**AN ANALYSIS OF TURKISH MIDDLE SCHOOL SCIENCE**

 **EDUCATION PROGRAM PLACING CLIMATE CHANGE ISSUES IN THE CONTEXT OF EDUCATION FOR SUSTAINABLE**

 **DEVELOPMENT**

**Res. Assist. Sinem Demirci**

Middle East Technical University, Faculty of Education, Elementary

Education Dept.

cosinem@metu.edu.tr

**Assoc. Prof. Dr. Elvan Şahin**

Middle East Technical University, Faculty of Education, Elementary

Education Dept.

selvan@metu.edu.tr

|  |
| --- |
| ***Abstract:*** *Children, who are likely to suffer adverse consequences of climate change, are expected to find out alternative strategies to struggle the mitigation and adaptation of climate change. Thus, education for sustainable development has been pointed out as an essential element of the global reaction to climate change permitting individuals gain with the necessary understandings, attitudes, values, and skills to combat climate change. Current Turkish middle school science education program have the vision which embraces the notion of sustainable development. In the current study, the concepts of greenhouse effect, global warming and climate change were examined within this program and textbooks by means of how these concepts may contribute to develop an understanding of sustainable development. From the grade level 5 to 8, several chapters related to the concepts of global warming and climate change were given in the textbooks. The scientific backgrounds of these concepts were elaborated compared to previous curricula. However, although UNESCO emphasized that every nation may choose their local needs as a context for education for sustainable development; the textbooks did not address any local climate change issue. Besides, no special emphasis was made on the interactions between these concepts and sustainable development. The objectives and content may be revised to emphasize the role of sustainable development within these concepts. Moreover, some local issues may be integrated into curricula so that children develop a sound understanding on climate change and sustainable development.****Keywords:*** *[Education for Sustainability, Climate Change, Curriculum, Middle School, Turkish Context]* |

**Introduction**

The reciprocal interactions between climate change issues and sustainable development has been recognized in IPCC Fourth Assessment Report on Climate Change (2007). In this report, it was denoted that climate change affects the natural settings which also have some effects on human life. These effects provide a basis for social and economic development, whereas humanity’s precedence on sustainable development manipulates both greenhouse gas emissions and the vulnerability. However, as Beg et al. (2002) highlighted, developing countries does not yet locate the climate change issues within the environmental or economic policy agendas, although they will experience severe effects of climate change in the near future which may hinder their development. Therefore, these authors emphasized that combatting and mitigating climate change necessitate a linkage between climate change policies and sustainable development strategies not only in developing countries but also in developed countries.

In order to mediate this linking process, education for sustainable development (ESD) could be regarded as an essential step. Education for sustainable development has been defined by UNECE (2007) stating that ESD depicted as a mediator that permits people to cultivate the knowledge, values, and skills in order to participate in activities both locally and globally that will increase the quality of life and without destructing the planet for the future. In addition, UN (2015) stated that the overall goal of ESD is to integrate the principles, values and practices of sustainable development into all phases of education and learning; and to support alterations in behaviour that will lead to a more sustainable future by means of environment, economy and society for both present and future generations. In line with these explanations, it was declared that the period between 2005 and 2014 as United Nations Decade of Education for Sustainable Development. Since 2005, other UN initiatives and reports are being included the significance of ESD and support ESD implementations in many countries including Turkey.

ESD contains key sustainable development issues to integrate teaching and learning like climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption (UNESCO, 2015). Correspondingly, climate change, which is one of the sustainable development issues, has been integrating in the worldwide science curricula as this concept is coherent with the mission which is raising scientific literate and environmentally responsible citizens (Koulaidis & Christidou, 1999) for a sustainable future. On the other hand, United Nations also continually call attention to the integration of climate change into curricula since the economic and social elements of climate change are naturally relevant to the everyday life and the future of our planet as well (Fleming, 1988; Lucas, 1988; Solomon, 1988; UN, 2015). Moreover, the greenhouse effect, global warming the nature of the climate and climate change are scientific concepts that include multifaceted processes, which is interdisciplinary in nature. Hence, developing a sound understanding of these concepts becomes one of the essential elements in worlwide curricula (Brody, 1991; Bybee, 1993; UNESCO, 2012). Based on these arguments, Turkish middle school science curriculum was revised and introduced by Ministry of Education (MoNE) in 2013. In this modified curricula, the concepts of global warming, and climate change were included. Moreover, the context of the sustainable development was embraced by national science curriculum. Correspondingly, the current study aimed to examine the concepts of greenhouse effect, global warming, and climate change within the current national science curriculum in Turkey to explore how these concepts were integrated within the context of sustainable development. The objectives and textbooks’ content were analyzed from the grade level 5 to 8. By examining the textbooks, it was targeted to contribute to raise scientifically literate individuals who are able to analyze the sustainable development issues, outline the necessary steps, and provide optimal solutions for both mitigation and adaptation of climate change. Moreover, the content of the textbook was scrutinized to diagnose possible limitions of the content and to suggest some improvements to develop a sound understanding in students’ minds about sustainable development issues.

