BUCA EĞİTİM FAKÜLTESİ DERGİSİ 29 (2011)

A RESEARCH ON HIGH SCHOOL STUDENTS' KNOWLEDGE RELATED TO GLOBAL WARMING

ORTAÖĞRETİM ÖĞRENCİLERİNİN KÜRESEL ISINMA HAKKINDAKİ BİLGİLERİ ÜZERİNE BİR ARAŞTIRMA

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ABSTRACT: In this research, an achievement test about global warming was administered to 193 selected students attending various high schools in Turkey. Their knowledge about global warming on theoretical, contemporary effects, and necessary precautions were measured. Using a self disclosure form, some characteristics of the students such as academic backgrounds of their parents, type of high school, and their economic status and whether the students had been involved in an activity on the subject before the examination were obtained. The data was analyzed by the statistical programs: Statistical Package for the Social Sciences (SPSS), Finesse, and then t test, Analysis of Variance (ANOVA), and correlation results were determined. The reliability (Cronbach's α) of the test was found to be 0.734. Considering the findings of the research, of three groups of question, the students were most knowledgeable about the effects of global warming.

Keywords: Environmental education, ecological awareness, global warming, high school students' knowledge, science education

1. INTRODUCTION

On the one hand science education supports industrialization because of its major contributions to technological research and development. On the other hand the natural environment can be damaged by the developed industrialization supported by science education. For this reason, technological developments shouldn't be planned regardless of the natural environment and ecological balance (Darçın et al., 2006).

One of today's important problems, perhaps the most important, is global warming since it damages the natural ecological balance. It is obvious that unconscious human behaviors generated by a lack of environmental knowledge contribute considerably, and, of course, negatively to global warming. Disruption of ecological balance, consuming fossil fuel, wasting non-renewable energy resources, destroying forests, etc. are included among these harmful human behaviors. Correspondingly, due to global warming, such important climatic changes as increases in atmosphere temperatures, abnormal hurricanes, storms, floods and forest fires, etc. can occur (Boyes & Stanisstreet, 2001; Groves, F. H. & Pugh A. F, 1999). As global warming goes on, the disorder of the ecological balance in the world deepens, and the world itself faces the dangers associated with this deterioration.

One of the solutions to these problems lies in educating people who are unconscious of their actions, making them aware of the dangers of the global warming, and getting them to

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change their minds (Boyes, Skamp and Stanisstreet, 2008). Therefore, measuring people's awareness on this matter can help us to raise their environmental consciousness. It is also important, in educational processes at every level that the question of the global warming and the issues regarding it should be included curricula (Mayer, 1997; Andersson & Wallin, 2000; Skamp, Boyes & Stanisstreet, 2004). Today the mass media is the prominent source of people's knowledge about global warming. However, they frequently include some misconceptions on the matter involved, and thus may affect people's minds in the wrong way. That is why some studies in literature are based on the misconceptions of students or of people about global warming (Adler, 1992; Boyes, Chuckran & Stanisstreet, 1993; Arons et al., 1994; Kılınç, Stanisstreet and Boyes, 2007).

Education plays an important role in the awareness of students (Taber and Taylor, 2009). Today environmental education in the world includes the subject of global warming from elementary school to the university level. The subject "global warming" is still discussed in science classrooms (Gayford, 1995). Education about the environment is the most effective way to reduce the insensitivity on environment. Especially children should be trained to be more sensitive to the environment because they are our future and will protect the environment (Bradley, Waliczek & Zajicek, 1999).

The general public isn't aware of what causes global warming. For instance, one million molecules of air generally contains 375 parts carbon dioxide on average. The increase of the average number is due to human impact. The basic parts of the increase are fossil-fuel combustion and biomass burning. The gases causing global warming are not only carbon dioxide but also chlorofluorocarbons (CFCs). Even one molecule of CFC gases can create worse effects on global warming than ten thousand molecules of carbon dioxide (Ramanathan, 2006). In addition, many scientists have revealed that the greenhouse gases such as Argon, Neon, Helium, Methane, Hydrogen, Nitrous Oxide and Ozone also have negative impact to global warming (Nordhaus, July 1991). It is a known fact that greenhouse effect is due to the infrared radiation absorbed by these gases and clouds. The absorbed radiation warms the earths' surface and then the heat of the atmosphere increases (Le Treut et al. 2007). CO_2 is the most contributed gas to the greenhouse effect, accounting for nearly 80 percent of the impact. Scientists have shown that if the ratio of CO_2' emissions were doubled; the global surface temperature could increase from 1 to 5 degrees (Nordhaus, May 1991). These gases arise from combustion of fossil fuels, industry, fertilizers, agricultural activities and energy use (Nordhaus, May 1991).

