooks from 5^{th} to 8^{th} grades based on determined objectives through document analysis. Actually, the objectives are as a guide to show where related parts are in the textbooks.

During the analysis of the textbooks, the parts which the objectives are founded are as expected parts; and therefore, there was not apply both usage of rubric and content analysis for this step. Other parts founded information related to the objectives were also represented as additional in order to interpret easily. The results were interpreted how the objectives were reflected and whether the SDGs with competences were addressed in the related content in the textbook as in the objectives.

For 5th grade level, it was founded that all objectives and corresponding goals were reflected in the content of the textbook as stated in the analysis of the objectives. Moreover, corresponding competences were addressed in the textbook as founded in related objectives.

As a result of analysis of the textbook, the competence (Osman et al., p.29) of ‘‘critical and engaged approach towards learning’’ (G.4.S5) is appeared in some objectives (e.g. 5.6.1.1, 5.6.2.3 and 5.6.3.2).

However, only one objective of ‘‘explains destructive natural events caused by natural process’’ (MoNE, 2018, p.29) was not evaluated as indicated in related objective. Instead, the name of these events was asked students via diagram in ‘‘what have we learned’’ part of the textbook. Despite of not addressing the objectives as stated in the curriculum, the determined part was also related to knowledge and understanding competence.

Accordingly, there can be made corrections for inclusion of the corresponding objective as it is in the related part of the textbook

When examining corresponding parts from the textbooks, ‘‘text’’ and ‘‘question (in text)’’ are the parts which the most of the objectives are displayed in 5th grade Science Textbook. The results may be indication of that the topics are taught with the help of questions and direct knowledge and therefore, other teaching methods such as discussion, projects, game etc. may be used for evaluation of the objectives. In other words, it can be said that for the evaluation of the objectives related to SDGs, there may not be used other techniques efficiently.

In addition, the issues related to SDGs in the 5th grade Science textbooks of MoNE were determined as ‘‘biodiversity, endangered species, factors threatening biodiversity, human-environment relationship, environmental pollution-health relationship, environmental problems and solutions, future environmental problems, destructive natural events and the way protection’’. According to the findings, the issues related to environment and biodiversity are mostly referred in the textbook.

Furthermore, additional information related objectives are determined in addition to related part in 5th grade Science Textbook. While some of additional information reflects expected information from students related to the objectives directly in related parts through text, some of them are related to assess students' knowledge with questions additionally. It was surprising that expected information were provided students directly in some parts of the textbook.

The findings from the analysis of 6th grade Science Textbook show that the objectives related SDGs were illustrated in related parts of the textbook as expected. In addition, related competences were also adressed in the textbook as in related objectives.

Nevertheless, the objective of ''classifies fuels as solid, liquid and gas and gives examples of commonly used fuels'' (MoNE, 2018, p.34) was not presented in the textbook as highlighted since classification of the fuels was not asked students in the textbook and just exemplification of these fuels were reflected via question. For this On the other hand, both the content of related SDGs and competence were determined same for founded part in the textbook.

Moreover, SDGs related issues in the textbook were founded as in the 6th grade Science textbook of MoNE as ''hygiene, heat insulation, fuels, sound insulation, poisoning, diseases and defects, health of organs, usage of drugs and first aid''. The indicated issues reveal that health and insulation subjects were dominant in the textbook.

In addition, additional information related to the objective were pointed out in related part of the textbook. This information was provided in the part such as ''Text'' by providing information directly to students or students' knowledge on the issue were assessed in some part of the textbook (e.g. subject evaluation part). Besides, the most of the objectives were reflected in the part of ''Text'' in the textbook. Therefore, it can be interpreted as that direct knowledge on issues may be provided students through text mostly.

Furthermore, the findings of 7th grade Science Textbook reveals that three chapters were related to SDGs and corresponding objectives and SDGs were reflected in the textbook as addressed in the objective. Moreover, related competences for all objectives in this grade were presented as founded in corresponding objectives.

As a result of analysis of the textbook, the competence (Osman et al., p.29) of ‘‘critical and engaged approach towards learning’’ (G.4.S5) is appeared in some objectives (e.g. 7.5.1.4).

Despite, two objectives were not indicated in the content of the textbook as in the objective.

One of them was ‘‘queries for efficient use of recycling resources’’ (MoNE, 2018, p.43). Although the objective highlights the query of the issue, related information was provided directly students through text. For this objective, both knowledge and skill competence related to G.12 (Sustainable consumption and production) were determined. However, information was presented only via text; and therefore, there was reflected only knowledge related competence for this objective in related part of 5th grade Science Textbook.

Another objective was ‘‘takes care of waste management in the vicinity’’ (MoNE, 2018, p.43). However, the context was reflected just in knowledge form in the ‘‘text’’ part. At the beginning, the objective implies value and attitude competence so it was identified for this objective as both knowledge and value competences related to G.12 (Sustainable consumption and production). After analysis of textbook, corresponding information was addressed via text. Therefore, there was determined only knowledge competence in the textbook so value competence was not applicable for related part of the textbook.

Additional information was provided and the knowledge of students were assessed in some part of textbook additionally. In addition, the objectives related to SDGs were figured out mostly in the parts of ‘‘Text’’ and ‘‘Let’s do activity’’. Therefore, it can

be inferred that activity and direct knowledge were predominant in the 7th grade Science Textbook.

The issues passing in related part were also found in 7th grade Science textbook of MoNE as ‘‘recycling, waste and waste management, hygiene, solar energy and health’’. Accordingly, the common subjects are health and recycling in the textbook.

In addition, the results of 8th grade level shows that four chapters illustrate the objectives in the textbook and these objectives and corresponding SDGs were expressed as they were in related parts of the textbook. Moreover, related competences were reflected in related part of the textbook as expected in related objectives.

As a result of analysis of the textbook, the competence (Osman et al., p.29) of ‘‘critical and engaged approach towards learning’’ (G.4.S5) is appeared in some objectives (e.g. 8.6.3.2, 8.6.4.4, and 8.7.3.3,).

On the other hand, there were determined 8 objectives that were not addressed in the textbook as mentioned in the objectives.

One of the objective was ‘‘states that Climate Science (Climatology) is a branch of Science and experts working in this field are called Climatologist’’ (MoNE, 2018, p.47). There was not founded any related part which students can state the expected knowledge. For competence and related SDGs, both of them were same for determined part in the textbook.

Another objective was founded as ‘‘take necessary precautions regarding the hazards that may occur during the use of acids and bases as cleaning materials’’ (MoNE, 2018, pp.117-118). Before analysis of related part from the textbook, it can be inferred that there may be found skill related activity etc. Therefore, both knowledge and skill competences related to G.3 (Good health and well-being) was considered. However,

the objective was reflected just knowledge form via text. Accordingly, there exist just knowledge competence in the textbook for related objective.

Other objective was ‘‘explains substance cycles by showing them on the diagram’’ (MoNE, 2018, p.52). However, the textbook illustrates a figures that show the substance cycles. There was not founded any part that students can show and explain the issue. Besides, determined SDGs and related competence was founded as same for this objective in the textbook.

The objective of ‘‘discusses the causes and possible consequences of global climate change’’ (MoNE, 2018, p.52) was not founded in the textbook. Therefore, there were not addressed any related SDGs (as G.4 (Quality education) and G.13 (Climate action)) or competences as knowledge and skill for this objective in the textbook.

