



If you change yourself, the world changes: the effect of exhibition on preservice science teachers' views about global climate change

Pelin Aksüt, Nihal Doğan & Mehmet Bahar
Abant İzzet Baysal University, TURKEY

•Received 26 November 2015•Revised 13 August 2016 •Accepted 14 August 2016

Although learning can occur in many environments e.g. science museum or zoo, some studies reported that teachers are prone to avoid outdoor activities since they lack of field trip training. For that reason; this study aims to explore the effect of the exhibition on preservice science teachers' views about global climate change (GCC) as well as teaching drawing technique. The visiting of American National History Museum's "Climate Change: The Threat to Life and A New Energy Future" exhibition allows to see how individual, communal, and governmental actions in using energy more efficiently, in combination with pursuing promising new energy alternatives, can make a meaningful impact in reducing GCC. Data analysis revealed that they have learned drawing technique which is an effective way to obtain students' perceptions. Additionally, the effect of exhibition on preservice teachers' awareness and knowledge of GCC showed clearly changing and teachers' self-confidence have been increased to use outdoor activities. Moreover, with this field trip experience let them to transfer their understanding about informal learning into classroom practice.

Keywords: field trip, global climate change, informal education, outdoor activity, science teachers

INTRODUCTION

"Did the planet betray us or did we betray the planet?" (An Inconvenient Truth, 2005). Today, *An Inconvenient Truth*, which is a film, and shows us that GCC is no longer a political issue but rather, the most important moral challenge facing for our society. ("The Global Warming", 2008). In the 17th century and during the 19th century, due to industrialization, environmental problems have been progressively increasing in the world, (Aydın and Coşkun, 2010) and this increasing confront to

Correspondence: Pelin Aksüt,
Department of Elementary Science Education, Faculty of Education, Abant İzzet Baysal University, Bolu, Turkey.
E-mail: aksutpelin@gmail.com

Copyright © 2016 by the authors; licensee iSER, Ankara, TURKEY. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0) (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original paper is accurately cited.

society regarding the GCC. According to Aydın (2010), GCC is a process in which atmospheric layers and the average earth temperature increases due to the increase of some gases called green house gases. These gases which emerge as consequences of various human activities for instance rapid growth of the population, unplanned urbanization, deforestation. Therefore, worldwide environmental problems which are caused by GCC, started to be handled by the scientists, environmentalists, and also educators.

Taking action on GCCe politicians, scientists and environmentalists might prompt for it in a different perspective, but educators deal with this problem in an educational perspective to be enlight acting of students and society. In this manner, education has as the most important key role to improve students' awareness and knowledge about GCC.

Knowledge about the environment and environmental issues among the general public is surprisingly low. The 1999 National Report Card on Environmental Knowledge, Attitudes, and Behaviors (NEETF/Roper Starch, 1999) gives Americans an "F" on their understanding of causes of basic environmental problems in the 21st century. (Meredith et al., 2000).

Accordingly, a solution would be found if people would be aware of environmental problems. This realisation could only be feasible with an effective environment education. Campbell, Medina-Jerez, Erdogan and Zhang (2010, p.4), regarding the importance of Environmental Education presented the following statement by UNESCO:

The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. (UNESCO, 1975, p. 3)

Environmental education maintains that all people in society are to be informed about environment, gain positive and permanent behavioral changes and participate actively in environmental issues. Many studies results show that how these differ views by gender, children's environmental concern, grade level, previous science achievement, socio-economic status (SES) and school location.

Over the past few decades an interest in and awareness of environmental issues has been increased, seen both from a national (in this case Turkey) and an international perspective. In Turkey, despite an increased interest in environmental issues, it is suprising that only few studies have actually been conducted on this topic, especially from educational perspectives. According to Yılmaz, Boone and Andersen (2004), due to the limited research on this subject, it has been difficult to guide some specific science education efforts in Turkey. Moreover, Orbay, Cansaran and Kalkan (2009) and Temelli, Kurt and Keçi Kurt (2011) stated that primary education teachers have quite some information on GCC. However, many research

State of the literature

- Environmental education maintains that all people in society are to be informed about environment, gain positive and permanent behavioral changes and participate actively in environmental issues.
- Students in all education levels from elementary to higher education, and even the teachers had misconceptions and deficient knowledge problems related to the issue of GCC and greenhouse effect.
- To leave a more pleasant future world for our future generations, teachers should be trained in an environment education concept in the university.

Contribution of this paper to the literature

- The investigation of science teachers' views of different aspects of GCC. Educators deal with GCC in an educational perspective to be enlight acting of students and society.
- Well-trained teachers are capable of improving not only the quality of education but also the quality of life
- This research would like to highlight the benefits of outdoor education and encourage preservice teachers to the use of this teaching method with drawing technique particularly in the science disciplines.

