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# DISCOVERING SECONDARY SCHOOL STUDENTS' MENTAL MODELS ABOUT GLOBAL WARMING BY DRAWING

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| ABSTRACT | ARTICLE INFO |
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| This research aims to reveal how middle school students express what they know about global warming with mental models. Our study, it is aimed to reveal what students know about global warming, one of the most important problems of our age, with the help of mental models and to raise awareness. For this purpose, the pictures that students draw were analyzed and interpreted. In our research, scanning design, one of the qualitative research methods, was used. While choosing the schools where data will be collected within the scope of the research, schools were determined with the maximum diversity method from the purposive sampling types. In this context, 210 students from schools with low, middle, and high economic levels were included in the study while choosing the sample. To collect data for the research, a semi-structured interview form was prepared for the researcher. According to the questions in the form, the students were asked to draw. The data obtained from the students were coded and themed by content analysis. As a result of the research, it has been revealed that the students have some basic knowledge about global warming and that the gases emitted from vehicles and factories are the causes of global warming. While most of the students stated drought as a result of global warming, there were no drawings indicating that there might be climatic changes, that is, precipitation will increase in some regions. This shows the lack of knowledge of the students. Suggestions were made according to the results of the research. | |
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# ORTAOKUL ÖĞRENCİLERİNİN KÜRESEL ISINMA HAKKINDAKİ ZİHİNSEL MODELLERİNİN ÇİZİM YOLUYLA ORTAYA ÇIKARILMASI

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| ÖZET | MAKALE BİLGİSİ |
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| Bu araştırma ortaokul öğrencilerinin küresel ısınma hakkında bildiklerini çizim yoluyla nasıl ifade ettiklerini ortayı çıkarmayı amaçlamaktadır. Çalışmada öğrencilerin çağımızın en önemli sorunlarından olan küresel ısınma hakkında ne bildiklerini zihinsel modeller yardımıyla ortaya çıkarmak ve farkındalık sağlamak amaçlanmıştır. Bu amaçla öğrencilere konuyla ilgili çizim yaptırılmış ve bu çizimler incelenerek yorumlanmıştır. Araştırmamızda nitel araştırma yöntemlerden tarama deseni kullanılmıştır. Araştırma kapsamında veri toplanacak okullar seçilirken amaçsal örneklem çeşitlerinden maksimum çeşitlilik yöntemi ile okullar belirlenmiştir. Bu bağlamda örneklem seçilirken birbirinden farklı sosyal ve ekonomik düzeye sahip yerlerdeki okullardan 210 öğrenci araştırmaya dahil edilmiştir. Araştırmada veri toplamak için araştırmacı tarafından yarı yapılandırılmış görüşme formu hazırlanmıştır**.** Formda yer alan sorulara göre öğrencilerden çizim yapması istenmiştir. Öğrencilerden elde edilen bu veriler içerik analizi ile kodlanarak temalandırılmıştır. Araştırmanın sonucunda öğrencilerin küresel ısınma hakkında temel bazı bilgilere sahip oldkları, taşıt ve fabrikalardan çıkan gazların küresel ısınmanın sebeplerinden olduğunu bildikleri ortaya çıkmıştır. Öğrencilerin çoğu küresel ısınmanın sonucu olarak kuraklığı belirtirken, iklim değişikliklerinin olabileceğini yani bazı bölgelerde de yağışların artacağını belirten çizimlere rastlanmamıştır. Bu da öğrencilerin bilgi eksikliği olduğunu göstermektedir. Araştırma sonuçlarına göre öneriler belirtilmiştir. | *Alınma Tarihi*:20.06.2022 *Çevrimiçi yayınlanma tarihi:* 30.07.2022 |
| **Anahtar Kelimeler:** Küresel ısınma, ortaokul öğrencileri, zihinsel modeller | |

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## Introduction

The living and mobile creatures called humans have interacted with the earth since they started to use it. As a result of rapid industrialization in recent centuries, the use of natural assets, wastes, and unconscious behaviors have both harmed humanity and caused various environmental problems that threaten the life of living things. At the beginning of this is global warming, which is an environmental problem, which will perhaps become impossible for humanity (Yalçınkaya, 2012). Global warming is defined as the temperature of our world rising above the average compared to many years ago. With the effect of this warming, problems such as the change in the amount of precipitation falling on the earth, the occurrence of different weather events, the change of vegetation, and serious problems in the lives of all living things and people began to emerge. Global warming and changes in climates have become concepts that we use frequently in our daily lives. In the age we live in, environmental problems have started to be seen more and more with the effect of people's unconscious use of natural resources and global warming (Temelli, Kurt, & Kurt, 2011). Related to this, it has been stated that it also causes global climate change (Birpınar, 2022).