Another objective was ‘‘takes care to be efficient in the use of resources’’ (MoNE, 2018, p.53). The objective seems including value related activity etc. but it was reflected in the textbook as direct information in the part of ‘‘Text’’. For related objective, both knowledge and value competences were determined related to G.12 (Responsible consumption and production). Therefore, it can be concluded that there exists only knowledge competence in the textbook for related objectives.

Other objective was determined as ‘‘generated ideas on the advantages and disadvantages of power plants’’ (MoNE, 2018, p.54). This objective was also not founded any part of the textbook. For this objective, both knowledge and skill competences related to G.7 (Affordable and clean energy) were identified but both competences and SDG were not addressed in the textbook.

Lastly, the objective of ‘‘pays attention to energy efficient use at homes’’ (MoNE, 2018, p.54) was thought at first including value related activity etc. yet information was provided to students through direct information in ‘‘Text’’ part. For this objective, value competence related to G.7 (Affordable and clean energy) was decided. On the contrary, there was founded only knowledge competence on related goal in the textbook.

In addition to related part in the textbook, there was identified additional information in the textbook. Based on the findings, some of additional information was pointed out through text as direct information, whereas some of them was assessed in some part of the textbook (e.g. Unit assessment). Besides, the parts which the most of the objectives were reflected in the textbook were determined as ‘‘Text’’ and ‘‘It’s your turn’’. For this grade level, it can be interpreted as that direct knowledge and applying of knowledge were dominant.

SDGs related issues addressed in the textbook were also founded in 8th grade Science textbook of MoNE as ‘‘climate science, acid rain, chemical industry, substance cycles, climate change, greenhouse effect, environmental problems, footprint, efficient use of resources, recycling, electric energy, power plants and energy efficiency’’.

The study made by Nguyen (2019) points out that ‘‘no poverty’’, ‘‘zero hunger’’, ‘‘good health and well-being’’, ‘‘gender equality’’, ‘‘affordable and clean energy’’, ‘‘industry, innovation and infrastructure’’ (p.8) were the common topics founded in the textbooks.

According to the current study, both the goals of no poverty and gender equality were not expressed in both the objectives and textbooks too.

It can be drawn conclusion that whereas related SDGs with related competences in the objectives were presented in the textbook as expected. Some objectives could not be addressed in the textbooks, while some objectives could not be founded as indicated. Moreover, specified competences for corresponding objectives were also not reflected in the textbooks. Therefore, it can be suggested that related parts can be reviewed in the light of the findings.

In terms of activities related to SDGs, it may be mentioned that number of activities overall was low. Most of them were in 7th grade, while there were not founded any activity in 8th grade. Regarding the results, the number of SDGs activities can be increased in the textbooks in order to prevent students remember topic only. In this way, they can apply knowledge to other issue or contexts.

Similarly, Demirbaş (2011) pointed out that there were activities related to SD. While most of them were founded in 11th grade, the least of them were determined in 10th grade. Moreover, it was stated that the program includes sufficient number of activities. For measurement and evaluation techniques, it was detected that there was not a smooth distribution in the study and there were not placed these measurement techniques in some of the objectives. Most of measurements were given in 12th grade level.

In addition, the studies related to analysis of textbooks or curriculums in terms of SD (Boehn & Hamann, 2011; Jóhannesson et al., 2011; Lee, Ma & Lee, 2016; Mamur & Köksal, 2016; Şahin, 2016; Iliško et al., 2017; Jimenez, Lerch & Bromley, 2017; Rosyidatun, 2017; Svalfors, 2017; Guo et al., 2018; Mohammadnia & Moghadam, 2019) prove that SD, ESD and with the current study for SDGs are important concepts which should be examined to prepare citizens for future well equipped. Therefore, textbooks and curriculums can be starting point for understanding of the place of SDGs, SD and ESD in a country.

On the whole, some of SDGs are addressed in the curriculum without giving their meaning in depth. A few of competences related to SDGs are reflected in the curriculum and some of competences cannot be determined in the textbooks as indicated in the objectives of the curriculum. Most of the objectives are determined in 8^{th} grade level, so the objectives may not be distributed equally in each grade levels. Values and understanding competence just found in 7^{th} and mostly in 8^{th} grades.

Environmental dimension of SD is more dominant, while all dimensions of SD are addressed in the curriculum. Some of the objectives cannot be founded in the textbooks. SDGs related activities may not be sufficient regarding total number of activities in Science textbooks. Question is the most commonly used assessment type in the textbooks. Most of the objectives are presented in through the part of ‘‘Texts’’. Most of the objectives are determined in the area of ‘‘Living thing and life’’ in the curriculum.

5.3. Educational Implications of the Study

The findings of the study show the need of implications in order to have guides (Curriculum and Textbooks) that guide individuals who can cope with all their problems in the global world and turn them into lifestyles.

Firstly, the framework with the rubric may provide a curriculum framework to achieve all Sustainable Development with its targets and goals so these tools can help redesign of the curriculum according to not only embedding just SD but also SDGs in this global world. The rubric is just a part of primary education part. In this framework, there is not mentioned SDGs but also expected the clusters of learning competences are indicated. Knowledge is not enough to achieve SDGs itself but also skills, attitudes and values are crucial to fully adopt the issues and adopt them lifestyle since there can be faced many both economic, environmental and social problems in daily life.

However, sometimes students do not have a knowledge about the background of problems or how to behave according to these problems. SDGs contain wide range of concepts and issues related from world and daily life. Accordingly, program developers and planners should consider the competences with SDGs as well.

Moreover, the analysis of Science curriculum (2018) reveals that the curriculum may not be sufficient to address all SDGs in the objectives as well as in the textbooks. Besides, the competences were just in knowledge and understanding level as well as values and attitudes competence are reflected a few in the objective; and therefore, all competences should be reflected while redesigning of the curriculum together with the textbooks.

While addressing SDGs with competences, all three dimensions of SD should be expressed equally. Furthermore, whereas some objectives seem to have some

competences, they were not reflected in the textbooks as expected in the curriculum. In addition, a few of objectives cannot be founded in the textbook; and therefore, corrections may be made based on the findings related this issue.

Besides, there should be prepared activities (indoor or outdoor) that students can be active during learning, reading books, sources that students can reach online such as games or videos. The rubric can be used for creation of such resources. There are also exist some studies to increase the amount of sources related to SDGs. Some of them can be summarized to create reference as:

- → ‘‘The World We Want: A Guide to the Goals for Children and Young People’’ (Bardales & Arenas, 2015).
- → ‘‘Teaching The Sustainable Development Goals’’ (Awate et al., n.d.).
- → ‘‘Sustainable Foundations: A Guide for Teaching the Sustainable Development Goals’’ (Manitoba Council for International Cooperation [MCIC], 2018).

Moreover, United Nations [UN] and UNESCO have many documents related to providing of Education for Sustainable Development Goals. In addition, during the application of the curriculum in schools, teachers have an important role. From lesson plans to instruction methods, teachers should have same competences and knowledge about SDGs so there should be provided teachers in service training related concept. Moreover, preservice should be educated in the light of program provided all materials and learning area from theoretical to practical. Therefore, the rubric with framework and the findings of the study shed light on what should be done for this area.

Furthermore, mass media and parents are other important factors that shape students all life. Accordingly, parental education and programs in media that address relevant competences with issues and corresponding issues can be beneficial to complete the

process of learning cycle of students. Such education also should be included from early childhood to adult education as stated in the framework lifelong learning (Osman et al., 2017). Based on the analysis, primary education should be strengthening accordingly and other education levels should be supported to achieve learning and understanding during life time.