indicated that the majority of primary teacher training students have low level of awareness and insufficient knowledge or misconception about global warming (Bozdoğan, 2009; Bozdoğan and Yanar, 2010; Eroğlu, 2009; Kahraman, Yalçın, Özkan and Aggöl, 2008; Kılınc. Stanisstreet, and Boyes, 2008; Kılıç and Yardımcı, 2010; Oluk and Oluk, 2007). In a similar vein, many research around the world has consently that students have not attained the desire level of understanding climate change and have struggled this concept for many years (Choi, Niyogi, Shepardson and Charusombat 2010; Pruneau Gravel, Courque and Langis, 2003; Ratinen, 2013; Shepardson, Niyogi, Roychoudhury, and Hirsch, 2012). Additional to this; students have many different ideas about GCC, some of which are misconceptions such as ozone depletion, acid rain, and pollution in general are conducive to climate change (Papadimitriou, 2004; Rye, Rubba and Wiesenmayer 1997). As is seen that the students in all education levels from elementary to higher education, and even the teachers had misconceptions and deficient knowledge problems related to the issue of GCC and greenhouse effect. For these reasons, environmental education should be taught as a lifelong training from pre-school period and be continued in all formal and non-formal education stages (Aydın, 2010). Lambert and Bleicher (2013) stated that preservice teachers' participated in an intervention in an elementary science methods course and majority of preservice teachers' reported feeling well informed about climate change by the end of the course. Likewise, Jeong and Kim (2015) examined the impact of hands-on GCC monitoring program on middle school students' knowledge and perceptions of STEAM (Science, Technology, Engineering, Arts, and Mathematics). The findings showed that strong evidence linking between the GCC monitoring activities and real-world problems. The results show that students attain the necessary knowledge about the environment in science analyses indicated that recent high achievement in science courses resulted in more positive attitudes toward environmental issues about environmental issues (Lambert and Bleicher, 2013; Malkus and Musser, 1997; Yılmaz et al, 2004).

However, the limited number of studies that specifically investigated preservice science teachers' views of GCC. To leave a more pleasant future world for our future generations the primary education teachers should be trained in an environment education concept in the university.

As mentioned above, in the national literature, there are some deficiencies with regard to this subject. This study will be evident that GCC is an area that is stressed clearly and broadly in the Turkish education system for schools at all levels. Primary Teachers' plays a very important role in a person's life. Well-trained teachers are capable of improving not only the quality of education but also the quality of life. Environmental education has a role in addressing the demands of science education organisations for developing awareness and knowledge of environment issues. For that reason; the present study attempts to answer the following research questions are:

- "What are Turkish preservice science teachers' views about the GCC"
- "What is the effect of the exhibition Turkish preservice science teachers' views about GCC?"

So in order for the teachers to be able to teach students properly about GCC, they themselves should acquire a better and deeper understanding of the subject. This research concerns the investigation of preservice science teachers' views of different aspects of GCC with the aim to take findings into account while teaching students about GCC. The regarding subject is in an existing "environmental education" course for three hours during the undergraduate education.

METHODOLOGY

How the data was collected?

This study has been designed qualitative research to determinate of 28 (4 Male, 24 Female) to this, preservice teachers have attended the exhibition and before and after the exhibition their views have investigated (Figure 1) by two different data collection tools which are 1. Open ended question and 2. Drawing technique. It was

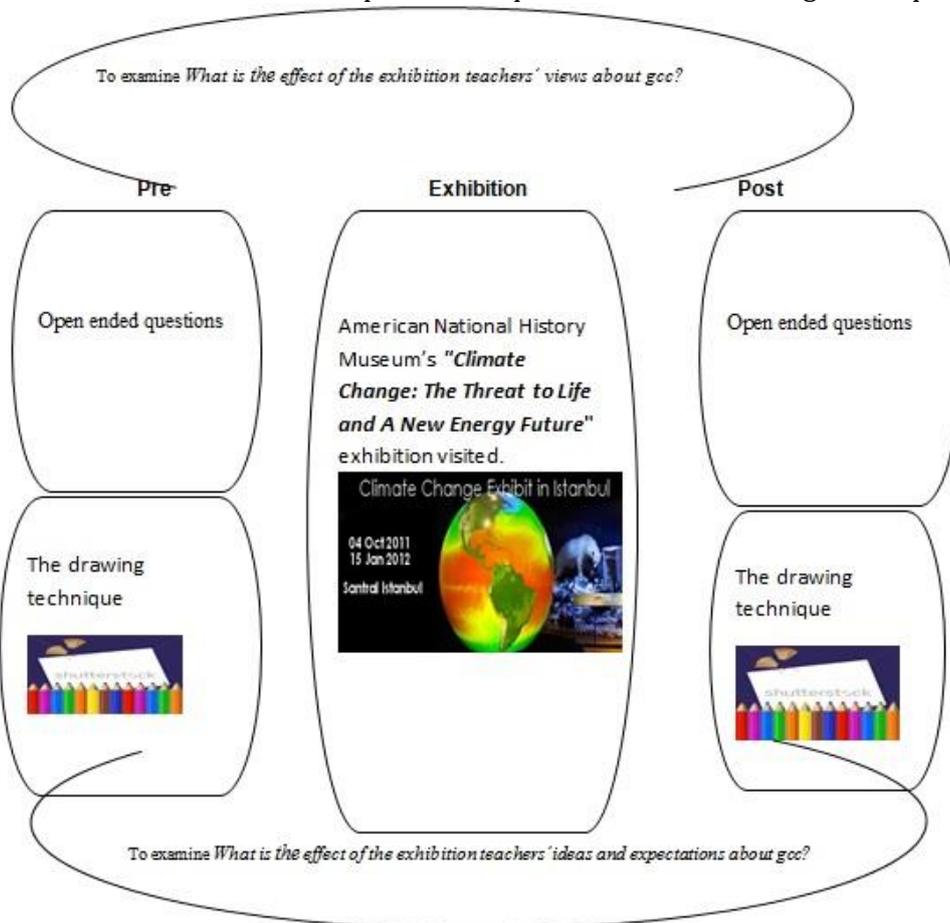


Figure 1. Context of the study

asked to write and draw about GCC. It wasn't said any direction while they were drawing and writing. Students need the time to write down their answers and to draw their drawings; the completion time of the test of question and the drawing is estimated to be around 20 minutes for each. So they could express their thinking freely. The researcher explaint to the participants that they need to make a drawing depicting what comes to their minds. The participants were also be told that it is not important how skilful they are at making drawings. The important issue is to visualise their thoughts, using preferred materials among pencils or crayons. Writing part opens a window for the students to explain their thoughts by using words. Also, the analysing the drawings in the light of the writing parts that make the analysis more coherent and objective. After the pre data collection participants visited the exhibition.

