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An Investigation on Turkish Primary School Students' Perceptions about Global Warming and Their Thoughts on Preventing Global Warming

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Abstract: This research aims to determine the perceptions of primary level students' about global warming and their thoughts about stopping global warming. This research used one form of qualitative research design, the case study method. This case study is carried out in two different socioeconomic environments in Turkey's Kirsehir province with students from grades of 4th to 8th. A Primary School was selected to represent the higher socioeconomic environment and B Primary School was selected to represent the lower socioeconomic environment. The research group was composed of 40 students, 20 students from each school. The semi-structured interview method was used to collect the data. The results showed that the vast majority of students have insufficient knowledge or misconception about global warming. Additionally the primary students have produced very interesting solutions in order to prevent global warming.

Key words: Global Warming · Preventing Global Warming · Primary School Students

INTRODUCTION

The burning of fossil fuels, population growth, the destruction of forests, changes in land use and technology and the accumulation of greenhouse gases emitted into the atmosphere by industrial production have all been increasing rapidly since the industrial revolution. This leads to an increase in the surface temperature of the world and the natural greenhouse effect is in turn exacerbated by urbanization [1,2]. The Intergovernmental Panel on Climate Change (IPCC) predicts and the United Nations sees these predictions as a very important scientific event, a considerable warming of the Earth's atmosphere in the twenty-first century. According to the most recent assessment (2007), temperature increase of between 1.1 and 4.6°C is to be expected by 2100. Increasing temperatures will cause an average sea-level rise of between 0.18 and 0.59 meters [3]. Scientists have indicated that the annual average global temperature has increased is 0.5°C since the second half of the nineteenth century, without agreeing on the reason for this increase [4].

The current dramatic changes in nature and the environment certainly affect the entire world and with each passing day these transformations are rapidly increasing environmental problems of the globalized world [5].

The greenhouse effect is the result of the difference in atmospheric behavior towards long and short wavelength radiation. A portion of the sun's short wavelength, high energy rays that reach the earth are reflected back into space by particles and dust in the atmosphere and clouds, while the rest are trapped by gas molecules in the atmosphere and thus warm up the air. The remainder (approximately half) reaches the Earth's surface, making it warmer. Long wavelength, low energy, radiation is known as infrared rays. The entire range of infrared rays is not reflected back into space. Some of it is absorbed by the atmosphere and radiates back to the Earth. This is the mechanism defined as the "greenhouse effect" [6]. This mechanism affects the steady state temperature values and energy balances. The main naturally occurring greenhouse gases absorbed by the infrared rays are water vapor, CO_2, CH_4, N_2O. The

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concentrations of these gases (especially CO_2 and CH_4) in the atmosphere are rapidly increasing because of human activities. We know very well that the greenhouse effect acts as a perfect black body to balance the sun's radioactive equilibrium and is responsible for the increase in the Earth's surface temperatures [7].

The warming of the Earth's surface atmosphere and the increase in the Earth's temperature are referred to as global warming, which is caused by greenhouse gases produced anthropogenically (as the result of human activity). Briefly, global warming is a direct result of the increase in greenhouse gases [8]. Global warming not only indicates an increase in maximum daily, monthly and annual temperatures, but also an increase in minimum temperatures. Today, environmental issues have become much more prominent due to the effects of global warming and humans' intensive consumption of natural sources. The evolving relationship between humans and their natural environments has begun to lead to the deterioration of our environment, provoking widespread debate over the scale and the scope of our environmental problems [9].

As the most urgent environmental problem, global warming is seen as the main source of pressure on future generations. Considering the importance of environmental issues for future generations, the environmental education provided by formal educational institutions is an effective way of informing children [10].