Many research studies were conducted to find out the misconceptions of students and their level of knowledge about global warming (Darçın et al., 2006; Boyes & Stanisstreet, 1992; 1994; Boyes, Stanisstreet & Daniel, 2004; Bozkurt & Aydoğdu, 2004; Koulaides & Christidou, 1999; Khalid, 1999; Andersson & Wallin, 2000). In these studies mostly likert-type scales which include the causes, the effecting factors and the results of global warming were used, and then it was determined that the students' knowledge was inadequate about greenhouse effect and global warming (Darçın et al., 2006).

Lee et al. (2007) tried the find out the conceptions of the greenhouse effect and global warming among elementary students. They collected data for that end through the use of the students' responses given to the writing prompts on these subjects, and classified students according to their various demographic properties like gender, ethnicity, socioeconomic status, English proficiency and home language. In the study's findings the students meaningfully understanding on the developed unit, Living Planet.

Schweizer & Kelly (2005) studied global warming by the use of a pedagogical tool. They used the argument method as a student- based learning on this subject. Through the use of a newspaper headline about global warming, they created an argument in the classroom. They observed how the students constructed debates about global warming, e.g. how they used the conceptions about climatic change. The results of the study revealed that the students availed themselves of the student- based learning and brought in such characteristics as scientific thinking and defending an opinion to other students.

Boyes, Stanisstreet & Papantoniou (1999) studied ozone layer depletion by using a closed form questionnaire developed by the results of the interviews with high school students. The results showed that these students have knowledge about damage to the ozone layer, but some of them think that it is useful for our world.

In his research, by using a closed – form questionnaire, Pekel (2005) also found that pre-service science teachers (biology and science) and high school students (aged 16-18) had some misconceptions about ozone layer depletion. It follows from the findings of the research that the pre-service teachers and the students know location ozone layers and its theoretical meaning, but they have less knowledge about the negative results of the subject.

Fortner (2001) investigated the knowledge of climate change for both teachers and students. In her research, it was maintained that, on the one hand, the teachers had insufficient knowledge on this matter, and, on the other hand, the students had some misconceptions. According to the research findings, it is indicated that instructional materials should be found in curriculum.

Koulaides & Christidou (1999) performed their study with primary school students. Thanks to individual, semi-structured interviews with the students they learned some of their conceptions about the green house effect. At the end of the interviews, they composed a number of thinking models of students about the greenhouse effect considering textbooks in grades 5 and 6. They also investigated conceptions concerning the subject.

In terms of protecting the natural ecological balance and richness of the earth, all of the research related to global warming are of great importance. Therefore, the aim of this research is to determine the knowledge of our young people about this important issue, who are the insurance of our future, and to examine the factors affecting their knowledge. By developing a multiple-choice test about global warming, this study was implemented to reveal the students' knowledge about the theoretical knowledge of global warming, its effects, and the precautions to be taken.

2. METHOD

2.1. The questionnaire

A multiple choice test was used in this survey and the students were required to check the boxes to find out the true answer. The statements in the answers were connected with each other. While preparing the test, theoretical knowledge that is covering the parts of global warming, effects of global warming and precautions against global warming were considered. The questions for the test were developed from the possible opinions of people, news from magazine and scientific literature; it contained 20 questions. Before using of the real questionnaires, a real preliminary study was applied to 193 random students who were selected from random high schools in Izmir. As a result of the data analysis of the

preliminary study, it was found that three questions should be taken out of the closed questionnaires by the finesse of a statistical program. After this correction, 17 questions were used in the scale. Expert opinions were taken for the extent validity of the test. The reliability (Cronbach's α) of the test was found to be 0.734. This reliability factor indicated that the multiple choice test was acceptable.