Increases in greenhouse gases in the atmosphere as a result of human-induced studies cause an increase in temperature in the lower part of the air layer and on the earth, which is called global warming (Çepel, 2008). It can also be defined as the gases in the atmosphere forming a layer like a cover in a greenhouse and keeping the temperature coming from the world (Galip, 2017). It is also called the increase of carbon monoxide, nitrogen, and methane gas in the atmosphere as a result of burning fossil fuels such as human-induced oil, coal, and natural gas, in the atmosphere (Aksay, Ketenoğlu, and Latif, 2005).

Global warming; It is thought that the natural balance will be disturbed by different factors, causing climate change, causing different negative consequences on the world, and causing an increase and decrease in temperature. (Tokar, 2014; Karakuş, 2012; Onay, 2007). To prevent this event, which is caused by the activities of people, which constantly increases and threatens living life, it is important to inform in terms of the protection of nature and its conscious use. For a secure future, this work should be continued throughout life (İbret, Demirbaş, & Demir, 2019). Education has a great place in raising the awareness of young people who are the owners of our future (Doğru, 2021). With citizenship education, the awareness of individuals and values are effectively explained to each generation (Demirbaş ve Aydınözü, 2020). Undoubtedly, the most appropriate course for this is social studies, which is one of the aims of raising good citizens. For this reason, this course, it is aimed to investigate the mental models of global warming by working on this subject.

The picture formed in the minds of individuals is called a mental model (Emli & Afacan, 2017). It emerges with the understanding and acceptance of scientific information, and with the addition and use of new information, a personal expression and mental model is formed (Çiltaş and Işık, 2012; Doğru, 2022). The mental model must be set up correctly. Because it is effective in later learning. If it is contrary to science, it may cause misperception and negative

model formation (Aydın, 2011). Those who dream are more successful in building and learning a mental model (Harman, 2016; Yıldız, 2006).

For this reason, our research aims to investigate the mental models of students with different social and economic structures related to global warming. When the literature is examined, it is seen that there are different studies related to this subject (Emli & Afacan, 2017; Eroğlu & Aydoğdu, 2016; Bozdoğan & Yanar, 2010; Bozdağan, 2011; Sever, 2013; Atik & Doğan, 2019). It aimed to obtain data based on the drawing. Because spectacles are important tools that reflect people's inner worlds (Pınar & Yakışan, 2017).

Our study, which aims to investigate the mental models of secondary school students about global warming, seeks answers to the following questions:

• What do students know about global warming? Are there any deficiencies or misconceptions in this information?

• What knowledge do students have as a cause or consequence of global warming?

• Do the students know about the prevention of global warming? What do they aim to do to prevent global warming?

• Can students transfer their knowledge about global warming to the picture as mental modeling?

## Method

### Research Model

This research, it was tried to reveal the views of secondary school students about global warming by using the scanning model, which is one of the qualitative research models. The screening model can be described as an information-gathering process that continues in the natural course of a situation (Creswell, 2002). The data collection technique and research used in the research are qualitative research methods that question social life and human problems (Yıldırım & Şimşek, 2006). Various methods have been used to understand students' mental models of global warming.

### Working Group

The study group of the research consists of secondary school students in Kastamonu city center. The sample of the study consisted of 290 students studying in three secondary schools in the center selected with the easy sampling method in the 2018/2019 academic year. While choosing the schools where data will be collected within the scope of the research, schools were determined with the maximum diversity method from the purposive sampling types. In this context, while choosing the sample, students from schools with low, middle, and high economic levels were tried to be included in the research (McMillan & Schumacher, 2006).

### Data collection tool

To obtain data in the research, a semi-structured interview form was prepared. The form will enable students to express what they know about global warming by making mental models. For example, what could be the causes and consequences of global warming? What measures can be taken?" They were asked to show what they understood from the instructions with drawings. They were also asked to write briefly what their drawings told. In this way, students contributed to the process both by drawing and by explaining what they drew to be more understandable. The draft interview form prepared was examined by four experts in the field and its deficiencies in terms of formal and grammatical knowledge were eliminated. Before the data were collected, detailed information about the interview form was given to the students. For the research to be healthy, it has been stated that the information they will give to the students and the drawings they will make on the subject will not be considered as notes, but will only be used as data in the research. In this way, it is aimed to ensure that students' mental models about climate change are objectively reflected in their drawings. A semi-structured interview form was used to collect data in the research.

**Analysis of Data**

The collected data were reviewed before starting the data analysis phase. 80 drawings that were not understood or made out of meaning were not included in the research. The remaining 210 drawings were coded to avoid confusion during the analysis phase. The coding was done as S/1 (first student), and S/2 (second student). A possible mistake was prevented by putting a mark on the papers containing the data used in the analysis. The data were made by the researcher.