5.4. Recommendations for Further Studies

In the light of the results of the study, there are made some recommendations for future researches as:

- ⇒ The study is conducted with content analysis. During analysis of the data, there can be applied more expert opinion to increase trustworthiness of the study.
- ⇒ The study was conducted based on Middle School Science Curriculum. Other studies can be conducted based on other educational parts (e.g. secondary education) in the framework
- ⇒ Same study can be also conducted for other curriculums such as chemistry, social science etc.
- ⇒ On the basis of the rubric, there can be created survey to evaluate students understanding of SDGs
- ⇒ Moreover, the same rubric can be used for examination of lesson plans of teachers as well and through well-developed surveys, teachers (pre or in service) knowledge, skill and values can be evaluated based on the study.

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APPENDICES

A. The Adopted Rubric (Osman et al., 2017)

Goal 1 –No Poverty (G1.)
Knowledge and understanding
K.1.Explore the complex issues of poverty to understand the interconnected world we live in
K.2. Concept of poverty, from an individual understanding within local context to a global perspective examining the extent of poverty in Commonwealth countries
K.3.Differences in economic, demographic and social characteristics between countries across the world
K.4.Causes of global poverty and inequality
K.5.Conditions of poverty due to lack of food, poor sanitation and other losses of services
K.6.Learning about the different concepts of poverty, and what life is like for people living in poverty
Skills and applications
S.1.Application of critical thinking for analysis of poverty and related issues through simulations, discussions, challenging assumptions, developing supporting arguments, and sharing and evaluating information, experiences and opinions
S.2.Learning supported by teamwork and co-operation, discussion and reflection, and the application of different methods (e.g. statistical analysis and persuasive writing) to examine and interpret poverty in the world around them
S.3.Understand the possibility of change and develop actions that support this change
S.4.Development of basic financial literacy skills
Values and attitudes
V.1.Awareness of the multiple causes of poverty
V.2.Qualities of empathy and understanding, sensitivity to the issues of poverty and inequalities, identification of personal biases regarding poverty, and acceptance of differences
V.3.Recognize people's common humanity and what can be learnt from others
V.4.Willingness to explore solutions and confidence that extreme poverty can be overcome in the learner's own lifetime
V.5.Action-oriented in furthering awareness
V.6.Placing value on education and financial management

Goal 2-Zero Hunger (G2.)
Knowledge and understanding
K.1.Nutrition education that combines classroom learning with practical learning activities (e.g. growing fruits and vegetables in school gardens, preparing food, planning meals, practicing personal hygiene, improving school meals and keeping a clean safe school environment)
K.2.Gardening activities, combined with eating the foods produced and learning about healthy dietary practices
K.3.Defining hunger and malnutrition
K.4.Explore the definition and problems of hunger, malnutrition and food insecurity
K.5.Food security, livelihood and gender inequality
K.6.Where different foods come from: fruits, vegetables, dairy, meat Follow food from the farm to the pot
K.7.Storing food: fresh, tinned, dried, frozen
Skills and applications
S.1.Distinguish between food groups and types of food to eat and why, and establish a balanced diet. Create mindful eating plan and commit to making changes in personal eating and buying habits
S.2.Ability to read labels and ingredient lists, and how to interpret health claims
S.3.Identify and access healthy alternatives to fast food
S.4.Apply healthy eating concepts to avoid food-related illnesses e.g. obesity or diabetes, including ability to distinguish between portion and serving size
Values and attitudes
V.1.Adopt healthy lifestyles and mindful eating habits beyond school and into adulthood
V.2.Willingness to find solutions to food insecurity and malnutrition
V.3.Appreciate indigenous or local perspectives on ways of living together and using resources sustainably
V.4.See every individual as a powerful agent of change to sustain the food system
V.5.Share learning with friends, family and community
V.6.Positive attitudes and skills that pave the way for carrying healthy habits beyond school and into adulthood
V.7.Taking responsibility for personal health
Goal 3- Good health and well-being (G3.)
Knowledge and understanding
K.1.Learning to address personal and food hygiene and sanitation, and disease and infection transmission/control
K.2.Understanding healthy eating and nutrition

K.3.Engage in various activities for health, fun, and development of motor skills
K.4.Physical literacy to establish a basis for lifelong physical activity and active living
K.5.Learning about pressures and harmful behaviors, and ways to resist them
K.6.Emergency preparedness, evacuation drills, first aid
K.7.Pedestrian and cycling safety
K.8.Basic understanding of physical and mental health conditions and disabilities, risk factors, etc., including non-communicable diseases
K.9.Antiviolence and bullying prevention
K.10.Learning about mental and emotional health, and sexual and reproductive health and rights
Skills and applications
S.1.Application of understanding to real life, such as personal hygiene and sanitation, and healthy living (e.g. food choices and exercise)
S.2.Ability to communicate healthy living practices to family and community
S.3.Ability to access information for informed decision making and application for positive and healthy behaviors (e.g. in relation to sexual and reproductive health, food and hygiene choices, participation in sport)
S.4.Ability to identify positive and negative influences, analyses risks, and make informed decisions
S.5.Coping, social and cognitive skills in managing personal health and well-being
S.6.Ability to express feelings in a healthy way, use self-control and impulse control, manage emotional and physical stress, and seek assistance if necessary
Values and attitudes
V.1.Responsibility for personal health and well-being, placing value on personal hygiene and sanitation, good nutrition, physical activity, and reducing risks to physical and mental health
V.2.Establishment of positive eating and fitness habits
V.3.Empowerment to take action and recognizing the ability to promote understanding and healthy practices to others
V.4.Positive attitudes toward self, and acceptance of responsibility for personal sexuality
V.5.Independent decision making that analyses health and well-being influences and risks, and respects human rights (e.g. resisting peer pressure in bullying)
V.6.Tolerance, respect and understanding of others' differences and emotions
Goal 4- Quality education (G4.)
Knowledge and understanding
K.1.My right to schooling
K.2.My responsibility to work hard
K.3.Why learning is important in my life

K.4.What I want to be when I leave school
K.5.Education in other parts of the world
K.6.Introduction to the SDGs as a set of targets with the aim of ending extreme poverty for everyone and tackling climate change
Skills and applications
S.1.Demonstrate appropriate schooling behaviors
S.2.Identify own learning needs for personal development
S.3.Make connections between own lives and those of others throughout the world
S.4.Learning to learn
S.5.Critical and engaged approach towards learning
Values and attitudes
V.1.Self-disciplined, self-reliant and integrated citizen
V.2.Values of gratitude and appreciation
V.3.Rights and responsibilities
V.4.Valuing quality education for all
V.5.Appreciate access to education
V.6.Empathy with children who do not have access to schooling
V.7.Appreciation and respect for diversity
Goal 5- Gender equality(G5.)
Knowledge and understanding
K.1.Gender roles as social constructs
K.2.Distinguish between biological sex, gender identity and gender expression
K.3.Separate adjectives, jobs, domestic duties and childcare responsibilities into female, male and gender-neutral sets
K.4.The impact of gender roles on the identity and rights of girls and boys
K.5.Meaning of the terms ‘rights’ and ‘equality’
K.6.Learn from case studies from different Commonwealth countries
Skills and applications
S.1.Analyze how gender affects everyday lives and devise solutions for any challenges
S.2.Take equal responsibility in classrooms and school activities
S.3.Analyze basic information on gender inequality worldwide
S.4.Analyze norms that hamper gender inequality
S.5.Think critically about socially ascribed gender roles and stereotypes in jobs, sports and the family
S.6.Identify issues of gender inequality in the school or community on which pupils could take action
S.7.Develop positive notions of gender