2.2. The random sample

The questionnaire was applied to 193 students. These students were selected from high schools in Izmir, Fatma Saygın Anatolian High School and Ahmet Yesevi High School. The grades of random samples were 9, 10 and 11. These grades groups were selected because of the fact that this subject is very common among them and they will be our future. For the purpose of balance and providing homogeneity of the scale, these students were selected from equal socio economic status.

2.3. Data analysis and presentation

Analyses were made by using SPSS, and the results presented in the tables 1 - 7. Tables 1-4 show some characteristic properties of the students.

3. RESULTS AND DISCUSSION

Table 1: ANOVA Results of the students' some characteristic properties

Source	F	P	
Mothers' academic background	,659	,621	p>.05
Fathers' academic background	,928	,428	p>.05
Economic situation	,389	,817	p>.05
High schools	8,503	,000*	p<.05

*Significant at 95% confidence interval (p<0.05).

The results of the analysis in Table 1 pointed out that there wasn't any difference among the student's scale score according to their mothers' and fathers' academic backgrounds [$F_{(4-188)}$= 0.659, p>.05, $F_{(4-188)}$= 0.928, p>.05]. Infact, we can say the academic backgrounds of their parents' didn't affect the knowledge of the students about global warming. For this analysis, the academic background of selected students' parents was elementary school, secondary school, high school, university and master's degree. According to the results, most of the mothers have an elementary school degree (48%) or high school degree (27%) and most of the fathers have an elementary school degree (34%) or high school degree (28%); the rest of the mothers and fathers have other degrees mentioned above. In conclusion, there wasn't any significant difference among all of these groups. Generally, it can be said that the students don't learn about global warming from their parents.

It can be seen in Table 1 there wasn't any relationship between the students' knowledge about global warming and the economic situation of their families [$F_{(4-188)}$= 0.389, p>.05]. But, as a result of the analysis in Table 1 it is noted that there is a difference between the kinds of high schools attended and their knowledge about global warming [$F_{(2-190)}$= 8.503,

p<.05]. According to the results of the Scheffe test, a difference was found between the two groups: Super High School and Anatolian High School. The results indicate that students of Anatolian High School ($\overline{X}$ =68.1356) have more knowledge about global warming than the students of Super High School* ($\overline{X}$=62.5000). This result shows us that environmental education and the students' standard of attainment are very important for awareness about environmental problems.

Table 2: Independent - Samples t Test Results of Students' Marks of Knowledge Test about Global Warming According To Their Gender

Gender	N	$\overline{X}$	S	df	T	p
Female	106	62,7358	16,44807	191	1,106	,270
Male	87	60,0000	17,84950			

The results of the analysis in Table 2 point out that there wasn't any difference according to their gender between the students' knowledge of global warming [$t_{(191)}$=1.106, p>.05].

Table 3: Rates of the Students' Participating in Activities Related To Global Warming

Activities	**Number of students (N)**	**Percentage (%)**
I have watched a TV program	168	87,0
I have watched a film related to Global Warming	73	37,8
I have participated in a seminar	16	8,3
I have listened to my teacher during the lecture	102	52,8
Other…	19	9,8

In this research, a self-disclosure form was applied to the students. The rates of the participating students' activities regarding global warming were obtained from this form. A general survey about the students' knowledge of global warming is given in Table 3. It can be seen from Table 3 that most of the students usually learn about global warming from TV programs or by themselves.

Table 4: Correlations among the Total Score of Knowledge Test Scores and Theoretical, Effect and Precaution Scores

Domain Variable(s)	Effect score	Precaution score	Theoretical score	Total score
Total score	,698(**) (.000)*	,696(**) (.000)*	,687(**) (.000)*	_

*Significant at 95% confidence interval (p<0.05).

**There is a strong positive correlation between the total score of knowledge test scores and theoretical, effect and precaution scores.

An examination of Table 4 showed that there is a high level of positive and meaningful difference among the students' knowledge test scores and their theoretical, effect and precaution scores (r=0,698, p<.01, r=0,696, p<.01, r=0,687, p<.01). When the three categories were compared the highest correlation was determined in the category of effect

* A kind of high school where students learn only English during the first year.

score of global warming. According to this fact, the students' success is affected more meaningfully from their knowledge of the effects of global warming. Considering the determination of the coefficient (r^2 =0.49), it could be said that 49 percent of the total variance in scale scores was due to the effects of knowledge of the students.