Given the negative effects of global environmental problems on the world's equilibrium, it is important to raise awareness of environmental issues. Educational institutions have an especially important role to play in actualizing this vision. Environmental education should be introduced as a matter of urgency at all levels of education [11], since providing environmental education at educational institutions is the most effective way of developing sensitivity towards environmental issues. Especially in Turkey, where the curriculum adopted in 2004 mandates an emphasis on science, technology, society and the environment in educational institutions and teaching the values and attitudes needed to educate environmentally conscious individuals. To find solutions to global environmental problems, people should first be made aware of the risks involved. They should then propose solutions based on their individual knowledge and put in the effort required to enact these proposals. In this way, preliminary information can effectively solve the problem. In fact, preliminary information is also deemed important by the curriculum adopted in 2004. Considering the effectiveness of preliminary information in learning, students' prior awareness and possible misconceptions and of environmental issues should be identified beforehand [5,13].

Quantitative studies of global warming in the literature indicate that there is a misconception about global warming among teacher candidates, undergraduate students and elementary and secondary level school students. This concern suggests the need for a qualitative study to identify elementary students' perceptions of global warming and to figure out what solutions they might propose.

It is quite clear that the effects of global warming jeopardize the future of humanity. In general, the environment and in particular, as those who will raise awareness of it and those who are our future, teachers' and students' level of knowledge and conscious awareness of the environment and the issues concerning it are of great importance in this respect. Thus the central aim of this study is to explore elementary level students' awareness of "global warming" as well as their ability to propose solutions to it.

MATERIALS AND METHODS

Research Design: This research used one form of qualitative research design, the case study method. Case study is a research strategy that examines a phenomenon in its natural setting by gathering information from one or several entities (individuals, small groups, etc.) [18]. Case studies are seen as a key research method for seeking answers to scientific questions [19]. According to McMillan [20], case studies intensively examine one or more cases, social environments, programs, social groups or other interconnected systems. A variety of disciplines rely on the strong theoretical foundations of qualitative research and the common objective of those disciplines is to comprehend human behavior in its natural habitat using multi-faceted perspectives [21]. Scientists mostly use case studies to seek answers to the "How?" and "Why?" question structures [22].

Maxwell [23] indicates that instead of using statistics to explain human beings or particular conditions, combining verbal statements and inductive research methods strengthens the qualitative research. For this reason, qualitative research methods offer a more robust strategy than quantitative methods [24].

Table 1: Distribution of students interviewed by grade level

	Grades					
Primary School	4th	5th	6th	7th	8th	Total
A	4	4	4	4	4	20
B	4	4	4	4	4	20
Total	8	8	8	8	8	40

It is possible to establish the validity of case studies by linking chains of evidence from the data. Internal validity is formed by a clear representation of the results and facilitating access to inferences based on evidence. External validity is derived from a theoretical basis or a conceptual model on the basis of results obtained and reliability is guaranteed by incorporating these in a clear representation of the research process [21]. The validity of this study is ensured by citing direct quotations from the students as evidences and its reliability is ensured by a clear representation of the research process.

Research Group: The research process was carried out in two different socioeconomic environments in Turkey's Kirsehir province with students from grades of 4th to 8th. A Primary School was selected to represent the higher socioeconomic environment and B Primary School was selected to represent the lower socioeconomic environment. The research group was composed of 40 students, 20 students from each school. Table 1 indicates the distribution of students interviewed and their grades.

Data Collection: The semi-structured interview method was used to collect the data. Two semi-structured questions were asked to students in the research group. The first question was "What is global warming?" and the second question was "What kind of solutions should be proposed to prevent global warming from accelerating?" These questions were asked of 40 students during face-to-face interviews. Each interview was recorded using an audio recording device. In addition, a camera was also used as a data recording media to observe students' reactions and to capture their gestures, to avoid any technical difficulties and to prevent the loss of data. As participants, students were informed and asked for their consent to use audio recording devices and cameras during the interviews. During the interviews the camera was switched off temporarily when students seemed uncomfortable. All recorded interviews were transcribed verbatim.

