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EVALUATING EFFECTS OF AN EXHIBITION VISIT ON PRE-SERVICE ELEMENTARY TEACHERS' UNDERSTANDINGS ON CLIMATE CHANGE

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ABSTRACT: This research aims to investigate to what extent a visit to climate change-oriented exhibition embedded within an environmental education course has effects on pre-service elementary teachers' understandings about climate change. Sample of the study includes 58 pre-service teachers, enrolled in Environmental Education course offered in the 2011-2012 academic year in Elementary Education Program at a private university in Turkey. The course lasted 13 weeks and the context is composed of various environmental issues as well as an exhibition visit and student reflections. Pre-service elementary teachers' pre- and post-reflections were analyzed and coded for examining effects of visit on their understandings about climate change. It was found that the course seem to have an impact on pre-service elementary teachers' understanding of climate change. Besides, the exhibition visit resulted in increased understanding in consequences of climate change and the participants were able to make more individual-oriented suggestions for the climate change problem.

Key words: Environmental education, understanding of climate change, pre-service elementary teachers.

INTRODUCTION

Since the planet we inhabit has been facing serious environmental problems, educating environmentally literate citizens becomes increasingly important and therefore, environmental education has taken place in the curricula from early grades to higher grades of education. Besides, there is growing emphasis on the environmental education research. However, the studies investigating effectiveness of teaching programs in terms of students' understandings of environmental problems are rarely found. Although the positive and inevitable outcomes of visits to informal science settings are reported in science education literature (Rickinson et. al., 2004), there are not enough environmental education researches studying effects of visits on visitors' understandings on environmental problems. Investigating pre-service elementary teachers' understanding of environmental problems is significant because they will educate future citizens.

Scientists argue that climate change has negative impacts on human life and natural systems and continuously leads to problems such as droughts, floods, heavy precipitation, diseases, etc. Educating children about climate change can decrease their vulnerability risk as well as it will contribute to their understandings of sustainability on Earth (UNICEF, 2013).

Selection of the theme for the visit was intentional, because climate change is a dynamic and complex problem by its nature. The complexity of climate change stems from long delays between emissions of greenhouse gases (GHGs), their accumulation in atmosphere, their effects to temperature and climate, and eventually insufficient changes in emission policies (Moxnes and Saysel, 2009). These complexities result in misconceptions about climate change. Even, graduate students from prestigious universities like MIT and Harvard have misconceptions about how GHGs accumulate in atmosphere (Sterman and Sweeney, 2002).

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Recent literature often focuses on perceptions, knowledge, and understanding about climate change (Bord, O'Connor, & Fisher, 2000; O'Connor, Bord, & Fisher, 1999), the gap between environmental knowledge, environmental awareness and displaying pro-environmental behavior (Kollmuss & Agyeman, 2002) and the actions people take in order to mitigate the climate change (Whitmarsh, 2009). However, studies searching the impact of a treatment on student learning about climate change are rarely found.

The treatment that might affect learning outcome is chosen as visit because the researches in science education point out the impact of the visits on various learning outcomes. The benefits of the visit to a science center or museums are reported as making students have fun (Lucas, 2000), fostering knowledge and learning (Bamberger & Tal, 2008), and increased attitudes toward protecting wildlife (Hughes, Packer, & Ballantyne, 2011). However, there are not enough studies investigating the effect of visit to science centers, museums, and etc. on students understanding of climate change.

The study presented here contributes to the environmental education (EE) literature in curricular way. The purpose of this study is to examine to what extent the visit to an exhibition embedded within an environmental education course has effects on pre-service elementary teachers' understandings about climate change. By pointing out this effect, it will be possible to improve environmental education courses at education faculties.

METHOD

Sample

58 students, who enrolled in EE course in Elementary Education Program at a private university in Turkey in the spring semester of 2011-2012, participated in this study. 14% of the participants was male and 86% was female. 71% of the participants specified their hometown as metropolitan, 22% of them specified it as rural area, 3% of them specified it as town and 2% specified it as village while 2% didn't answer this question. Metropolitans let in so many immigrants in recent years in Turkey, so identification may not be sufficient to depict the sample. For this reason, we need to identify the education level of the participants' parents. Regarding the education level of their mothers, 10% of the participants specified the education level of their mothers as university graduate, 31% as high-school graduate, 16% as middle school graduate, 38% as primary-school graduate, and %5 didn't specify at all. Regarding the education level of their fathers, 2% of the participants specified the education level of their fathers as doctorate, 19% of them specified it as university graduate, 39% as high-school graduate, 17% as middle school graduate, and 21% as primary-school graduate, while 2% didn't answer this question.

Research Questions

This paper reports effects of an exhibition visit on pre-service elementary teachers' understanding of climate change. The study presented here addresses the following research questions:

1. To what extent does the exhibition visit embedded within an environmental education program have effects on pre-service elementary teachers' understandings about climate change?
2. Does the EE course have an effect on participants' understandings on climate change?
3. Is there a significant difference of understanding climate change between the students who attended the exhibition and those who did not?