Table 5: ANOVA Results the Students' Kinds of Their High School According To Their Marks of Theoretical, Effect and Precaution Knowledge

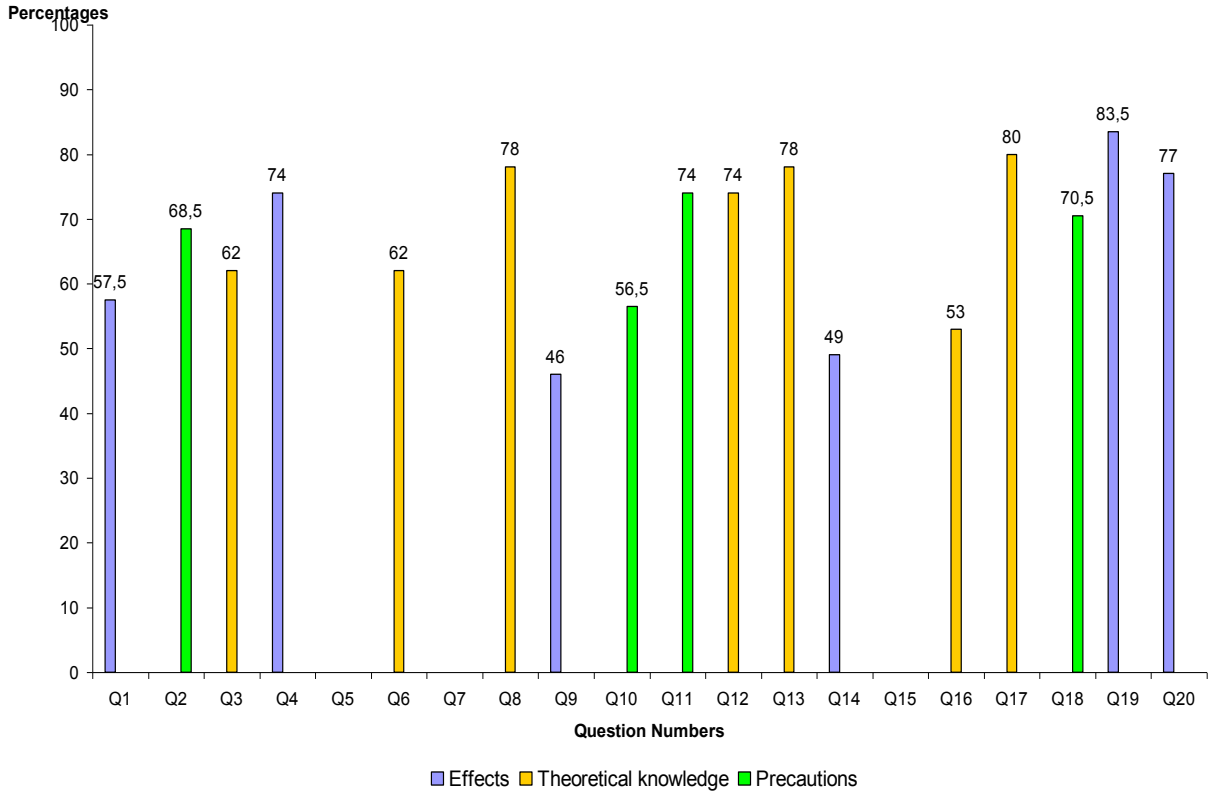
Source		Sum of Squares	df	Mean Square	F	p
Theoretical score	Between groups	44,253	2	22,127	,834	,436
	Within groups	5043,830	190	26,546		
	Total	5088,083	192			
Effect score	Between groups	44,253	2	236,387	9,017	,000*
	Within groups	4980,853	190	26,215		
	Total	5453,627	192			
Precaution score	Between groups	319,248	2	159,624	5,043	,007*
	Within groups	6014,431	190	31,655		
	Total	6333,679	192			

*Significant at 95% confidence interval (p<0.05).