In an effort to expand and deepen the pre-service science teachers' awareness around this area, informal education might play a crucial role. For instance, exhibitions would help people to become more environmentally responsible. In this study, American National History Museum's "Climate Change: The Threat to Life and A New Energy Future" exhibition visited by researchers and pre-service science

teachers' in Turkey, in Istanbul, which was visited by 237.000 people in New York. And this *Climate Change* exhibition addresses one of the most complex and urgent scientific and social issues of the 21st century: GCC. The exhibition explains the science of climate change to visitors of all ages and explores the implications of unchecked climate change for future generations.

The exhibition consists of eight sections which are *How did we get here?*, *Climate change today*, *Changing atmosphere*, *Changing ice*, *Changing ocean*, *Changing land*, *Adaptations*, *Making a difference* and *A new energy future*. In the exhibition take place 4 interactive, 4 animated sphere, 2 video screening and 20 display objects. Also regarding sponsors have developed and added to the exhibition an additional section, which includes some samples from Turkey. Visitors can able to find details about the exhibition about the changing atmosphere, ice, ocean, land and new energy future.

The visiting of this exhibition allows visitors to see how individual, collective, communal, and governmental actions in using energy more efficiently, in combination with pursuing promising new energy alternatives, can make a meaningful impact in reducing GCC and this might provide more effective awareness and knowledge. So, this research attempts to inform educational practice in terms of the increase of pre-service science teachers' scientific knowledge, level of awareness and positive attitudes with regard to GCC.

Data collecting tools

Open ended questions

The data of the study comprises four open-ended questions and drawings produced by pre-service science teachers', combined with subsequent writing parts. The data collected before and after the *Climate Change Exhibition*, in spring 2012. The first step is carried out with the four open-ended questions to examine pre-service science teachers' awareness and knowledge of GCC. Afterwards, by using drawing technique in order to identify pre-service science teachers' ideas and expectations about GCC.

In order to explore pre-service science teachers' awareness and knowledge of global climate change four open ended question were used (Kahraman et al, 2008). Before visiting the exhibition, pre-service science teachers' have been given a test of four open-ended questions.

The questions are the following.

1. What does GCC mean for you? Explain in detail.
2. What can the effects of GCC be? Explain in detail.
3. What measures can it be taken to prevent GCC? Explain in detail.
4. Who do you think as responsible in preventing GCC and what acts do they perform? Explain in detail.

Drawing technique: Visualization

Over the last decade, in science and science education the roles of models and of visualization have gained theoretical and practical conspicuity separately (Gilbert, 2005). It is the generation of internal visualizations that is of the greatest significance in science education. Also, it provides an exciting window through which a 'model of the operation of a

Mental model' can be a sign and a way to the development of metavisual capacity perhaps determined.

Vygotsky (1971) argues that art and thinking are closely connected, and that art comprises an advanced way of thinking. To the same direction, Arnheim (1969) demonstrates that visual arts are a source of visual thinking, because thinking calls for images, and images contain thoughts.

Barraza (1999) stated that the drawing method ensure an effective way to collect data about students' perceptions and the drawings derives from the method of Reiss and Tunnicliffe (2001). Thus, this technique provides a more in depth and rich data related to individual ideas of this topic. However, visualizations can be both external and internal to the learner of science and there are many distinct systems of representation each of which has its strengths and weaknesses (Gilbert, 2005). Although drawing technique is time consuming, it allows to open a 'window' into their thoughts and feelings, mainly because they reflect an image of their own mind (Thomas and Silk, 1990).

By now a considerable literature exists about the use of the drawings as a research technique in education (e.g., Alerby, 2000; Reiss and Tunnicliffe 2001; Prokop, Fancovicová and Tunnicliffe, 2009; Barraza, 1999). Moreover, students' drawings might be used to explore their view of major problems in the world today and in the future. In a similar manner Barraza (1999), students' drawings are useful tools in providing valuable information for the assessment of their environmental awarenesses and expectations. In this study, pre-service science teachers' express in their drawings their thoughts about their knowledge, awarenesses and expectations of GCC and the future environment.

In this study, preservice science teachers' might reflect their thoughts and imaginations by drawings easily and in an enjoyable way. Therefore, this technique could prove more preferable as the preservice science teachers' are more likely to complete it. For this reason, in this study, they will be given the following instruction:

Draw what your think is about GCC; you may use words to label parts of your drawing. In the space below your drawing, you explain your drawing.

This sentence has been developed based on Prokop et al. (2009) research method. Nevertheless, the drawing tool is modified slightly so as to be relevant to this study's research question. Specifically, drawings combined with subsequent writing comments.

Analysis

Open ended questions

Data were analyzed individually through content analysis to identify pre-service science teachers' views. The categories that emerged from the preservice science teachers' responses, can be reflected in more than one category.

Drawing technique

To obtain adequate data about GCC knowledge and awareness level of the pre-service science teachers, the literature has been reviewed and a code system has been developed. Tunnicliffe and Reiss (1999) investigated students' understanding of animal skeletons and they used a code system. Specifically, they created this system which includes levels of students' knowledge about the subject. In this study, repeated inspections of the completed drawings allowed us to construct a five level scale of these representations. Researchers scored drawings following Reiss and Tunnicliffe's score system (2001) and describe following Alerby's (2000) themes to examine general awareness and knowledge about GCC. Our ranking of this issue is created by our own knowledge of GCC and reference to some articles and also the exhibiton. Then, researchers depicted a model drawing which include mainly the exhibition's sections contexts. Afterwards, researchers analysed drawings separately and independently according to the model drawing. In some cases where our scorings differ we discussed the drawing until we agree on the level to be awarded. During the drawing analysis different structures and patterns gradually

crystallized, which were investigated in detail, and eventually some different levels emerged which are described in Table 1.