Data Analysis: The data obtained during the interviews were analyzed using the content analysis method. The content analysis method is a widely used qualitative research technique used to examine and analyze the context of documents by interpreting words and sentences from the documents. The data were then classified by the analyst. Content analysis, in the first place, is the conceptualization of the data obtained, which entails arranging the concepts and determining the main themes present in the data. The categorization of data is the stage that develops a macro conclusion concerning the data. The categorization of data is initiated by reading the interviews, taking notes and then arranging the data obtained. By this refinement method, interesting content and prominent elements in the data obtained are marked. While going over the interviews, notes are taken to identify what may be significant for the researcher. After the breakdown of the data, the notes taken are reconsidered and classified. The categories are listed and the pages are separated according to the titles listed. In this case the relevancy of the classified categories is still uncertain. At the end of the study, the researcher reviews the entire set of data and proposes a new list. Then the first and second lists are compared and classified. [21,25-27].

The content analysis of the respondents' views and attitudes was done at two different times by two researchers who are experts in the field of science education. After the classification of categories, the researchers convened to compare them. The reliability of the research was measured by using Miles and Huberman's formula based on instances of achieved *consensus* and *disagreement*. Measurement of the results demonstrated an agreement level of 92%, which ensures adequate reliability in qualitative research if the desired level of reliability is over 90% [28].

The respondents' views were immediately transcribed to categories while interpreting the data. For each response that related to a given category, "Name (School-Grade)" [e.g. Şenol (A8)] was used to indicate the respondent's name, school and grade. Instead of encoding the students' identities with numbers, we preferred to use names from the sample of human participants, specifically children. Therefore, in order to comply with ethical rules, we have chosen not to publish the respondents' names nor that of their schools and each student has been assigned a pseudonym.

Findings: The responses given by the primary school students to a particular question "What is global warming?" are listed in Table 2.

Table 2: The responses given by the primary school students to "What is global warming?"

Categories	Student Responses+	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
About the sun	The sun emits more heat and light	1				
	More solar rays reach the Earth's surface	1				1
	The sun sends intense harmful rays to Earth	2				
	The rapid growth of the sun		1			
	Sun rays are not reflected back			2		
	Sun rays are perpendicular to the surface of the Earth				1	1
	The increase in solar temperature		1			
	The sun warms up the earth more	1				
About the Earth	Increase in Earth's rotation around the sun	1				
	Earth's rotation slows down in its orbit				1	
Greenhouse gases	Melting glaciers		1	1	2	1
	Temperature increase*		1	1	2	
	Climate change	1	1	1	3	
	Rising seas		1			
	Carbon monoxide gas keeps the sun's rays					1
	Carbon dioxide gas traps the sun's rays*					2
For living organisms	Animal extinction	1	1			1
	Destruction of animal habitat		1			
Contamination/ Deterioration of	The world is coming to an end			2		
the ecological balance of the world	An increase in factory waste	1			2	
	Forest fires					1
	Release of toxic gases into nature*		1	1		
	Air pollution			1		
	The world is coming to an end	1		1		
Water scarcity/ Decrease	Water depletion		2			
in water sources	Drought	2	1	2		1
	Seas and lakes drying up					1
The human factor	Lack of awareness		3			
	Insensitivity					1
	Wastefulness			1		
No response						1

* Responses addressing the main concepts + Students gave more than one answer to the question.

According to Table 2, students responded to the question "What is global warming?" as follows: twelve students mentioned "the sun," two students mentioned "the Earth," nineteen students mentioned "greenhouse gases," four students mentioned "living organisms," eleven mentioned "contamination/deterioration of the ecological balance of the world," nine mentioned "water scarcity/decrease in water sources," and five mentioned "the human factor." One of the students did not respond to this question.

The scientifically accurate answer to this question is: global warming is due to the increase of greenhouse gases in the atmosphere which results in fluctuations in the temperature of the lower layers of the atmosphere and the Earth's surface due to human agency [8].