In the study, after the analysis of the drawings, the drawings expressing why global warming occurs, the drawings describing the causes of global warming, the drawings in which the causes and consequences of global warming are expressed at the same time, and the drawings expressing the damage caused by global warming by comparing it with the previous ones are divided into groups according to their themes. While creating the themes, the comments about the drawings made by the students also played an important role in grouping the works.

**Results**

Drawings expressing the mental models made by the students according to their meanings, drawings expressing why global warming occurs, drawings describing the causes of global warming, drawings showing the causes and consequences of global warming at the same time, and drawings expressing the damage caused by global warming by comparing before and after. interpreted in four themes.

Out of 210 drawings collected from students; 110 drawings expressed the cause of global warming, 50 drawings described the consequences of global warming, 30 drawings expressed the causes and consequences of global warming at the same time, and 20 drawings expressed

the damage caused by global warming by comparing it with the previous ones. analyzed in four main themes (Table 1).

***Tablo 1.*** *Separation of Obtained Data into Themes*

| Data | Frequency |
|---|---|
| Illustrations Expressing Why Global Warming Happens | 110 |
| Illustrations Describing the Consequences of Global Warming | 50 |
| Drawings Expressing the Causes and Consequences of Global Warming Simultaneously | 30 |
| Drawings Expressing the Damages of Global Warming by Comparing it with Before | 20 |
| **Toplam** | **210** |

**Illustrations Expressing Why Global Warming Happens**

In the drawings under the theme of drawings expressing why global warming occurs, the gases that are harmful to the environment (f= 20) from vehicles, the drawings describing the gases emitted from vehicles and factories (f=13), the drawings describing the pollution in the air (f=9), the nature left to nature. drawings describing hazardous waste (f=6), spray, etc. There are 50 drawings (f=2) describing polluting nature These drawings are tabulated and given below.

*Tablo 2. Illustrations Expressing Why Global Warming Occurs*

| Data | Frequency |
|---|---|
| Environmentally Harmful Gases Coming From Visas | 20 |
| Gases From Factories | 13 |
| Pollution in the Air | 9 |
| Environmentally Harmful Wastes Released to Nature | 6 |
| Spray Etc. | 2 |
| Total | 50 |

As indicated in Table 2, most of the students drew pictures of the gases emitted by vehicles such as cars, buses, trains, and ships polluting nature. In most of the drawings, the smoke coming out of the vehicles is drawn very clearly. In addition, in the images where the vehicles are drawn, it is seen that the students especially try to emphasize the air pollution by trying to draw the sky close to dark gray.

In the other paintings made by the students, they used only the drawings indicating the pollution in the air, the drawings indicating the things that people think harm nature, such as perfume and deodorant, and the drawings showing the harmful wastes left to nature to explain

why global warming occurs. The students drew the gases coming out of the vehicles in most of the pictures. The students made drawings showing why global warming is caused by the gases coming out of vehicles and factories.

**Illustrations Describing the Consequences of Global Warming**

Drawings describing what has happened due to global warming (f=43), Drawings describing the rising air temperature as a result of warming (f=32), drawings explaining that precipitation and glaciers are affected by warming (f=28), negative effects on agricultural areas and forests. There are a total of 110 drawings, including drawings (f=7) describing the Data related to these drawings given in Table 3:

*Tablo 3. Illustrations Describing the Consequences of Global Warming*

| Data | Frequencies |
|---|---|
| Assets Affected by Global Warming | 43 |
| Rising Air Temperature and Drought as a result of Warming | 32 |
| How Precipitation and Glaciers Are Affected by Warming | 28 |
| Negative Impact of Agricultural Fields and Forests | 7 |
| **Total** | **110** |

Table 3 shows the codes describing how living things are affected by global warming. As it can be understood from the table, most of the drawings mentioned in this theme are drawings describing the negative effects of living beings on earth. In some of these drawings, creatures that cannot find water and food are tried to be drawn.

Students especially made drawings describing the rise in air temperature and drought. In these drawings, they drew desertification and cracks in arid lands. In the drawings describing the impact of agricultural areas, the students drew a crop field dried out from the heat. Some students have drawn dried lakes and streams. They made drawings describing the drought by showing the bones of fish and some creatures.

**Drawings Expressing the Causes and Consequences of Global Warming Simultaneously**

In the drawings in which the causes and consequences of global warming are expressed simultaneously, drawings describing how the causes and consequences of global warming affect living things other than animals (f=16), drawings describing how animals are affected (f=7), drawings describing how the world's water resources are affected (f=7 ), there are a total of 30 drawings. These drawings are shown in the table below:

*Tablo 4.* *Drawings Expressing the Causes and Consequences of Global Warming Simultaneously*

| Data | Frequency |
|---|---|
| How Living Things Are Affected | 16 |
| How Animals Are Affected | 7 |
| How the World's Water Resources Are Affected | 7 |
| **Total** | **30** |

As indicated in Table 4, the students made drawings indicating its causes and consequences while describing global warming. The students first drew that the gases coming out of the vehicles and the chimney smokes coming out of the factories polluted the air very much, and then they drew how the trees, people, and animals there were affected. As a result, the student who drew the exhaust gases drew the glaciers melting and the polar bears living there as they were forced to swim in the water or died. Drawing the smoke from the factory chimneys causing the air to become blocked, the student then tried to paint the picture in his mind by drawing a dry land and dried crops and drawing the drought due to global warming.