RESULTS

Open-ended questions

What does GCC mean for you?

According to Table 2, after visiting the exhibition, the majority of pre-service science teachers used for the first time which is "Lacking of drinking water" and increasing of the greenhouse effect". Moreover, %27 of them answered this question "Changing climate" as with the pre-test. Perhaps what is more interesting is that only two of these categories are directly in regarding human beings which categories are "Diseases (exp. Skin cancer)" and "Disruption of the ecological/nature balance".

Below the Table 2, before visiting the exhibition, the majority of participants answered that *changing climate* because of the rising temperature. Here some examples:

Can pre: In recent years, especially in the media global warming is a global climate changing. It includes the change of seasons worldwide. 'changing climate'

Pelin post: decrease of the natural water resources..... 'Lacking of drinking water'.

Sena post Especially rising the amount of carbon dioxide, increasing the greenhouse effect..... 'Increasing the greenhouse effect'

"What can the effects of GCC be?"

According to Table 3, after visiting the exhibition, for this question's answer, the some of pre-service science teachers used for the first time which are "Increasing the greenhouse effect", "decreasing of the green areas", "pollution" and "acid rain". Moreover, as with the pre-test %4 preservice science teachers answers are feature in 'Extinction of the polar bear' category, with the post-test none of them answers are feature in the same category.

Here some examples:

Pelin post: Rising the greenhouse effect..... "Increasing the greenhouse effect",

Can post: green areas will be decrease..... "decreasing of the green areas",

Table 1. The description of levels and scores

Scores	Levels' descriptions	Levels
0	No representation of GCC.	Level 1
1	Drawings which focus only one dimensional specimen on the bad world. (<i>only drought, only melting polar etc.</i>)	Level 2
2	Drawings which focus on the dialectics between the today and future (good and bad) world. (<i>CO2 level ozon depletion effects on humanity, animals and plants</i>)	Level 3
3	Drawings which focus on two- and three and more-dimensional specimens of GCC (<i>melting polar-drought-lacking of drinking water etc.)</i>	Level 4
4	Drawings which focus on actions (Public transport, <i>Using of saving bulbs etc.</i>); solutions (<i>Renewable energy sources, Energy efficiency etc.</i>) to protect the future world.	Level 5

Table 2. Preservice science teachers' answers' categories for the question of "What does GCC mean for you?"

Categories	Frequency (%)		
	Pre-test	Post-test	
Changing climate	42	27	2939
Disruption of the ecological/nature balance	37	7	
Extinction of the some plant/animal species	5	2	
Natural disaster (exp. 2015)	7	7	
Melting polar	5	2	
Diseases (exp. Skin cancer)	3	2	
Ozone layer depletion	3	7	
Lacking of drinking water	0	6	
Increasing the greenhouse effect	0	40	

Pelin post:pollution..... “pollution”,
 Esra post: Acid rain could be..... “acid rain”.

What measures can it be taken to prevent GCC?’

Below the Table 4, after visiting the exhibition, for this question’s answer, the some of pre-service science teachers used for the first time which are “Using of saving bulbs” and “Reducing industrialization”.

Here some examples:

Emel post: industrialization should be reduce....“Reducing industrialization”

Damla post: In our home, changing with saving bulbs . “Using of saving bulbs”

As with the pre-test %21 preservice science teachers answers are feature in “Public awareness” category, with the post-test %9 of them answers are feature in the same category. Moreover, of the 28 preservice science teachers, respectively, %6 and %8 were either *Public transport* and *Energy efficiency be taken to prevent GCC* at the beginning of the exhibition, compared to % 14 and %12 were at the end of the exhibition,

Who do you think as responsible in preventing GCC and what acts do they perform?

According Table 5, after visiting the exhibition, for this question’s answer, the 1% of pre-service science teachers used for the first time which is “Politicians”. Moreover, as with the pre-test %50 preservice science teachers answers are feature in ‘Press and publications’ and ‘Educators’ category, with the post-test %45 of them answers are feature in the same categories.

Table 3. Preservice science teachers’ answers’ categories for the question of “What can the effects of GCC be?”

Categories	Frequency (%)	
	Pre-test	Post-test
Melting polar	25	16
Disruption of the ecological/nature balance	22	6
Changing climate	18	17
Natural disaster (exp. Drought, flood)	16	14
Extinction of the some plant/animal species	14	11
Lacking of drinking water	10	8
Diseases (exp. Skin cancer)	6	5
Ozone layer depletion	2	2
Increasing the greenhouse effect	0	6
Decreasing of the green areas	0	6
Pollution	0	4
Acid rain	0	2

Table 4. Preservice science teachers’ answers’ categories for the question of “What measures can it be taken to prevent GCC?”

Categories	Frequency (%)	
	Pre-test	Post-test
Public awareness	21	9
Renewable energy sources should be used	15	12
More green areas	14	13
Reduction in the use of parfume	12	2
Factories have to fit filter	9	3
Energy efficiency	8	12
Water efficiency	6	7
Public transport	6	14
Recycling	5	8
Make a law	2	3
Reducing urbanization	1	3
Using of saving bulbs	0	6
Reducing industrialization	0	2

Table 5. Preservice science teachers’ answers’ categories for the question of “Who do you think as responsible in preventing GCC and what acts do they perform?”