Students' views regarding the question "What is global warming?" can be categorized by grade level as follows: "about the sun," 5 students from 4th grade, two students from 5th grade, two students from 6th grade, one student from 7th grade and two students from 8th grade; "about the Earth," one student from 4th grade, one student from 7th grade; "greenhouse gases" category, one student from 4th grade, four students from 5th grade, three students from 6th grade, seven students from 7th grade, four students from 8th grade; "living organisms," one student from 4th grade, two students from 5th grade, one student from 8th grade; "water scarcity/decrease in water sources," two students from 4th grade, three students from 5th grade, two students from 6th grade, two students from 8th grade; "the human factor," three students from 5th grade, one student from 6th grade and one student from 8th grade and one student from 8th grade did not respond to this question.

HYPOTHESIS 1: Students do not have accurate information about global warming, but they are familiar with the causes and consequences of global warming.

Considering the scientifically correct content of the responses, one student from 5th grade, four students from 6th grade, two students from 7th grade and two students from 8th grade gave partially correct answers. It may be concluded that grade level is an effective variable that predicts students' knowledge about global warming.

Ismet (B5), whose response includes scientific concepts in appropriate ways, said, *"Global warming is the increase in temperature and decrease in frost...yes, increase in temperature." Derviş (A6) stated, "Atmospheric accumulation of toxic gases resulted in greenhouse effects. From there, sun rays enter the earth atmosphere. Since they are not reflected back, global warming occurs. Selma (B6)* responded, *"Global warming is the result of sun rays not reflecting back."* According to *Mert (A8), "Global warming... carbon dioxide traps the sun's rays. For this reason if carbon dioxide levels increase the Earth will warm up. This is global warming."*

Here are some sample responses for the "about the sun" category:

- *Göksu (A4), "Due to the sun's electrical charge, sun emits more light and heat, this is called global warming."*
- *Ferhat (A4), "The sun's harmful rays are intense when they reach the world."*
- *Leman (B8), "Global warming is not the result of human-produced wastes, but factory fumes. That's why the sun's rays are perpendicular to the surface of the Earth."*
- *AslI (A5), "I thought that it was the result of human activities and the effect of the rapid growth of the sun. Most people think that it is the result of human activities, but the sun is a star, which gradually grows because of the explosions inside. That's why the distance between the earth and the sun is reduced and we get more sunlight, so things like global warming or climate change are occurring and at the same time people are responsible for these things"*

Here are some sample responses for the "about the Earth" category:

- *Ersin (A4), "This is an issue that concerns the entire world because the Earth rotates around the sun more often. It is an issue because the sun warms up the Earth and then global warming is occurring."*
- *AydIn (A7), "I thought like this about global warming. The world rotates around itself for almost four billion years, in other words before its rotation around the sun, it was rotating around itself rapidly. Then this rotation slowed down and stopped and then settled into an orbit. I mean, everything has inertia; this rotation will stop after a while. That's why the sun rays that reach the Earth are increasing and the Earth is warming up. I heard that the last few months saw the coldest winter ever in California."*

Here are some sample responses for the "greenhouse gases" category:

- *Recep (A7), "This winter we had almost no snow. So global warming means heat."*
- *Yasin (A8), "The industrial revolution made the mass production of goods possible and in the end it produced larger amounts of waste, air pollution also increased, then carbon monoxide and carbon dioxide warmed the air. Global warming is the result of air warming."*
- *Hicran (A6) stated, "Since global warming releases toxic gases into nature, those toxic gases make clouds clouds. Particles in those clouds are closely packed together and when the sun's rays come to our world and collide with them, the sun's rays are reflected back to the world and so our world is warming up."*

Here are some sample responses for the "contamination/deterioration of the ecological balance of the world" category:

- *Serap (A7), "Uh, I think global warming, um, is the sign of doomsday."*
- *Gül (B7), "Global warming requires us to use less water and electricity. They're why global warming is happening. Global warming...if we consume more water and electricity, then doomsday will come for that reason."*
- *Kalender (B7), "Because of warming at the poles glaciers are breaking off and moving east and that's why the heat is rising and by evaporating glaciers create a water imbalance and there is less water and that's why climate change is occurring."*
- *Ayşe (A6):,"The human factor is the key here. That's why, in reality, global warming is the result of atmospheric pollution."*