 **Method**

Content analysis was used in this study since written contents of communication such as the textbooks and the objectives (Fraenkel & Wallen, 2006) were analysed to grasp how national elementary science education objectives and textbooks place the climate change within the notion of sustainable development. The objectives of the national science curriculum and the textbooks were examined by means of including the concept of greenhouse effect, global warming, and climate change within the context of sustainable development.

**Results**

The textbooks and the objectives were examined with respect to grade level. The results of each grade level were given in the following sections.

*Grade Level 5*

Within the grade level 5, there are two units namely *The World of Living* and *The World and the Universe* have just one objective within the each unit. The former’s objective is “The students will be able to investigate the environmental problems caused by humans”. Within the textbook, it is written as (p.247) “the most important reason for the environmental pollution is human beings. Releasing some gases in the atmosphere, unconscious usage of natural resources, and increase in consumption and produced wastes are the major reasons for those pollutions.” At the right hand side of the text, the famous photograph, a polar bear surviving in ice melting is present. Moreover, in the conclusion part, it is said that students have learned the concept of global warming which is not explained explicitly within the textbook and the related objective. The latter’s objective is “The students will be able to discuss the reasons, the negative effects for air, water, and soil pollutions and make provisions against these pollutions.”. This objective includes more than one objective –nearly 9 objectives - and this makes it harder to decide how you measure achieving it. When the textbook is examined, the content of the air, water, and soil pollution are elaborated compared to the previous curricula. For example, it is stated that (p.315) “Dirt air result in severe diseases such as bronchitis and asthma. Besides, some poisonous gases releases into the atmosphere leads to heating up the Earth, and climate change, correspondingly.” The definition of global warming and/or climate change is provided in grade level 8 according to the science curriculum. However, students meet the term the climate change within the concepts of air pollution and diseases caused by air pollution.

*Grade Level 6*

There is one unit in Grade Level 6 which can contain the context of climate change. The units are Matter and Heat. The related objective is given as “The students will be able to investigate and present the different types of fuels which are used for heating purposes”. Despite of not having related objective(s), there is a section in this unit titled as *Energy Resources and Global Warming*. The relationship between the greenhouse effect, global warming, and climate change is given in this section. Some of the visuals in the textbook can be still associated with air pollution, but the content seems to more proper compared to 5th grade. The textbook defined the greenhouse gases as releasing from fossil fuels. Moreover, it is also pointed out that the gases covered the Earth increase the temperature by trapping sunlight. Here, there is no clear distinction between the greenhouse gases and the other gases within the atmosphere. Nevertheless, the textbook emphasizes that the greenhouse effect is beneficial for sustaining the life on Earth and increasing them may result in global warming. This description was not present in the previously used textbook. After that, the textbook lists the possible effects of global warming within which the climate change is also given.

*Grade Level 7*

When the content of the 7th grade is examined, one unit seems to include the concept of climate change, namely *Human and Environment*. Within the unit, the relevant objective can be given as “The students will be able to discuss the threatening factors for the biodiversity based on the scientific data and propose solutions for this issue”. When the textbook examined, after definition of the biodiversity, some factors that lead to loss of biodiversity are listed and climate change named as one of those factors that result in loss of biodiversity. However, no additional explanation is given about the interaction between the loss of biodiversity and climate change.

*Grade Level 8*

The grade level of 8 does not have textbook yet. Nevertheless, the lists of objectives were announced by MoNE (2013). There are two units related to the climate change which are *The Relationship between the Energy* *and the Living Organisms* and *The Earthquakes and the Weather Conditions*. The former unit includes water cycles, nitrogen cycles and carbon cycles which can be attributed to the global warming and/or climate change. The other topic of this unit is the ozone depletion. The good news is that the term “ozone hole” is removed from the objective which leads to forming misconception. The other unit, the earthquakes and the weather conditions have several objectives related to the weather and climate. The some of the objectives are listed as (1) know the main elements of the air; (2) record the daily weather events and conclude that it is not stable; (3) explain the differences between climate and weather events; and (4) investigate the possible reasons for global climate change and present the results. The inclusion of the differences between the climate change and daily weathers can be stated as one of the improvements of the science curricula in terms of climate change education.

 **Discussion**

The current study aimed to explore the objectives and the textbook content of the Turkish elementary science curriculum. The results indicated the scientific backgrounds of these concepts were elaborated compared to previous curricula. Still, the textbook content may lead to some misconceptions reported in the literature (Koulaidis & Christidou, 1999; Arik, 2014) as “greenhouse gases are perceived as air pollution” by placing the famous photograph, a polar bear surviving in ice melting, within the concept of global warming. The combination of the text and the photograph may form misconceptions in students’ minds. Moreover, this may also affect their conceptions of climate change. In addition, some contents in grade level 6 may evoke another misconception as the greenhouse gases are increased in the atmosphere due to only fossil fuel usages (Boyes & Stanisstreet, 1993; Boyes, & Stanisstreet, 1997; Christidou, & Koulaidis, 1999; Andersson & Wallin, 2000). On the other hand, when the loss of biodiversity section was examined, it can be inferred that listing the factors that leads to loss of biodiversity does not develop sound understanding on the relationships between those factors and biodiversity. Hence, more explanation can be added to the textbook. Besides, the relationship between the loss of diversity and climate change needs specification. Last but not least, the textbooks did not address any explicit emphasis about the reciprocal interactions between climate change issues and sustainable development even though it was declared that this revised curriculum were prepared based on the principles of sustainable development in the vision part of the curriculum.