Values and attitudes
V.1.Girls and boys respect each other
V.2.Advocate for a harassment-free school or learning environment
V.3.Shared responsibility between boys and girls in classrooms and school activities
V.4.Girls and boys participate in extracurricular activities
V.5.Awareness of cultural practices that affect girls' and women's rights in society
V.6.Gender equality and empowered women and girls
V.7.Degendered understanding of professions, sports and family roles
V.8.Exercise later in life, active citizenship and claim rights relating to gender equality
Goal 6-Clean water and sanitation (G6.)
Knowledge and understanding
K.1.Use of water in domestic activities for cleanliness, hygiene, relaxation and food preparation, and formation of daily habits, routines and lifestyles
K.2.Deconstructing the routines, habits and lifestyles in which water plays a part, and the influence of peers, family and social norms on water use
K.3.Principle of water abundance v. water scarcity, both physical and economic, and as a finite resource
K.4.Potential effects of dirty water: poor health, increased hunger, poverty and lack of access to education
K.5.Water resources and utilization by humans (agriculture, industrial, domestic, recreational, fisheries)
K.6.Safe disposal of wastewater, human excreta, solid waste
K.7.Household sanitation and food hygiene
K.8.Basic understanding of water science –hydrology, the hydrologic cycle and connection to climate change
Skills and applications
S.1.Understanding and conscious water consumption
S.2.Understanding of water-related issues for behavioral changes
S.3.Understanding of water scarcity and abundance
S.4.Conceptualizing water flowing through landscape scale systems
S.5.Apply understanding of the structure of watershed to explain the movement of water and other substances
S.6.Ability to interpret common representations, such as maps of waterways
S.7.Safe handling of drinking water
S.8.Understanding how water moves through environmental systems, interacts with other substances, dissolves and moves certain substances underground

Values and attitudes
V.1.Responsible and sustainable consumption
V.2. Motivation to change patterns of unsustainable consumption
V.3. Understand appropriate personal hygiene; washing hands, brushing teeth. etc.
V.4.Safe use of toilets and urinals ,including cleansing and washing
V.5.Responsible and sustainable consumption
V.6.Motivation to change patterns of unsustainable consumption
V.7.Link collection and treatment of solid waste with overall health risks
V.9.Sensitized to the ways that water is borrowed from and returned to nature through human activities
V.10.Making informed decisions about water at an individual or societal level
V.11.Participate in community decisions about how to manage landfills
Goal 7-Affordable and clean energy (G7.)
Knowledge and understanding
K.1.Basic concepts of energy and consumptive uses (e.g. powering cars)
K.2.Different forms of energy production (e.g. fossil fuels, wind energy, etc.), associated technologies, and why different forms of energy production are best used in different geographies and contexts
K.3.Introduction to the concept of global warming and how it links to human energy production and consumption
Skills and applications
S.1.Act as an energy monitor (including in the classroom)
S.2.Identification and practice of actions and choices for sustainable and safe living
S.3.Uses of alternative energy at home, school and in the wider community (e.g. solar energy for cooking and heating)
S.4.Application of simple calculations and analysis of different energy choices and uses (e.g. efficiency and cost analysis)
Values and attitudes
V.1.Environmentally sound ethics
V.2.Commitment to energy conservation
V.3.Daily living habits and behaviors for sustainable living
V.4.Consumptive behavioral change
V.5.Reuse items such as plastic bags, glass jars, plastic containers, envelopes and paper
Goal 8-Decenth work and economic growth (G8.)
Knowledge and understanding
K.1.Job classifications
K.2.Jobs in the school, community, etc.

K.3.People who care
K.4.Why people work
K.5.Work, employment, unemployment, self-employment and enterprise
K.6.Social enterprise
K.7.The SDGs
K.8.What it means to combat inequality
Skills and applications
S.1.Explain the different kinds of jobs in other parts of the world
S.2.Exploring solutions for inequality
S.3.Access and opportunity for all
S.4.Holding meetings, budgeting, making rules and selling products through role play
Values and attitudes
V.1.Appreciation of the multifaceted nature of the world/surroundings
V.2.Value/appreciate the resources and services available
V.3.Gratitude
V.4.Finding positive solutions
V.5.Learn to value the different forms of work including paid work, unpaid care work, voluntary work and creative expression
Goal 9-Industry, innovation and infrastructure (G9.)
Knowledge and understanding
K.1.Understanding of different types of infrastructure and their uses (e.g. transport, energy, utilities)
K.2.Concepts of sustainability, industry, economic development, human well-being
K.3.Understanding the economic, environmental and social benefits and challenges of different types of infrastructure and industry
K.4.Hard (e.g. roadways, buildings) and soft infrastructure (e.g. financial systems, hospitals, schools)
K.5.Computer literacy
Skills and applications
S.1.Ability to identify different community places and their purposes
S.2.Ability to identify different sources of energy used in communities
S.3.Understanding that sources of energy are not sustainable
S.4.Computer skills for research, word processing, etc.
S.5.Information management
S.6.Ability to analyses the benefits and drawbacks of different forms of infrastructure and industry

Values and attitudes
V.1.Focus on sustainability
V.2.Inquisitive
V.3.Value well-being and economic resilience
V.4.Affordable and equitable access for all
V.5.Willingness to explore
V.6.Use of experiences to understand theories
V.7.Appreciation for provision of public services
Goal 10- Reduced inequalities (G10.)
Knowledge and understanding
K.1.Basic understanding of fairness and equality in the world (e.g. through sport and games as relatable examples)
K.2.Links between education and inequality – education as both a factor that conditions inequalities later in life (e.g. access to formal jobs) and a powerful instrument for advancing equity, and impact on income
K.3.Unpacking stereotypes regarding gender, religion and race
K.4.Ratios using inequality statistics, e.g. the number of disabled people in work compared with non-disabled people, or the number of women on boards compared with men
Skills and applications
S.1.Application of knowledge to reflect on and analyze real world issues (e.g. factors that may affect a country's participation/success in an Olympic sport
S.2.Express views on why a particular inequality is bad and develop solutions for changing the situation
S.3.Analyze issues affecting the lives of people in local and global contexts
Values and attitudes
V.1.Respect for others and diversity
V.2.Empathies with people's situations
V.3.Value of education as a tool for progress and empowerment
V.4.Willingness to take action and advocate equal access to education globally
V.5.Empathy and tolerance
V.6.Appreciate the feelings of people involved in negative experiences
Goal 11- Sustainable cities and communities (G11.)
Knowledge and understanding
K.1.The nature and components of cities and our basic needs: food, housing, energy, transport and water
K.2.Understanding of warnings and disaster preparedness
K.3.Ways in which green spaces and nature are integrated in the community