- *Helin (B6), "Waste being thrown into the environment, uh, pollution is upsetting the balance of the world."*

Here are some sample responses for the "water scarcity/decrease in water sources" category:

- *Çisem (B4), "If we do harmful things, then, in the future, they will cause global warming. I watched a film, maybe we'll live in a place that's like a desert."*
- *Ethem (B4), "Global warming... the drought has begun."*
- *Can (B8), "When it doesn't rain very much the heat rises, I mean, the seas draw back and the seas dry up."*
- *Ismail (A6), "Things like people running lights in empty places cause water scarcity."*
- *Rabia (A5), "Sometimes people look for water, since there is no water in the deserts, maybe there is global warming there. So, if we have water here, if a lot of global warming comes, then sometimes people here cannot drink water."*

Here are some sample responses for the "living things" category:

- *Perihan (B5), "Global warming harms some of the animals. It is the cause of melting icecaps and if the ice where they live melts, then the animals that live on the ice cannot survive. Global warming is also very harmful to bears and other animals."*
- *Elif (A5), "I think it means the extinction of animals. Some animals live in the poles, such as polar bears and penguins. Because of global warming, the icecaps are melting and those animals can no longer survive."*

Here are some sample responses for the "human factor" category:

- *Reyhan (B5)* stated: *"Perfumes people use thoughtlessly, setting fires that destroy forests. People opened the way for global warming. Now, the world becomes hotter than ever. For example, the weather is not that cold even in the winter. In summer, the sun heats up, but it is still cold. People behaving thoughtlessly opened the way for global warming."*

The responses given by the primary school students to the question "What kind of solutions should be proposed to prevent global warming from accelerating?" are listed in Table 3.

As shown in Table 3, when students were asked the question: "What kind of solutions should be proposed to prevent global warming from accelerating?", fifteen students mentioned "saving electricity," fourteen students indicated that "saving water," twenty-four mentioned the "prevention of environmental pollution," six said "the use of deodorants," nine responded with "alternative, interesting solutions." In addition, two students said, "We should do nothing about global warming," five students stated that, "people should be made aware," and eight students gave no responses.

Students' views about the question "What kind of solutions should be proposed to prevent global warming from accelerating?" are categorized according to their grades as follows: the "saving electricity" category, 2 students from 4th grade, six students from 6th grade, two students from 7th grade, five students from 8th grade; the "saving water" category, one student from 4th grade, five students from 6th grade, four students from 7th grade and four students from 8th grade; the "prevention of environmental pollution" category, four students from 4th grade, four students from 5th grade, seven students from 6th grade, two students from 7th grade, seven students from 8th grade; the "using deodorants" category, three students from 4th grade, one student from 5th grade, one student from 7th grade and one student from 8th grade; the "alternative, interesting solutions" category, one student from 4th grade, three students from 5th grade, two students from 6th grade, three students from 7th grade.

HYPOTHESIS 2: *The majority of students have adequate knowledge concerning the question: "What kind of solutions should be proposed to prevent global warming from accelerating?"*

Here are some sample student responses from the "saving electricity" category:

- *Gül (B7), "We should not use electricity unnecessarily."*
- *Sezen (B8), "To avoid wasting electricity, saving methods should be used. We shouldn't even use extra electricity for a single light. I think we should economize."*

Table 3: Primary school student responses to the question: "What kind of solutions should be proposed to prevent global warming from accelerating?"