The results of the analysis in Table 5 point out that there was a meaningful difference according to students' kinds of high school on their effect and precaution scores [$F_{(2\text{-}190)}$ =9.017, p<.05, $F_{(2\text{-}190)}$ =5.043, p<.05].

According to the results of Scheffe test for determining the difference among the high school groups, the students of Anatolian High School ($\overline{X}$ =14.91) had more knowledge about the effect of global warming than the other high school groups ($\overline{X}$ =12.25, 11.33) and they had more knowledge about the precautions to be taken than the others ($\overline{X}$ =12.29).

Figure 1: The percentages of questions' correct answers in test about global warming



The percentages of the correct answers of the questions about global warming at the test can be seen in Figure 1. For example questions, 5, 7 and 15 were deleted from the test because the reliabilities of these questions were low.

4. CONCLUSION

In Turkey, the students have been informed about global warming, which is one of today's most important topics. For this study, a test was developed in order to measure the level of knowledge about global warming of the students and thanks to the self disclosure form applied to the students it was understood where they received their knowledge on this subject. The questions of the developed test were divided into three groups: theoretical knowledge, effect of global warming and precautions to be taken for that.

Nowadays television programs have been dealing with this subject so it enhances the attention of the students. In order that the students can have better knowledge about the effects of global warming and the theoretical knowledge about it, but they have not enough knowledge about precautions to be taken in the future. As shown in students answered the questions related to the effects and theoretical knowledge of the issues with a high percentage (Figure 1).

It can be realized by increase the periods regarding environment in schools or documentaries in TV programs. This is important because of growing individuals to be in various characters ahead (Pekel, Kaya and Demir, 2007).

It has been mentioned that the subject "Global Warming" is studied as a two hours class in the science and technology lesson in elementary school with the title "Our world is warming". The subjects regarding environment should be increased to make the students were sensitive to the environment.

As a result of this study, it is found out that the students are interested in this subject but they learn more from TV programs than from their lessons. It is important for the next generation that the knowledge of students is determined on the current environment issues (Pekel, Kaya and Demir, 2007).

The concerning levels of the knowledge about global warming of the students are considered. There is not a difference between the students of Anatolian High School and Super High School. However the students of Anatolian High School have more knowledge than the others. The reason for this is that training in Anatolian High School is better than the other High Schools because these kinds of High Schools accept their students with an exam. So these students are curious and more research-oriented. The other reason is that some characteristic properties such as parents' academic backgrounds, economical situation and their gender don't affect their knowledge on this subject results. The subject is quite contemporary and the students can easily find sources of this subject if they are ambitious. Even so, it should attract to the students' attention on this matter. It should be suggested to run seminar and panels on this subject and it should be related to this subject on broadcast at some programs on TV. Especially, it can be proposed that it should be focused on the precautions of global warming while doing these actions rather than focusing on the other features of the matter.

Investigation about global warming can be studied with the problem based learning method by finding collective subjects related to global warming in science lessons such as physics, chemistry and biology. Thanks to this kind of research it can be provided that the students understand the knowledge about this subject more effectively. As a result of this it is thought that a more impressive environment-science education should be provided.

REFERENCES

Adler, J. H. (1992). Little green lies. Policy Review 61: 18–26.

Andersson, B. and Wallin, A. (2000). Students' Understanding of Greenhouse Effect, the Societal Consequences of Reducing CO_2 Emissions and the Problem of Ozone Layer Depletion. Journal of Research in Science Teaching 37(10), 1096–1111.

Arons, H., Francek, M., Nelson, B., & Bisard, W. (1994). Atmospheric misconceptions. The Science Teacher 61: 30–33.

Boyes, E., Chuckran, D. & Stanisstreet, M. (1993). How do high school students perceive global climatic change: What are its manifestations? What are its origins? What corrective action can be taken? Journal of Science Education and Technology 2: 541–557.

Boyes, E., Skamp, K. & Stanisstreet, M. (2008). Australian Secondary Students' Views about Global Warming: Beliefs About Actions, and Willingness to Act. Research in Science Education, published online 29 August 2008.

Boyes E & Stanisstreet M (2001).Global warming: what do high school students know 10 years on?. World Resource Review, 13(2), 221-238.