K.4.Participatory design of city parks, playgrounds, large-scale public spaces, open spaces
K.5.Local ecosystems and accessible examples of sustainable lifestyles
K.6.Investigation of the urban environment, urban design and planning
K.7.Urban environmental education
K.8.DRR (Disaster Risk Reduction) and management
Skills and applications
S.1.Ability to care for parts of cities and human settlements (e.g. starting a community vegetable garden)
S.2.Collaborative learning and engagement
S.3.Multicultural nature of cities/towns
S.4.Innovations for urban environments
S.5.Disaster preparedness
Values and attitudes
V.1.Awareness of the importance of sustaining the natural environment
V.2.Creative self-expression
V.3.Application of diversity
V.4.Environmental consciousness
V.5.Appreciation of safe spaces and security
Goal 12-Responsible consumption and production (G12.)
Knowledge and understanding
K.1.Sustainable and unsustainable consumption, including resource use, waste generation and disposal, and environmental and health impacts
K.2.Further understanding of the ‘4 Rs’
K.3.Identify examples or irresponsible and unsustainable consumption and production both locally and globally
K.4.Understand impact of consumptive choices (e.g. diet)
K.5.Participatory learning
K.6.Explore how technology can be harnessed and used to support responsible consumption and production
K.7.Calculate and compare Ecological Footprints
Skills and applications
S.1.Distinguishing between and analyzing consumer impacts and risks of different choices (e.g. discovering what products are made of, decomposition times, where waste goes)
S.2.Participating in recycling, composting and other environmental schemes
S.3.Analyze carbon and methane impacts of diet and food purchasing behavior
S.4.Food chain analysis (e.g. family food purchasing behavior and impacts)

S.5.Understand the challenges facing the planet and the need for more responsible consumption and production patterns
S.6.Understand how fast resources are consumed and waste is generated
Values and attitudes
V.1.Appreciation of the need to reduce harm, of impact and of finite resources
V.2.Adoption of non-wasteful behaviors (e.g. reduce packaging, use compost, seek environmentally friendly options)
V.3.Awareness of environmental/health risks, and benefits of safe disposal
V.4.Informed purchasing (product lifecycle implications)
V.5.Consumer awareness and commitment to sustainable choices
V.6.Prepared to take action to bring about change and reduce the Ecological Footprints
Goal 13- Climate action (G13.)
Knowledge and understanding
K.1.Understanding of and preparedness for natural disasters (e.g. floods, tsunamis, earthquakes)
K.2.Basic understanding of climate science (e.g. carbon cycles, greenhouse gas effects) and physical impacts (e.g. sea-level rise, extreme weather)
K.3.Foundation in economic, environmental and social concepts of climate change, and how it relates to human lives (e.g. health, energy, food production)
K.4.Exploration of traditional/indigenous knowledge and culture
K.5.Concepts of climate mitigation and adaptation, resilience, sustainable development
Skills and applications
S.1.Natural-disaster preparedness
S.2.Ability to describe the causes and effects of climate change
S.3.Understand and distinguish climate change impact in relation to self/context
S.4.Analyze impacts and vulnerability in key sectors due to climate change
S.5.Impact analysis (e.g. interpret maps, graphs and statistics) across spatial and temporal scales
S.6. Understanding issues of equity and climate justice
S.7.Differentiate between adaptation and mitigation measures, and employ creative solution-finding skills
Values and attitudes
V.1.Awareness of the impacts of human activities and consequences of personal actions
V.2.Concern for and responsibility for living organisms and their environment
V.3.Motivation to make informed decisions and take responsible action
V.4.Awareness of different impacts (e.g. geographic, socio-economic)
V.5.Global citizenship

V.6.Appreciation of traditional cultures
Goal 14-Life below water (G14.)
Knowledge and understanding
K.1.Introduction to understanding the role of the ocean (e.g. moderating climate, providing oxygen and food, medicine, energy and minerals)
K.2.Introduction to ocean zones, and marine plants and animals, their habitats and behaviors
K.3.Knowledge of ocean animals and adaptation
K.4.Introduction to recognizing the global context of challenges for local fisheries and how this affects fishermen's livelihoods
Skills and applications
S.1.Application of critical thinking skills to investigate threatened or endangered species, and conducting surveys or interviews with fishermen and fish processors to develop potential solutions to the challenges faced
S.2.Application of concepts to investigate how ocean animals adapt to certain parts of their environment to develop potential solutions on how to protect oceans
Values and attitudes
V.1.Awareness and appreciation of, and respect for, the environment and nature, oceans and marine life, their fruitfulness and the need to care for these resources
V.2.Show concern and responsibility for living organisms and their environment, including endangered species
V.3.Awareness and behavioral change towards more sustainable practices during daily life
Goal 15- Life on land (G15.)
Knowledge and understanding
K.1.Basic understanding of forest ecosystems, freshwater ecosystems, ecosystem health and consequences of human impact
K.2.Understand the importance of biodiversity and threats to biodiversity, habitat loss; concept of endangered species
Skills and applications
S.1.Ability to communicate the importance of terrestrial ecosystems
S.2.Analyze impacts and risks associated with biodiversity loss and ecosystem degradation
S.3.Beginning to apply systems thinking to understand ecosystem interdependencies (e.g. deforestation leads to habitat loss)
Values and attitudes
V.1.Appreciation for the need to conserve biodiversity
V.2.Basic understanding of rights of other species, and valuing the interdependence of species

Goal 16- Peace, justice and strong institutions (G16.)
Knowledge and understanding
K.1.Linking to the expressive arts, pupils develop imaginative and creative ways of expressing some of their own commitments, including working hard at sport or music, caring for animals and the environment, loving their family or serving God
K.2.Diversity of national and international religious and ethnic identities; the need for mutual respect and understanding at global level
K.3. Religious and cultural literacy
Skills and applications
S.1.Skills of enquiry: contribution to discussions and debates
S.2.Ability to challenge injustice and inequality
S.3.Learn to weigh up the value of wisdom from different sources, to develop and express insights in response, and to agree or disagree respectfully
S.4.Application of critical thinking skills to describe, explain and analyze beliefs, practices and different ways of life
S.5.Research and evaluation of global issues related to religion, culture, identity and peace
Values and attitudes
V.1.Appreciation of experiences of others
V.2.Value co-operation
V.3.Empathy and open-mindedness
V.4.Sense of identity and self-esteem
V.5.Belief that people can make a difference
V.6.Participation in society and civic responsibility
V.7.Confidence in beliefs and values, respect for religious and cultural differences, and willingness to contribute to a cohesive and compassionate society
V.8.Appreciate the significance and impact of different ways of life
V.9.Value justice, freedom, equality and well-being
Goal 17- Partnerships for the goals (G17.)
Knowledge and understanding
K.1.Creative collaboration to work in teams to design a mini-project to support better partnerships later in life
Skills and applications
S.1.Critical thinking, analytical enquiry, numerical skills, basic statistical analysis
S.2.Arguing a viewpoint other than one’s own
S.3.Communicating ideas, listening to others, working with others to solve problems
S.4.Team building and negotiation skills
Values and attitudes

V.1.Empathizing with others. Advocating policy change at local and/or national level, and taking informed and responsible action
V.2.Personal, social and emotional development. Children understand that they can expect respect; work as part of a group, taking turns and sharing fairly, and understand that groups of people, including adults and children, need values and codes of behavior to work together harmoniously
V.3.Show sensitivity to others' needs and feelings

(Source: Osman et. al, 2017)