Categories	Frequency (%)	
	Pre-test	Post-test
Press and publications	25	27
Educators	25	18
Society-individual	21	27
Government	18	16
Environmental protection agencies	11	11
Politicians	0	1

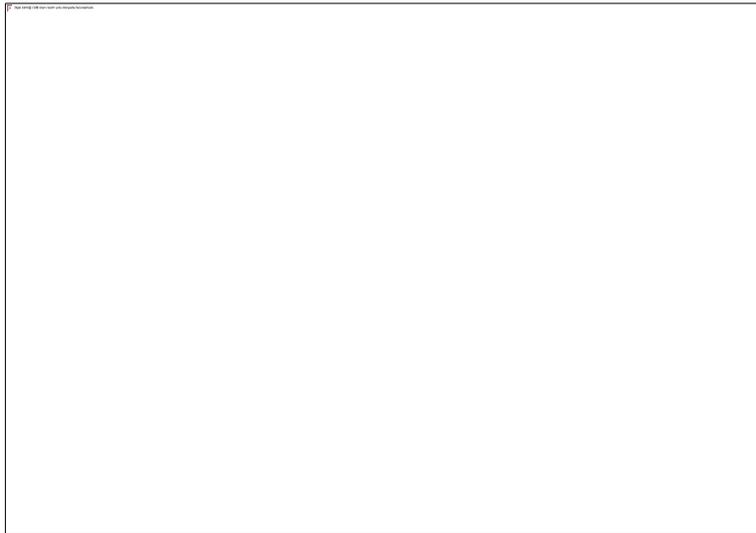


Figure 2. Example of science teachers’ drawings representing in level 2
A: Melting Polar- Extinction of the some plant/animal species

Here some examples:

Sude post:educators must teach this kind of subjects to the students.

These subjects must be taught in lessons.... “Educators”

Beril post: Politicians have roles in society, they directing people, society and educators.... ” “Politicians”

Of the 28 preservice science teachers, %11 were either *Environmental protection agencies* be at the beginning of the exhibition, and also at the end of the exhibition.

Sena post:..... Environmental protection agencies take care of afforestation..... “Environmental protection agencies”.

Drawings technique

As showed Table 6, before visiting the exhibition, majority of the drawings which focused only one dimensional specimen on the bad world (see Figure 2). Meanwhile, the minority of the drawings which focused on the dialectics between the today and future (good and the bad) world or focused on two- and three and more-dimensional specimens of GCC. However there is no drawing in the level 5.

As indicated in Table 6, after visiting the exhibition, majority of the drawings which focused on two- and three and more-dimensional specimens of GCC (see Figure 3). As might be expected, the effect of exhibition on pre-service science teachers’ awareness and knowledge of climate change showed clearly changing. Although, after visiting the exhibition, drawings of climate change by pre-service science teachers would score highest, the score of drawings increased. While 5 of drawings represent the dialectics between the today and future (good and the bad)

Table 6. The frequencies of levels of pre and post-test drawings' results

Levels	Frequency %	
	Pre-test drawings' results	Post-test drawings' results
Level 1	3.57	0
Level 2	64.28	17.85
Level 3	17.85	17.85
Level 4	14.3	50
Level 5	0	14.3

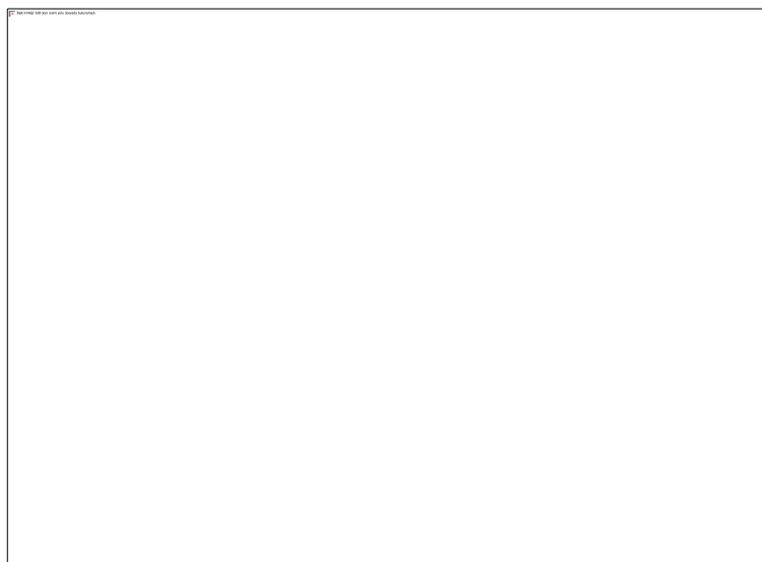


Figure 3. Example of science teachers' drawings representing in level 4

- A: Drought B: Extinction of some species
 C: Global warming D: Melting polars

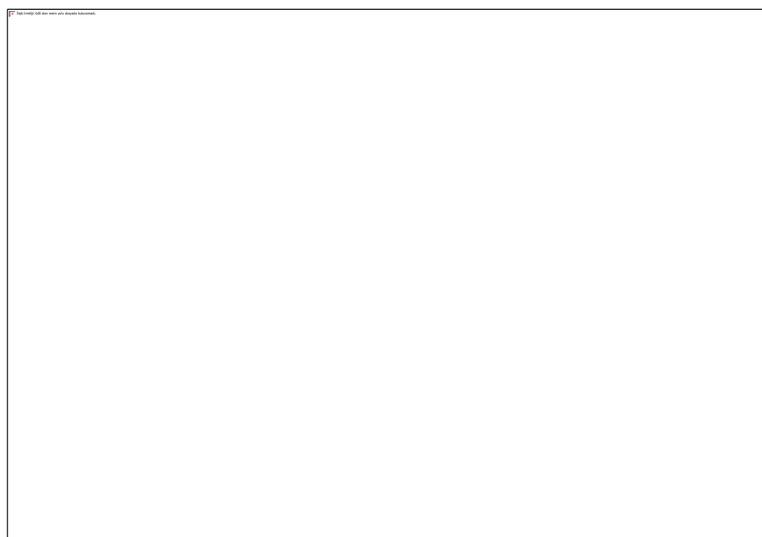


Figure 4. Example of science teachers' drawings representing in level 5

- A: Renewable energy sources should be used
 B: Public transport
 C: Recycling
 D: Using of saving bulbs
 E: More green areas