Categories	+Student Responses	4th Grade	5th Grade	6th Grade	7th Grade	8th Grade
*/Saving electricity	Using electrical appliances less	1				
	Turn off the TV with the off button	1		1		
	Lights should be turned on when they are not necessary			2		
	Power-saving light bulbs should be used			1		
	Conscious electric consumption			2	2	4
	Not using radiation-emitting products					1
*/ Saving water	Not wasting water	1		1		
	Not using water unnecessarily			1		
	Using water economically			3	4	4
*Prevention of environmental pollution	Waste should be discarded in the recycle bin			1		
	Saving the atmosphere			1		
	Factories should be closed			1	1	
	Do not contaminate the environment		1	2		2
	Factory wastes should be prevented				1	1
	Factories should be operated not at full capacity					1
	Toxic gases should not be released into the atmosphere			1		
	Filters should be attached to chimneys of factories	1				1
	Air pollution should be prevented	1	1			
	Prohibiting fires/ Fire prevention	1	1			
	Tree planting 1	1	1		2	
*Using deodorants	Not using deodorants	3				
	Using less	1		1	1	
Alternative/interesting solutions	Soil excavation operations should be prevented			1		
	Sea water purified into drinking water				1	
	Using solid deodorants instead of spray versions				1	
	People should not smoke			1		
	Alternative machines and drugs can be produced		1			
	Less harmful fragrances can be produced		1			
	Consulting scientists about these issues				1	
	Discarded rockets should be observed		1			
	I wish it would snow	1				
No response		3		3	2	
We should do nothing about global warming		1			1	
*People should be made aware		2	2		1	

* Responses addressing the main concepts + Students gave more than one answer to the question.

- *Göksu (A4): "Electricity should not be used too much. People should not leave the TV on."*
- *Can (B8), "I mean, we can use less electricity."*

Here are some student responses from the "saving water" category:

- *Helin (B6), "Because of global warming, water sources are important and should be used only where they are needed. Sometimes people getting water leave it running, but it should be turned off."*
- *Kalender (B7), "We should do some things to avoid them. For example, people use water in empty places. Rather than using water sources in empty places, we should conserve it."*

Here are some sample responses in the "prevention of environmental pollution" category:

- *Hicran (A6), "These kinds of toxic gases and things should not be made or should only be made after taking necessary precautions. Waste products should not be haphazardly thrown away in nature. First their toxic things should be made harmless, then they should be thrown away. For example, plastics and such should be thrown away in the recycle bin."*
- *Mert (A8), "The environment needs to be planted with trees. I think less factories should be in operation. If they are not needed, they should not be running." Similarly, Ali (A4)* said, *"People can plant trees for one thing."*

- *Ayşe (A6), "Materially, we can live without industries. Let's close industries down."*
- *Yasin (A8), "Filters can be attached to chimneys of factories."*
- *Ismail(A6), "Lights should not be used in empty places, for example, low-voltage lights should be used."*
- *Gizem (B8), "Factory wastes should not be thrown away and chemicals should be reduced, then environmental pollution would be prevented, more plants need to be grown."*

Here are some student responses from the "using deodorants" category:

- *Ferhat (A4), "To prevent global warming, things like sprays and deodorants should not be used, or used in very small amounts."*
- *Ömer (B4), "We do not need to produce and use deodorants and perfumes."*

Here are some student responses from the "alternative, interesting solutions" category:

- *Derviş (A6), "people... should be warned about the effects of excavating soil and smoking"*
- *Perihan (B4), "To prevent it, I wish it would snow. (Why?) Because global warming is harmful to animals, but when it snows then it will turn into ice which is good for bears, that's why.*
- *Reyhan (B5), "We can find less harmful perfumes."*
- *Begüm (A7), "We can build a water purification system. Sea water can be purified into drinking water."*
- *Recep (A7), "We can ask scientists what we can do to prevent it."*
- *Taci (B5), "To end this problem, rockets should be sent into space to gather information."*

Here is a student response from the "people should be made aware" category:

- *Leman (B8), "Images with smoke and pollution can be used to create awareness among people."*

Among the responses in the "We should do nothing" category, Ersin (A4) responded: *"Teacher, we can do almost nothing about this issue, because the sun, nobody can fight with the sun because it is the hottest thing, whenever we approach it a little bit, then we get burned. That's why there is nothing to do about this."*

AydIn (A7), *"I swear nothing can be done to solve this problem, we cannot take the world and play with it, if it is the way I think it is."*

According to their responses, the students do have misconceptions. The most important misconception among the students is about the growing "hole" in the ozone and the transmission of the sun's rays by the ozone layer warming up the Earth.