K: Knowledge and understanding

S: Skills and applications

V: Value and attitudes

B. UN SDGs with 169 Targets (Sustainable Development Goals Knowledge Platform, n.d.; UN, n.d.; UN, 2015)

SDG 1- No Poverty
Top target of specified goal of UN SDGs
End poverty in all its forms everywhere
Explanation
Poverty can be described as living far away from sustainable lifestyle including as: low income, deficient in resources, lack of basic services, malnutrition, restricted education, inequality in society, discrimination and exclusion, not having sustainable jobs, lack of social protection system and not able to take decision in the society as well
Targets
1.1. By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day 1.2. By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions 1.3. Implement nationally appropriate social protection systems and measures for all, including floors, and by 2030 achieve substantial coverage of the poor and the vulnerable 1.4. By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance 1.5. By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters 1.a. Ensure significant mobilization of resources from a variety of sources, including through enhanced development cooperation, in order to provide adequate and predictable means for developing countries, in particular least developed countries, to implement programmes and policies to end poverty in all its dimensions 1.b.Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions

SDG 2-Zero Hunger
Top target of specified goal of UN SDGs
End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Explanation
Growing and then consuming food should be rethought while protecting environment and in this process, there can occur some damage to soil, forests, water and even if to biodiversity and as a result, it results in degradation in the land. Beside, climate change has an effective role in this process with floods or droughts. Then, this leads to not able to meet their nutrition as malnutrition and food insecurity in especially poor and rural areas. The situation in these societies who overcome hunger can be decreased with help of sustainable agriculture, agriculture productivity and systems and also agriculture practices for resilient for disasters. And the goal can be clearly defined as equal access to sufficient and safe food for all with suitable price and also access to land
Targets
2.1.By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round 2.2.By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons 2.3.By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment 2.4.By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality 2.5.By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of

benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed

2.a.Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries

2.b.Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round

2.c.Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility

SDG 3-Good health and well-being

Top target of specified goal of UN SDGs

Ensure healthy lives and promote well-being for all at all ages

Explanation

Decreasing maternal mortality and also deaths of children come forward in the goal so there occurs some requirement as improvement delivery care and technology and also some arrangements in health systems. Besides, the increment on consciousness in the issue of hygiene and sanitation and also some improvement in such subject in the society are targeted in addition to being accessible to doctor. Another important topic is to decrease on pollution in the environment to provide healthy life for millions of people and prevent and combat severe diseases. In addition, the some precautions should be taken on substance abuse and people can reach necessary medicines and also vaccines as well

Targets

3.1.By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births

3.2.By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births

3.3.By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases

3.4. By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being
3.5. Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol
3.6. By 2020, halve the number of global deaths and injuries from road traffic accidents
3.7. By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes
3.8. Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all
3.9. By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination
3.a. Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate
3.b. Support the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all
3.c. Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States
3.d. Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks

SDG 4-Quality Education

Top target of specified goal of UN SDGs

Ensure inclusive and equitable quality education and promote life -long learning opportunities for all

Explanation

Quality education is the basics of sustainable development since equipping knowledge will help to overcome problems and bring solutions and it will increase welfare along with increasing income and conscious people. Quality education consists of not only attending the schools but also gaining skills and improving of basic literacy. Providing such education to everyone and to all gender equally are main target. To fulfill such goal ,there occurs need of providing other requirement such as school conditions, scholarship and well-trained teachers by taking consideration especially the rural areas

Targets

4.1.By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes

4.2.By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education

4.3.By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university

4.4.By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship

4.5.By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations

4.6.By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy

4.7.By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development

4.a.Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all

4.b.By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology,

technical, engineering and scientific programmes, in developed countries and other developing countries

4.c..By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States

SDG 5-Gender Equality

Top target of specified goal of UN SDGs

Achieve gender equality and empower all women and girls

Explanation

Equality is the way of sustainable development due to creating peaceful world together with protecting basic human rights. The main problems in this issue can be summarized as child marriage, harassment both sexually and physically, violence and discrimination. Therefore, eradication in these inequalities need to begin in education accessibility, finding job and workplace, decision making, laws ,all type of resources ,basic services, technology and in health care.

Targets

5.1. End all forms of discrimination against all women and girls everywhere

5.2. Eliminate all forms of violence against all women and girls in the public and private spheres, including trafficking and sexual and other types of exploitation

5.3. Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation

5.4. Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate

5.5. Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life

5.6. Ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the International Conference on Population and Development and the Beijing Platform for Action and the outcome documents of their review conferences

5.a. Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws

5.b. Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women

5.c.Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels

SDG 6-Clean Water and Sanitation

Top target of specified goal of UN SDGs

Ensure availability and sustainable management of water and sanitation for all

Explanation

In the global world, still it is possible to encounter water related problems like hygiene, sanitation, drought or supplying of water. All these problems are actually result of lacking of needed infrastructure and weak economy. Then they at the end affect life quality and resulted in affecting millions of people from diseases. Moreover, food security, opportunities to access education and even if lifestyle can be influenced with shortage of water, insufficient hygiene, sanitation and accessible usable water. In the world, most of people have a difficulty in fresh water and its resources. In addition to such reality, drought has an important portion on causing hunger and malnutrition since all these events can be said linked to each other. These scenarios can be prevented with improvement in sanitation, efficient use of water, minimizing waste water, protecting water related resources and related system providing fresh water

Targets

6.1. By 2030, achieve universal and equitable access to safe and affordable drinking water for all

6.2. By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3. By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

6.4. By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5. By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6. By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

6.a. By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.b.Support and strengthen the participation of local communities in improving water and sanitation management

SDG 7-Affordable and Clean Energy

Top target of specified goal of UN SDGs

Ensure access to affordable, reliable, sustainable and modern energy for all

Explanation

Energy is as important as finding job, production of food or economy. That it is important to boosting usage of renewable energy usage which has a particularly effect on environment and effective use of energy and providing it equally for all is crucial to keep on sustainability and raising of environment resilience to any disasters. On the other hand, reverse energy usage will lead to impact both economy, environment, health and lifestyle. One of them is pollution because most of people still continue to use of unclean type of energy such as coal and today technological world, some of people cannot use energy. Some solutions seen to prevent challenges are usage of renewable energy with modern technology and it can be applied to all areas as industries, constructs, transports etc. but the equity should be considered in this progress

Targets

7.1. By 2030, ensure universal access to affordable, reliable and modern energy services

7.2. By 2030, increase substantially the share of renewable energy in the global energy mix

7.3. By 2030, double the global rate of improvement in energy efficiency

7.a. By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

7.b.By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support

SDG 8-Decent Work and Economic Growth
Top target of specified goal of UN SDGs
Promote inclusive and sustainable economic growth ,employment and decent work all
Explanation
Still most of people try to continue their life with low income and some of them are unemployed. And raising of unemployment rate and non-guaranteed job findings drift people to poverty so the policies on social and economic need to be rethought. Lower salaries cause people live under living conditions. Also, productivity of labor and not enough work opportunities conclude with increasing the unemployment rate. Then the such case will also affect the economic growth .The better economy can be supplied by providing and encouraging of investment ,trade and infrastructure in agriculture to everyone with paying equally and supplying productive working environment conditions considering labor rights
Targets
8.1. Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries 8.2. Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors 8.3. Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services 8.4. Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead 8.5. By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value 8.6. By 2020, substantially reduce the proportion of youth not in employment, education or training 8.7. Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination

of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms

8.8. Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment

8.9. By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products

8.10. Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all

8.a. Increase Aid for Trade support for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries

8.b.By 2020, develop and operationalize a global strategy for youth employment and implement the Global Jobs Pact of the International Labour Organization

SDG 9 -Industries, Innovations and Infrastructure

Top target of specified goal of UN SDGs

Build resilient infrastructure, promote sustainable industrialization and foster innovation