Figure 5. Model drawing

world, 5 of them focus on two- and three and more-dimensional specimens of GCC. and, 4 of them (see Figure 4) focus on symbols/actions/solutions to protect the future world .

DISCUSSION

The study results give us a picture, which is changed by visiting exhibition. This study indicates that before visiting the exhibition, preservice science teachers have low level of awareness and knowledge about GCC. Also Kahraman et al. (2008) indicated that the same results for majority of the primary teacher training students. Moreover, preservice science teachers demonstrated that they thought they were more knowledgeable about GCC after visiting the exhibition. Attending the course, monitoring programme, instructional model, organizing the trip, visiting the exhibition is one of the efficient way to gain more awareness and knowledge; and so it helps to change in their behaviours towards the environment (Balkan Kiyıcı and Atabek Yiğit, 2010; Jeong, Kim, Chae and Kim, 2014; Jeong and Kim, 2015; Lambert, Lingren and Bleicher 2012; Lambert and Bleicher, 2013; McNeill and Vaughn 2012; Ratinen, Viiri and Lehesvuori, 2013; Trenbath, 2012). At this point, agreed with Hansen, (2010) linking the conceptual problems to hands-on experiences. In a similar vein, Balkan Kiyıcı and Atabek Yiğit (2010) conclude that the trip provided an opening to socialization and fun as well as gave an opportunity to learn at first-hand, provide observation chance, bridging over meaningful and lasting learning as a result of observing the learned information as substantial. Likewise, in this study conclude that the exhibition has the same effect for preservice science teachers.

In this study, after visiting the exhibition, the majority of pre-service science teachers used the '*increasing of the greenhouse effect*' category for the first time to explain their knowledge about GCC. This may be because context of the exhibition allows them to link GCC and a greenhouse effect that is well known by preservice science teachers. After the exhibition they could conclude that the increase of the greenhouse effect leading to GCC and connected changes in the climate system, is one of the most important environmental challenges confronting the people in the 21st century (Schreiner, Henriksen and Hansen, 2005; Aydın, 2010; Aydın and Coşkun, 2010). Even if preservice science teachers do not construct this link as a

result of “*environment education*” course in their graduate education programme, the exhibition’s activities effect their awarenesses and knowledge.

Moreover, four questions’ post-test answers’ categories are more than pre-test answers’ categories. It can be interpreted that preservice science teachers’ awareness and knowledge have increased and changed after visiting exhibition. Likewise, Trenbath (2012) indicated that how the students’ ideas changed throughout the course. All the students contribute to a lack of understanding about climate change. After the course, they learnt about the cycling of carbon in the Earth system and their knowledge of GCC improved.

After the exhibition, their answers are more specifically (*more green areas, energy efficiency, public transport, using of saving bulbs etc.*) to prevent GCC change. For instance, the “*Public transport*” category, preservice science teachers answered more after visiting the exhibition. It concludes that the more people are awareness and knowledge, the more likely that people might take action about this issue. Moreover, Kılınc, Boyes and Strainsstreet (2011) stated that planting of more trees and switching off un-used electrical devices are stated as useful by many students. Although, Ambusaidi, Boyes, Stanisstree and Taylor (2012) claimed that preservice science teachers are aware of the measures that individuals could take to help enhancement the global warming despite this, showed a lack of willingness to act in key areas, such as the use of public transport. Besides Dal et al. (2015) investigated that an adaptation of awareness to climate change questionnaire allowed to investigate whether increased awareness regarding climate change lead to willingness to act for pro-climate change friendly behavior amongst Turkish preservice science teachers.

Consequentially, after the drawings data analysis and the four open ended questions data analysis, preservice science teachers’ major expectations and concerns for the future environment, regarding that the question ‘Are the preservice teachers optimistic or pessimistic about the future?’ can arise. This study might shed light on the deficiencies of this area of knowledge in Turkey. Preservice teacher education programme may include like this exhibition and during the “*environment education*” courses may mention about GCC more than casual period. Some implications from this study are that the exhibitions can help researchers, teachers and curriculum developers to understand students’ learning and scientific knowledge better about climate change. Also, to determinate the informal learning environments like the exhibitons impact on participants’ knowledge and awareness may investigate the longitudinal studies.

CONCLUSIONS

Visiting an exhibition about GCC has led preservice science teachers to aware that GCC has an impact on their everyday life. After the visiting exhibition, they were much more interested in GCC than they were previously. Also, their answers indicate that the importance of GCC and how rapidly it is occurring. After the visiting exhibition, % 4 of them depicted in their drawings not only animals, trees and glaciers, but also depicted to take a proactive role in preventing as much GCC as possible. Some of them could represent for the first time some symbols/solutions/actions on their post drawing. Likewise, this study have shown that pre-service science teachers’ views of the impact of GCC was expanded after visiting the exhibition. After visiting the exhibition, some of preservice science teachers’ answers feature in the first time with some concepts which are shown the tables. Also, post-test results showed that they might be more eager to action to protect the world and to be more conscious on this issue. It conclude that the exhibition context are consist of more action/solution based context and also aimed to increase awareness and knowledge regarding GCC.