*Recommendations for Further Studies*

For the future revisions of the national elementary science curriculum, it can be suggested that the objectives and content may be revised to emphasize the role of sustainable development more within the concepts of greenhouse effect, global warming, and climate change. Moreover, some local issues may be integrated into curricula so that children develop a sound understanding on the interrelationships between the climate change and sustainable development.

**References**

Andersson, B., & Wallin, A. (2000). Students' understanding of the greenhouse

 effect, the societal consequences of reducing CO2 emissions and

 the problem of ozone layer depletion. *Journal of research in science*

 *teaching*, *37*(10), 1096-1111.

Arik, I. (2014). Examining 7th grade turkish eco-school students‘ mental models

 of greenhouse effect. (Master’s Thesis).Available from METU Theses,

Ankara.

Beg, N., Morlot, J. C., Davidson, O., Afrane-Okesse, Y., Tyani, L., Denton, F.,

 Sokona Y., Thomas, J.P., La Rovere, E.L., Parikh, J.K., Parikh, K. &

Rahman, A. A. (2002). Linkages between climate change and

sustainable development. *Climate policy, 2*(2-3), 129-144.

Boyes, E. & Stanisstreet, M. (1993) The greenhouse effect: children's percepti

 ons of causes, consequences and cures, *International Journal of Sci*

 *ence Education, 15*, 531-552.

Boyes, E. & Stanisstreet, M. (1997) Children's Models of Understanding of Two

 Major Global Environmental Issues (Ozone Layer and Greenhouse

 Effect), *Research in Science & Technological Education, 15*(1), 19-28,

 DOI: 10.1080/0263514970150102

Brody, M. (1991). Understanding of pollution among 4th, 8th and 11th grade

 students. *Journal of Environmental Education, 22*, 24–33.

Bybee, R. W. (1993). *Reforming science education—social perspectives and*

 *personal reflections.* New York: Teachers College Press.

Christidou. V., & Koulaidis, V. (1999). Models of students‘ thinking concerning

 the greenhouse effect and teaching implications. *Science Educa*

 *tion, 83*(5), 559–76.

Fleming, R. (1988). Undergraduate science students’ views on the relationship

 between science, technology and society. *International Journal of*

 *Science Education, 10,* 449–463.

Fraenkel, J. R., & Wallen, N.E. (2006). *How to design and evaluate research in*

 *education (6th Edition)*. New York: McGraw-Hill.

IPCC, (2007). *Climate Change 2007: Synthesis Report. Contribution of Working*

 *Groups I, II and III to the Fourth Assessment Report of the Intergov*

 *ernmental Panel on Climate Change* [Core Writing Team, Pachauri,

 R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

Koulaidis, V., & Christidou, V. (1999). Models of students' thinking concerning

 the greenhouse effect and teaching implications. *Science Educa*

 *tion, 83*(5), 559-576.

Lucas, A. M. (1988). Public knowledge of elementary physics*. Physics Educa*

 *tion, 23*, 10–16.

Ministry of National Education [MoNE], (2013). *İlköğretim fen bilgisi dersi öğre*

 *tim programı 3-8. sınıflar.* Retrieved from <http://ttkb.meb.gov.tr>

Ministry of National Education [MoNE], (2013). *Ortaokul 7. Sınıf Fen ve Tekno*

 *loji Ders Kitabı*, 195-196.

Ministry of National Education [MoNE], (2013). *Ortaokul 6. Sınıf Fen ve Tekno*

 *loji Ders Kitabı*, 198.

Ministry of National Education [MoNE], (2013). *İlkokul 5. Sınıf Fen ve Teknoloji*

 *Ders Kitabı*.

Solomon, J. (1987). The pupils' view of electricity revisited: social development

 or cognitive growth? *International Journal of Science Education, 9*,

 13-22.

United Nations [UN] (2015). Retrieved from, <http://www.un.org/>

UNESCO, (2012). Education for Sustainable Development: Sourcebook. United

 Nations Educational, Scientific and Cultural Organization, Paris,

 France.

United Nations Economic Commission for Europe (2007). Good practices in

 education for sustainable development in the UNECE region. Sixth min

 isterial conference, environment for Europe, Serbia.

UNESCO, (2015). Education for Sustainable Development. Retrieved from <http://www.unesco.org.tr/?page=3:70:2:turkce>