**Drawings Expressing the Damages of Global Warming by Comparing them with Before and After**

In the theme of drawings that express the damage caused by global warming by comparing it with before, drawings describing before and after global warming in terms of plant existence (f=14), drawings describing the effect of precipitation (f=6), and drawings describing from different perspectives (f=10). There are 30 drawings in total. Data on these drawings are given in table 5:

*Table 5*. *Drawings Comparing Before and After Global Warming*

| Data | Frequency |
|---|---|
| Telling in Terms of Plant Existence | 14 |
| Describing the Impact of Precipitation | 6 |
| Telling From Different Perspectives | 10 |
| **Total** | **30** |

When Table 5 is examined; Students drew especially the melting of glaciers in terms of precipitation. Some students paint the glaciers in their drawings. Some students also drew a picture of the drought caused by the decrease in precipitation.

In the pictures drawn by the students, a landscape with plenty of greenery and a beautiful appearance was drawn before, and then they drew an environment that looked arid. Again, while a pond was drawn in the forest where many animals drink water before, they drew a small pond and only a few

animals. In this picture, they explained that animals would die after global warming or their numbers would decrease drastically. While the students drew pictures such as people who are always happy with beautiful things and a beautiful environment in the first picture they drew in their pictures included in this theme, they always drew pictures containing hopeless and negative elements. In general, the students tried to explain how life would be negatively affected as a result of global warming by drawing them into lines in their imaginations.

## Conclusion and Discussion

This research, it is aimed to reveal what students know about global warming or whether they have wrong information by drawing with the help of mental models. Drawings related to the subject made by the students were separated and evaluated. 110 drawings of the obtained pictures expressing why global warming occurs, 50 drawings describing the result of global warming, 30 pictures showing the causes and consequences of global warming at the same time, and 20 drawings comparing the damages caused by global warming with the previous ones. represented as illustrations.

In most of the drawings examined, drawings are showing that the cause of global warming is the exhaust gases from the vehicles used and the gases coming out of the chimneys of production facilities such as factories. Almost a large part of the children described global warming due to the waste gases emitted into the atmosphere, which we can define as the greenhouse effect. In addition, drought is mentioned as a result of global warming in the drawings of most of the students, but it is seen that almost none of the drawings show that there will be more precipitation in some regions or that there may be flooding in some regions due to the melting of glaciers. In a similar study conducted by Karakuş and Yel (2019), it was stated that in the drawings made by the pre-service teachers, there were no expressions such as floods drawn by drought or excessive precipitation in some regions.

In the research, although few, there were drawings with perfume, spray, and deodorants as the causes of global warming in student drawings. Similar to this result, Kahraman et al. (2008) concluded that students stated that perfume, deodorant, and sprays are among the causes of global warming (Kılıç, 2009). In most of the pictures drawn by the students, air pollution was prioritized as the cause of global warming, and they especially drew exhaust gases to explain air pollution. Students tried to draw how living things might be affected by global warming in the pictures they made as a result of global warming. While painting before global warming, students generally drew forests and tried to draw animals (penguins, polar bears, seals, etc.) living in the arctic region. Afterward, they drew these animals either dead or very few in number. In the eyes of the students, the damage of global warming is mostly concentrated on the creatures living in the polar region. Students are more likely to have watched or listened to the harms of global warming on the poles rather than the media or mass media. Although they draw many pictures about drought, the fact that they do not draw pictures about floods or excessive precipitation means that they only associate global warming with drought due to temperature increase (Seçgin et al. 2010).

Students made many pictures about global warming, and most of the pictures describe the consequences and negative effects of global warming. There are no drawings that can prevent global warming in the pictures. The students did not draw the precautions that can be taken in this regard. They mostly painted pictures that the temperature of the world will increase and the drought will increase accordingly. This shows that the secondary school students in the sample were not given much information on how to prevent global warming. It shows that students compensate for this lack of knowledge by knowing the result of global warming rather than the media or different social media tools. (Karaman and Gokalp, 2010).

## Recommendations

The following suggestions can be made in light of the data obtained as a result of the research.
   • Animations about the consequences of global warming and how to prevent global warming can be prepared for students and these animations can be watched in the lessons.
   • Videos, documentaries, etc. that show the importance of using renewable energy to students. things can be viewed.
   • Students can be made to conduct experiments describing the effect of global warming.

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