Both before and after visiting the exhibition, the emerged of a category 'Educators' is showed that becoming more interested in learning about GCC in general. It conclude that teachers are more important role to have been effective in changing awarenesses and knowledge about it and promoting interest in this subject.

In schools, environmental education should not only prepare future scientists but also help future citizens acquire a wider understanding of environmental issues and its impacts upon society. The findings showed that after the exhibitions, the majority of preservice science teachers had the idea that CO₂ and other gases are emitted as a result of the commonly used chemicals and so these gases make ozone layer thinner. This thinning causes the lights emanating from the sun to reach the earth surface without absorbing. And it can be caused called "GCC". This study also shows that regarding this subject outdoor activity with drawing technique affected their awareness and knowledge about GCC. Although the present study has some limitations such as number of participants and based on GCC exhibition, this findings will be of great value to guide such efforts at a national level. Nevertheless, more studies are still needed to be further exploration to determine students' knowledge and awareness about GCC.

AUTHORS' NOTE

A part of this research was presented as a oral presentation in International Conference on Environment and Renewable Energy (ICERE) 2014.

REFERENCES

- Alerby, E. (2000). A way of visualising children's and young people's thoughts about the environment: a study of drawings. *Environmental Education Research*, 6 (3), 205-222.
- Ambusaidi, A., Boyes, E., Stanisstreet, M. & Taylor, N. (2012). Omani pre-service science teachers' views about global warming: Beliefs about actions and willingness to act. *International Journal of Environmental & Science Education*, 7 (2).
- An Inconvenient Truth (2005) In *The Climate Crisis. An Inconvenient Truth: The Impact* available online at: <http://www.takepart.com/an-inconvenient-truth/film> (Accessed: 19.03.2011).
- Arnheim, R. (1969). *Visual Thinking*. Berkeley: University of California Press. In Alerby, E. (2000). A way of visualising children's and young people's thoughts about the environment: a study of drawings. *Environmental Education Research*, 6 (3), 205-222.
- Aydın, F. (2010). Secondary school students' perceptions towards global warming: a phenomenographic analysis. *Scientific Research and Essays*, 5(12), 1566-1570.
- Aydın, F., & Coşkun, M. (2010). Global warming perceptions of primary education 7th grade students in Turkey. *World Applied Sciences Journal*, 10 (4), 426-432.
- Balkan Kıyıcı, F. & Atabek Yiğit, E. (2010). Science education beyond the classroom: a field trip to wind power plant. *International Online Journal of Educational Sciences*, 2 (1), 225-243
- Barraza, L. (1999). Children's drawings about the environment. *Environmental Education Research*, 5 (1), 49 -66.
- Bozdoğan, A. E. (2009). An investigation on Turkish prospective primary science teachers' perceptions about global warming. *World Applied Sciences Journal* 7 (1), 43-48.
- Bozdoğan, A. E., & Yanar, O. (2010). Sınıf öğretmeni adaylarının küresel ısınmanın gelecek yüzyıldaki etkilerine ilişkin görüşleri. *Karadeniz Fen Bilimleri Dergisi*, 1(2), 48-60.
- Campbell, T., Medina-Jerez, W., Erdogan, İ., & Zhang, D. (2010). Exploring science teachers' attitudes and knowledge about environmental education in three international teaching communities. *International Journal of Environmental & Science Education*, 5(1),3-29.
- Choi, S., Niyogi, D., Shepardson, D. P., & Charusombat, U. (2010). Do earth and environmental science textbooks promote middle and high school students' conceptual development