Here are some responses that reveal the students' misconceptions:

- *Ferhat (A4), "The ozone layer protects us from the sun's harmful rays. People are making a hole in the ozone layer by using harmful gases and sprays. That's why global warming occurs."*
- *Ali (A4), "The sun's harmful rays pass through the ozone layer to the world. When they come, the world gets warmer and warmer and in the end breaks up into pieces."*
- *Ömer (B4), "Global warming causes serious damage as the result of thinning ozone layer."*
- *Begüm (A7), "When global warming occurs then ozone layer gets thinner, the sun's rays get more perpendicular to the world. That's why the poles and such are melting."*
- *Gizem (B8), "Global warming gets thinner as the result of people's insensitivity. This hole is getting bigger day by day... normally ozone layer filters out harmful sun rays but nowadays it does not filter them out. That's why those rays are harmful, in addition, ozone layer allows sufficient amount of sun light"*

The students' misconceptions about global warming in the sentences above have been addressed in the literature.

The students involved in this research project and the students described in the relevant literature have similar misconceptions in their sample sentences:

- *"... if we don't stop using aerosol gases then the ozone hole is going to get bigger and the rays are going to shine on the ice and its... er... going to melt the ice and flood the earth"*[29].

- *"That's like, when the carbon dioxide is let off and it breaks down the ozone layer, it lets more sunlight in and then that makes it get warmer. That's what I think is causing it [global warming]"* [17].

- *"... as the [ozone] hole gets bigger then global warming gets worse with the sun's ultraviolet rays and it makes it hotter"[*4].

RESULTS AND DISCUSSION

The results of the research indicate that elementary level students' knowledge about global warming is not accurate. However, it can be said that although the students do not have accurate knowledge about global warming, they do have sufficient knowledge about the causes and consequences of global warming.

Some of the students stated that global warming is a result of air pollution, toxic gases, thinning of the ozone layer and movements of the sun and the Earth. These results are similar to those to be found in the literature [30-35].

Some of the study participants have concerns about the thinning of ozone layer giving rise to global warming and climate change. A common belief among students about global warming and climate change is that the hole in the ozone transmits sun rays and ultraviolet (UV) rays more readily. These results are in line with studies in the literature [17,34-39]. Rye *et al.* [17] indicated that 54% of the students involved in their research agreed that the thinning of the ozone layer and increased UV radiation are the major causes of global warming. In addition, students are confused about the thinning of ozone layer and global warming. Similarly, Boyes and Stanisstreet [16] emphasized that undergraduate students associate global warming with the hole in the ozone layer. According to Bozdoğan [15], one of the common misconceptions among teachers is that they believe global warming is the result of the thinning of the ozone layer. Unexpectedly, Boyes and Stanisstreet [40] found the same result in their survey of middle school students.

Some students think that an increase in solar radiation or seasonal changes in the world's proximity to the sun are the causes of global warming. Again, these results are similar to those to be found in the literature [30,31,37]. In the final stages of their research, Boyes and Stanisstreet [16] confirmed that high school students do not retain all of their misconceptions during their undergraduate years, but they do retain some of them.

Another result of the study is that the majority of elementary level students do have accurate knowledge about how to prevent global warming. They believe that saving electricity and water and the prevention of environmental pollution will enable us to prevent global warming. The students also proposed interesting alternative solutions to the problem.

The aim of protecting, developing and enhancing the environment is to ensure that people can live in a healthy and safe environment. It is every human's personal responsibility since humans are the only creatures on the Earth that are capable of concern for the environment. Instead, we damage it. In order to solve global warming problem, public awareness must be raised. In this sense, teachers working in schools at all levels are responsible. Elementary level teachers are responsible for informing students about global warming, the greenhouse effect and other environmental concerns. To do this, teachers have many techniques on hand. They can organize informative seminars for the students, plant trees, design new things using waste products, arrange field trips and design posters and brochures.

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