Explanation

Community needs some basic need to keep on their lives accurately such as transport, technology, infrastructure, and energy etc. Like them, production in industries constructs the heart of growth of economy together with employment. In addition to production, carbon dioxide emission is another outcome of industries since expectation on declining emission is not at the expected level. Therefore, there occurs necessity of sustainability in this areas with necessary resilient practices and precautions. In that point, technology and innovation has critical role for continuity of development since both factors will help of preventing environmental impacts and increase efficiency in resource and energy usage. Moreover, same approach require for infrastructure which is more sustainable and resilient

Targets

9.1. Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all

9.2. Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries

9.3. Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets 9.4. By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities 9.5. Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending 9.a. Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States 9.b. Support domestic technology development, research and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities 9.c. Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020
SDG 10-Reduced Inequalities
Top target of specified goal of UN SDGs
Reduce inequality within and among countries
Explanation
Maintaining stereotypes in society as rich and poor ones and disparities among those people will meet the same manner in health, education, property, income and other services. All of these inequalities that is one of the reason of poverty can be prevented by focusing on the groups who are disadvantages and poor and also policies should reshape considering these results. And inequalities can be summarized as inequality in sex, race, ethnicity, religion ,status, law, policies, migration, health ,education, prosperity ,resources , food etc.
Targets
10.1. By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average

10.2. By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status
10.3. Ensure equal opportunity and reduce inequalities of outcome, including by eliminating discriminatory laws, policies and practices and promoting appropriate legislation, policies and action in this regard
10.4. Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality
10.5. Improve the regulation and monitoring of global financial markets and institutions and strengthen the implementation of such regulations
10.6. Ensure enhanced representation and voice for developing countries in decision-making in global international economic and financial institutions in order to deliver more effective, credible, accountable and legitimate institutions
10.7. Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies
10.a. Implement the principle of special and differential treatment for developing countries, in particular least developed countries, in accordance with World Trade Organization agreements
10.b. Encourage official development assistance and financial flows, including foreign direct investment, to States where the need is greatest, in particular least developed countries, African countries, small island developing States and landlocked developing countries, in accordance with their national plans and programmes
10.c. By 2030, reduce to less than 3 per cent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 per cent

SDG 11-Sustainable cities and communities

Top target of specified goal of UN SDGs

Make cities inclusive, safe, resilient and sustainable

Explanation

Cities where most of people living and sharing norms can be efficient and suitable places for all on social and economic areas and these locations bring together urbanization problems as well so there need to be good and sustainable construction planning that consists of sustainable cities and resilient constructions for any disasters and management of cities. Besides, together with settlement in cities can emerge problems as land degradation and resource deficiency .In general the main issues in these places are meeting of basic services, transport ,decent shelter for all ,adequate infrastructure ,pollution , energy and crowd etc. .Another

facing problem is waste management so authorities have responsibilities for supplying such service to all with good infrastructure and systems and by decreasing level of impact of cities on environment
Targets
11.1. By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums 11.2. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons 11.3. By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries 11.4. Strengthen efforts to protect and safeguard the world's cultural and natural heritage 11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations 11.6. By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management 11.7. By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities 11.a. Support positive economic, social and environmental links between urban, per-urban and rural areas by strengthening national and regional development planning 11.b. By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015-2030, holistic disaster risk management at all levels 11.c. Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

SDG 12-Responsible Consumption and Production
Top target of specified goal of UN SDGs
Ensure sustainable consumption and production
Explanation
Responsible consumption and production can be equal to sustainable one and it is directly related with other subjects such as resource supporting, efficient usage of energy, adequate infrastructure, accessibility of basic services, or job opportunities. The best application of such needs will result in reduction of poverty, strength of economy and social relationships. Furthermore, continuing increment on natural resource consumption is raising. When reduction in pollution, land degradation, resource usage and also degradation of lands is actualized, it will also positive effect on both economy and life quality. For consumer part, they should be educated about sustainable consumption and also lifestyles. On the whole , reduction, recycling and reuse should be tried to provide continuity to prevent human impact with sustainable way and such approach should be applied in chemical usage by taking into account its impact to environment
Targets
12.1. Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries 12.2. By 2030, achieve the sustainable management and efficient use of natural resources 12.3. By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses 12.4. By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment 12.5. By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse 12.6. Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle 12.7. Promote public procurement practices that are sustainable, in accordance with national policies and priorities

12.8. By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
12.a. Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production
12.b. Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products
12.c. Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities

SDG 13-Climate Action

Top target of specified goal of UN SDGs

Take urgent action to combat climate change and its impacts

Explanation

Climate change is main concern of global world. It has not local but also global effects and some of these effects are economy disruption, sea level raising, changes in weather patterns. Also, greenhouse gas emission is at top level. All these cases raise temperature and its consequences will especially have an influential effect on poor people. Some precautions to these problems are renewable energy preference, decreasing of emissions, and adaptation practices. One of this adaptation is Paris Agreement that aims to decline of temperature. For this purpose, there should be given education about climate change and way of overcoming its effects. Besides, all countries should have planning and strategies on resilient to climate change and disasters

Targets

13.1. Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries
13.2. Integrate climate change measures into national policies, strategies and planning
13.3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning
13.a. Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the

needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible

13.b. Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

SDG 14-Life Below Water
Top target of specified goal of UN SDGs
Conserve and sustainably use oceans, seas and marine resources
Explanation
Seas, oceans, rivers, lakes and so on are actually beginning and source of life since from beginning of human life, it has a role of supplying and regulating food, oxygen, drinkable water, shorelines. Not only these regulations are provided but also they contain within their inside a huge ecosystem with its temperature, chemistry or currents. If there want to keep the balance in these ecosystems and continue to other generations , there occurs need of sustainable management and use of its sources but in current time ,humankind still disrupt this balance by creating pollution and increasing acidification in these places .All of these events will impact again human especially for fisheries and also biodiversity of these ecosystems .Therefore , when thinking these consequences ,there requires precautions for particularly on overfishing ,pollution and acidification of these water sources by thinking of life below the water
Targets
14.1 By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution 14.2. By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans 14.3. Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels 14.4. By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics

14.5. By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information
14.6. By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation
14.7. By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation
14.a. Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries
14.b. Provide access for small-scale artisanal fishers to marine resources and markets
14.c. Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want

SDG 15-Life on Land

Top target of specified goal of UN SDGs

Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

Explanation

Forest ecosystem is source of shelter at the same time source of food. Moreover, these ecosystems contribute struggling with climate change and protecting the biodiversity in this system. Consequently, conservation of forests will return as protection of natural resources and land degradation. Although this important place of forests in our life, there is a continuing corruption in lands together with desertification so it threats biodiversity and endangered species as well. Mostly

affected people are poor ones from this events such as desertification due to usage of lands for agriculture above from its capacity and deforestation as two important topics in the global world which are products of climate change and the effects of human to nature. Even though these corruptions, some studies are made to prevent these consequences before meeting irrepressible results

Targets

15.1. By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

15.2. By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally

15.3. By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world

15.4. By 2030, ensure the conservation of mountain ecosystems, including their biodiversity, in order to enhance their capacity to provide benefits that are essential for sustainable development

15.5. Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

15.6. Promote fair and equitable sharing of the benefits arising from the utilization of genetic resources and promote appropriate access to such resources, as internationally agreed