- about climate change? Textbooks' consideration of students' misconceptions. *Bulletin of the American Meteorological Society*, 91,889-898.
- Dal, B., Alper, U., Özdem-Yılmaz, Y., Öztürk, N., & Sönmez, D. (2015). A model for pre-service teachers' climate change awareness and willingness to act for pro-climate change friendly behavior: adaptation of awareness to climate change questionnaire. *International Research in Geographical and Environmental Education*, 24 (3). 184-200, <http://dx.doi.org/10.1080/10382046.2015.1034456>
- Eroğlu, B. (2009). *Fen bilgisi öğretmen adaylarının küresel iklim değişikliği hakkındaki bilgi düzeylerinin belirlenmesi*, Yüksek Lisans Tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara.
- Gilbert, K. J. (2005). *Visualization in Science Education*. Springer: The Netherlands.
- Hansen, P. J. K. (2010). Knowledge about the greenhouse effect and the effects of the ozone layer among Norwegian pupils finishing compulsory education in 1989, 1993, and 2005—what now?. *International Journal of Science Education*, 32(3), 397-419.
- Jeong, J., Kim, H., Chae, D., & Kim, E. (2014). The effect of a case-based reasoning instructional model on korean high school students'awareness in climate change unit. *Eurasia Journal of Mathematics, Science & Technology Education*,10(5), 427-435.
- Jeong, S. & Kim, H. (2015). The effect of a climate change monitoring program on students' knowledge and perceptions of STEAM education in Korea. *Eurasia Journal of Mathematics, Science & Technology Education*,11(6), 1321-1338 .
- Kahraman, S., Yalçın, M., Özkan, E., & Aggöl, F. (2008). Sınıf öğretmenliği öğrencilerinin küresel ısınma konusundaki farkındalıkları ve bilgi düzeyleri, *Gazi Eğitim Fakültesi Dergisi*,28 (3), 249-263.
- Kılıç, B. G., & Yardımcı, E. (2010). Children's views of environment and environmental problems. *İlköğretim Online*, 9(3), 1122-1136.[Online] Available at: <<http://ilkogretim-online.org.tr>> [Accessed: 04.03.2011].
- Kılınç, A., Stanisstreet, M., & Boyes, E. (2008). Turkish students' ideas about global warming. *International Journal of Environment Science Education*. 3(2); 89-98.
- Kılınç, A., Boyes, E., & Strainsstreet, M. (2011). Turkish school students and global warming: beliefs and willingness to act. *Eurasia Journal of Mathematics, Science & Technology Education*, 7(2), 121-134.
- Lambert, J.L., Lingren, J., & Bleicher, R. (2012). Assessing Elementary Science Methods Students' Understanding About Global Climate Change. *International Journal of Science Education*, 34(8), 1167-1187.
- Lambert, J. L & Bleicher, R.E. (2013). Climate Change in the Preservice Teacher's Mind. *Journal of Science Teacher Education*. DOI 10.1007/s10972-013-9344-1
- Malkus, A. J., & Musser, L. M. (1997). Environmental concern in school-age children. *Elementary and Childhood Education*. ERIC Document Reproduction Service No. ED 407099.M
- McNeill, K.L. & Vaughn, M.H. (2012). Urban high school students' critical science agency: conceptual understandings and environmental actions around climate change. *Research in Science Education*, 42 (2), 373-399.
- Meredith, J., Cantrell, D., Conner, M., Evener, B., & Hunn, D. (2000). Best Practices for Environmental Education Guidelines for Success: Ohio EE Project 2000. Retrieved from: <http://www.eeco-online.org/publications/pdfs/eeohio/bestpractices.pdf>
- Oluk, A. E., & Oluk, S. (2007). Yükseköğretim öğrencilerinin sera etkisi, küresel ısınma ve iklim değişikliği algılarının analizi, *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi*, 22,45-53.
- Orbay, K., Cansaran, A. & Kalkan, M. (2009). Öğretmen adaylarının küresel ısınmaya bakış açısı, *Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi*, 27, 85-97.
- Papadimitriou, V. (2004). Prospective primary teachers' understanding of climate change, greenhouse effect, and ozone layer depletion. *Journal of Science Education and Technology*, 13(2).
- Prokop, P., Fancovicová, J. , & Tunncliffe, S.D. (2009). The effect of type of instruction on expression of children's knowledge: how do children see the endocrine and urinary system?. *International Journal of Environmental & Science Education*, 4(1), 75-93.
- Pruneau, D., Gravel, H., Courque, W., & Langis, J. (2003). Experimentation with a socioconstructivist process for climate change education. *Environmental Education Research*, 9(4), 429-446.

- Ratinen, I.J. (2013). Primary student-teachers' conceptual understanding of the greenhouse effect: A mixed method study. *International Journal of Science Education*, 35(6), 929-955. doi:10.1080/09500693.2011.587845
- Ratinen, I.J., Viiri, J. & Lehesvuori, S. (2013). Primary school student teachers' understanding of climate change: comparing the results given by concept maps and communication analysis. *Research in Science Education*, 43(5), 1801-1823
- Reiss, M. J. & Tunnicliffe, S. D. (2001). *Students' understandings of human organs and organ systems*. Research in Science Education, 31, 383 - 399.
- Rye, J. A., Rubba, P. A., & Wiesenmayer, R. L. (1997). An investigation of middle school students' alternative conceptions of global warming. *International Journal of Science Education*, 19 (5), 527-551.
- Schreiner, C., Henriksen, E. K., & Hansen, P. J. K. (2005). *Climate education: empowering today's youth to meet tomorrow's challenges*. *Studies in Science Education*, 41 (1), 3-49.
- Shepardson, D. P., Niyogi, D., Roychoudhury, A., & Hirsch, A. (2012). Conceptualizing climate change in the context of a climate system: Implications for climate and environmental education. *Environmental Education Research*, 18 (3), 323-352.
- Temelli, A., Kurt, M., & Keçci Kurt, S. (2011). İlköğretim öğretmenlerinin küresel ısınmaya ilişkin görüşleri. *Kuramsal Eğitimbilim*, 4 (2), 208-220.
- Thomas, G. & Silk, A. (1990). An Introduction to the Psychology of Children's Drawings (London, Harvester Wheatsheaf). In Barraza, L. 1999. Children's Drawings about the Environment. *Environmental Education Research*, 5 (1), 49 -66.
- Tunnicliffe, S. D. & Reiss, M. J. (1999). Students' understandings about animal skeletons. *International Journal of Science Education*, 21(11), 1187-1200.
- UNESCO, "Trends in environmental education." Based on working documents for the Belgrade Conference. Paris: UNESCO, 1975
- Vygotsky, L.S. (1971). *The Psychology of Art*. Cambridge: The MIT Press. In Alerby, E. 2000. *A Way of Visualising Children's and Young People's Thoughts about the Environment: A study of drawings*. Environmental Education Research, 6 (3), 205-222.
- Yılmaz, O., Boone, J.W., & Andersen, O.H. (2004). Views of elementary and middle school Turkish students toward environmental issues. *International Journal of Science Education*, 26(12), 1527-1546.
- The Global Warming. (2008). In *The Climate Crisis. An Inconvenient Truth: The Impact* available online at: <http://www.takepart.com/an-inconvenient-truth/film> (Accessed: 19.03.2011)
- Trenbath, T.L (2012). *Undergraduate Students' Conceptions of Natural and Anthropogenic Climate Change: A Case Study Approach*. Faculty of the Graduate School of the University of Colorado , the Department of Atmospheric and Oceanic Sciences.