Boyes, E. & Stanisstreet, M. (1994). The ideas of secondary school children concerning ozone layer damage, Global Environmental Change, 4, 317-330.

Boyes, E. & Stanisstreet, M. (1992). Students' perceptions of global warming. International Journal of Environmental Studies, 42, 287-300.

Boyes, E., Stanisstreet, M. & Daniel B. (2004).High school students' beliefs about the extent to which actions might reduce global warming, Paper to be given at the 15th Global Warming International Conference and Expo, San Francisco, April 2004.

Boyes, E., Stanisstreet, M., & Papantoniou, V. S. (1999). The ideas of Greek high school students about the "ozone layer". Science Education, 83, 724-737.

Bozkurt, O. & Aydoğdu M. (2004) Misconceptions of 6th, 7th and 8th Grade Students about "Ozone Layer and Its Functions" and Forms of Constitution for This Misconceptions, Kastamonu Education Journal, 12(2), 369-376.

Bradley J. C., Waliczek, T. M., Zajicek, J. M. (1999) Relationship between Environmental Knowledge and Environmental Attitude of High School Students, Journal of Environmental Education, Vol. 30, 5 pgs.

Darçın E. S., Bozkurt O., Hamalosmanoğlu M. & Köse S. (2006). Determination of Elementary Students' Level of Knowledge and Misconceptions about Greenhouse Effect, International Journal of Environmental and Science Education, 1(2), 104-115.

Fortner, R. W. (2001). Climate Change in School: Where Does It Fit and How Ready Are We? Canadian Journal of Environmental Education, 6, 18-31.

Gayford, C. (1995) Science education and sustainability; a case study in discussion based Learning, Research in Science and Technological Education, 13, 135–145.

Groves, F. H. & Pugh, A.F. (1999). Elementary pre-service teacher perceptions of the greenhouse effect. Journal of Science Education & Technology, 8(1), 75-81.

Khalid, T. (1999). Pre-Service Teachers Alternative Conceptions Regarding Three Ecological Issues, Paper Presented at The Annual Meeting of The National Association for Research in Science Teaching, Boston, Massachusetts.

Kılınç, A, Stanisstreet, M, & Boyes, E (2007). Turkish students' ideas about Global Warming, International Journal of Environmental & Science Education, 3(2), 89-98.

Koulaides, V. & Christidou, V. (1999). Models of Students Thinking concerning The Greenhouse Effect and Teaching Implications. Science Education, 83(5), 559-576.

Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather, (2007). Historical Overview of Climate Change. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Lee et al. (2007). Conceptions of the Greenhouse Effect and Global Warming among Elementary Students from Diverse Languages and Cultures, Journal of Geoscience Education, 01, 117-125.

Mayer, V.J. (1997). Global Science Literacy: an earth system view. Journal of Research in Science Teaching, 34(2), 101-105.

Nordhau, W. D. (May 1991). A Sketch of the Economics of the Greenhouse Effect, The American Economic Review, 81(2), Papers and Proceedings of the Hundred and Third Annual Meeting of the American Economic Association, 146-150.

Nordhau, W. D. (July 1991). To slow or not to slow: The economics of the greenhouse effect, The Economic Journal, 101(407), 920-937.

Pekel, F. O. (2005). High School Students' and Trainee Science Teachers' Perceptions of Ozone Layer Depletion, Journal Of Baltic Science Education, 1 (7), 12-21.

Pekel, F. O., Kaya E., Demir Y. (2007). A Comparative Study of Different High School Students' Perceptions about Ozone Layer Depletion, Kastamonu Education Journal, 15(1), 169-174.

Ramanathan, V. (2006), Global Warming, Bulletin of the American Academy, spring 2006. Skamp K, Boyes E & Stanisstreet M (2004) Students' ideas and attitudes about air quality. Research in Science Education, 34, pp 131-342.

Schweizer, D. M. & Kelly, G., J. (2005). An Investigation of Student Engagement in a Global Warming Debate, Journal of Geoscience Education, 53(1), 75-84.

Taber, F. & Taylor, N. (2009). Climate of concern: A search for effective strategies for teaching children about Global Warming. International Journal of Environmental and Science Education, 4(2), 97-116.