15.7. Take urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products

15.8. By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species

15.9. By 2020, integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts

15.a. Mobilize and significantly increase financial resources from all sources to conserve and sustainably use biodiversity and ecosystems

15.b. Mobilize significant resources from all sources and at all levels to finance sustainable forest management and provide adequate incentives to developing countries to advance such management, including for conservation and reforestation

15.c. Enhance global support for efforts to combat poaching and trafficking of protected species, including by increasing the capacity of local communities to pursue sustainable livelihood opportunities

SDG 16-Peace,Justice and Strong Institutions

Top target of specified goal of UN SDGs

Promote justice ,peaceful and inclusive societies

Explanation

For construction of peaceful and inclusive societies, violence trafficking, homicide etc. should be at low level. Besides, justice should be priority of all institutions and these institutions should be accessible for everyone but according to findings, violence, harassment and suicide still continue so there can made policies or regulations or preventative practices for these problems regarding of human rights

Targets

16.1. Significantly reduce all forms of violence and related death rates everywhere

16.2. End abuse, exploitation, trafficking and all forms of violence against and torture of children

16.3. Promote the rule of law at the national and international levels and ensure equal access to justice for all

16.4. By 2030, significantly reduce illicit financial and arms flows, strengthen the recovery and return of stolen assets and combat all forms of organized crime

16.5. Substantially reduce corruption and bribery in all their forms

16.6. Develop effective, accountable and transparent institutions at all levels

16.7. Ensure responsive, inclusive, participatory and representative decision-making at all levels

16.8. Broaden and strengthen the participation of developing countries in the institutions of global governance

16.9. By 2030, provide legal identity for all, including birth registration

16.10. Ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements

16.a. Strengthen relevant national institutions, including through international cooperation, for building capacity at all levels, in particular in developing countries, to prevent violence and combat terrorism and crime

16.b.Promote and enforce non-discriminatory laws and policies for sustainable development

SDG 17-Partnerships for the Goals
Top target of specified goal of UN SDGs
Revitalize the global partnerships for sustainable development
Explanation
For implementation of all sustainable development goals (SDGs) effectively, all level which is from local to global and from private sectors to government should work in cooperation. And first step for this aim is to put clear goals and visions for implementation of SDGs by all sectors. Then, investments form second step of this goal and the investments should have made in all sectors in technology, energy, technology, information etc.
Targets
FINANCE 17.1. Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection 17.2. Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent of ODA/GNI to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries 17.3. Mobilize additional financial resources for developing countries from multiple sources 17.4. Assist developing countries in attaining long-term debt sustainability through coordinated policies aimed at fostering debt financing, debt relief and debt restructuring, as appropriate, and address the external debt of highly indebted poor countries to reduce debt distress 17.5. Adopt and implement investment promotion regimes for least developed countries TECHNOLOGY 17.6. Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level, and through a global technology facilitation mechanism 17.7. Promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed

17.8. Fully operationalize the technology bank and science, technology and innovation capacity-building mechanism for least developed countries by 2017 and enhance the use of enabling technology, in particular information and communications technology

CAPACITY-BUILDING

17.9. Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation

TRADE

17.10. Promote a universal, rules-based, open, non-discriminatory and equitable multilateral trading system under the World Trade Organization, including through the conclusion of negotiations under its Doha Development Agenda

17.11. Significantly increase the exports of developing countries, in particular with a view to doubling the least developed countries' share of global exports by 2020

17.12. Realize timely implementation of duty-free and quota-free market access on a lasting basis for all least developed countries, consistent with World Trade Organization decisions, including by ensuring that preferential rules of origin applicable to imports from least developed countries are transparent and simple, and contribute to facilitating market access

SYSTEMIC ISSUES

17.13. Enhance global macroeconomic stability, including through policy coordination and policy coherence

17.14. Enhance policy coherence for sustainable development

17.15. Respect each country's policy space and leadership to establish and implement policies for poverty eradication and sustainable development

17.16. Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries

17.17. Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships

17.18. By 2020, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status,

disability, geographic location and other characteristics relevant in national contexts 17.19. By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries

(Sources: Sustainable Development Goals Knowledge Platform, n.d.; UN, n.d.; UN, 2015)

C. The Parts of Science Textbooks from 5th to 8th Grades (Özkan & Mısırlıoğlu, 2018; Çiğdem, Minoğlu & Karaca, 2018; Gezer, 2018; Aytaç et al., 2018)

Grades	Parts	Description
5th	Learning area	Includes questions and visuals related to the studies related to unit topics
	Questions (in Text) *	There are questions related topic in the text
	Do You Know?	It is aimed at arousing curiosity with information in this section
	Activity	Activities related to the subject are included
	Discussion (in Text)*	There involves discussion related studies in the text part
	What Have We Learned?	Measurement and evaluation activities at the end of the subject are included
	Discussion	Studies for creating discussion environment are involved in this part
	Science, engineering and entrepreneurship applications	There are problems related to issues to identify alternative solutions and then create products at the end
	Unit measurement and evaluation studies	At the end of the unit, it includes evaluation studies consisting of questions related to unit
	Text	There is included information related to topic
	Figures	As Visuals
	Think and Research	Studies that provide thinking, research and debate on the issue

	News article	It contains various daily life and interesting newspaper new
6th	Questions (in Text)*	-
	Discussion (in Text)*	-
	Figure	-
	Text	-
	Science, engineering and entrepreneurship	-
	Do you know these things?	Interesting and brief information about the topic is provided
	Let's do the activity	Activities related to the subject are included
	Working Time	There are questions to assess acquired the relevant gains.
	What have we learned?	This section presents a summary of what have learned
	Subject evaluation	Researches and presentations about the subject are included
	Let's remember	Information acquired in previous years are provided
	Unit evaluation	Studies to evaluate what learned in the unit are included
	Research	Research questions related to the subject are provided
	Let's do experiment	The experiments related to the subject are given.
	Science, life and technology	Science, technology and life related issues are given.
	Examples	Sample question solutions are provided
	Discussion	Based on knowledge, argument related to the issue is created

	Let's do what	Recommendations about what should be done are provided
7th	Discussion (in Text)*	-
	Questions (in Text)*	-
	Text	-
	Figures	-
	What do we remember?	At the beginning of the unit, questions for remembering of the 4, 5 and 6 grades are given
	Course preparation	This section includes examples, visuals, events, or questions
	Science workshop	In this section, various activities, experiments, games or modeling are done with friends or groups
	Let's apply what we've learned	There are repetitive or different types of practice questions are provided
	For Curious ones	Interesting or historical information related to subject are given
	Review of the unit	Summary of the topics covered in unit is given
	Unit evaluation	Assessment questions related to the unit are presented
	Researching	Investigation of the subjects is provided
	Let’s do together	Examples, problem and solution applications are included
	Where is it in life?	Examples from daily life are given
8th	Text	-
	Questions (in Text)*	-

	Figures	-
	Science, technology, and life**	-
	It's your turn	There will be reached the result by trying, discovering, discovering and practicing.
	Let's Research-Discuss**	-
	Preparatory Works	Curious Information and questions are given
	Activity	The event, visual, the materials and the steps for activity are presented
	Do you know?	There is provided to information to attract students attention
	Science, engineering and entrepreneurship**	-
	End of section evaluation	Evaluation questions related to subject are given
	Unit evaluation questions	Measurement and evaluation studies related to the unit are given.

* These parts are separated as a section by researcher

** Due to providing information related parts, information is not repeated for these parts