Research Design and Procedure

This research incorporates pre-test-post-test design by collecting pre and post-reflections at the beginning and at the end of the EE course. Quantitative and qualitative analyses were implemented to get deeper insights from the reflections and to make more comprehensive comparisons between pre and post-reflections.

The treatment was implemented in the EE course that lasted 13 weeks. During the first five weeks, basic concepts about ecology and general information about the historical development and the causes of environmental problems were introduced. The following five weeks, the pre-service teacher- groups (with three or four members) made presentations about various current environmental problems listed below:

1. Water pollution,
2. Air pollution,
3. Soil pollution and erosion,
4. Radioactive pollution,
5. The depletion of ozone layer,

6. The loss of biological diversity,
7. Wastes,
8. Energy,
9. Hormone-injected foods and genetically modified organisms, and
10. Global warming.

At the beginning of the term, the pre-service teachers submitted pre-reflections on climate. After the presentations, the participants went to an exhibition about climate change. Participation to exhibition visit was voluntary, but they were all supposed to submit their post-reflections on climate change at the end of the term. 33 pre-service teachers volunteered to participate the visit, while 25 did not.

INSTRUMENTS

Pre-and post-reflections are the instruments in this study. The reflections were expected to include definition, causes, consequences, and suggestions for possible solutions for climate change. The exhibition visitors were expected to write their impressions about the exhibition including the things that attracted their attention most on their post-reflections. The reflections were coded and evaluated by the first and the second author of this paper. Agreement percentages for each code were calculated and it was found the two experts were in 75-99% range of agreement. After individual assessments, the two raters came together to discuss about the inconsistencies and complete agreement was reached.

RESULTS

The reflections were analyzed under four categories. Specified codes, their frequencies, and percentages within the sample are reported on separate tables for each category. Tables (1-4) are formed to represent the general picture for the categories; definitions, causes, consequences, and suggestions of climate change, respectively. Further statistical analyses are included in the following pages.

Table 1. Frequency distributions for definitions of climate change

		CODES		
		Change	Long-term	Weather Conditions
Pre-Reflection	Frequency	16	6	17
	Percentage (%)	27.5	10.3	29.3
Post-Reflection	Frequency	46	34	47
	Percentage (%)	79.3	58.6	81

The McNemar test was used to analyze the codes emerged from the participants' pre- and post-reflections. This test is used for investigating whether there are significant differences on dichotomous variables for dependent samples (Laerd Statistics, 2013). Table 5 shows the statistically significant results of the change in understanding of climate change of pre-service elementary teachers both who attended the exhibition and those who did not throughout the course at .05 confidence interval. It is found that the EE course results in significant changes in specified categories for both visitors and non-visitors to the exhibitions.

Table 2. Frequency distributions for causes of climate change

		CODES								
		GHGs	Name of GHGs	Source of GHGs	Natural Causes	Deforestration	Industry	Global Warming	Ozone Depletion	Irregular Urbanization
Pre-Ref.	Fre.	31	13	12	4	5	13	10	9	5
	Perc. (%)	53.4	22.4	20.6	6.8	8.6	22.4	17.2	15.5	8.6
Post-Ref.	Fre.	51	36	41	24	28	31	6	9	11
	Perc.	87.9	62	70.6	41.3	48.2	53.4	10.3	15.5	18.9

	(%)

Table 3. Frequency distributions for consequences of climate change

		CODES								
-------		Melting of Glaciers	Rising Sea Level	Global Warming	Droughts	Floods	Famine	Diseases & Deaths	Extinction of Species	Discussion about Turkey
Pre-Ref.	Fre. Perc. (%)	18 31	18 31	26 44.8	24 41.3	22 37.9	11 18.9	18 31	22 37.9	8 13.7
Post-Ref.	Fre. Perc. (%)	40 68.9	38 65.5	41 70.6	37 63.7	33 56.8	13 22.4	30 51.7	34 58.6	12 20.6

Table 4. Frequency distributions of suggestions for climate change

		CODES						
		Saving Energy	Renew. Energy	Public Transport	Green Buildings	Forestation	Organizations	Waste Management
Pre-Ref.	Fre. Perc. (%)	15 25.8	7 12	5 8.6	1 1.7	11 18.9	13 22.4	0 0
Post-Ref.	Fre. Perc. (%)	29 50	38 65.5	30 51.7	8 13.7	28 48.2	23 46.5	8 13.7

Two groups were formed according to participation to the exhibition; the visitors groups (n=33) and the non-visitors group (n=25). To make deeper analyses between visitors and non-visitors to the exhibitions, Chi-square test was used to compare the data for each. At the beginning of the course, the number of students who did not attend the exhibition addressed the importance of the role of the organizations, foundations, and governments for the solution of the climate change is significantly higher than those who attended the exhibition ($p<0.05$) (Table 6). These students might have attributed the solutions of environmental problems on the decisions of organizations, foundations and governments and underestimate individual efforts. This result can be accepted as an indication of their unwillingness to act environmentally. No significant difference was found between the two groups in terms of the other categories ($p>0.05$).

Table 5. McNemar test results for the reflection categories wrt visitors and non-visitors

		Visitors		Non-Visitors	
		N	Sig. (2-tailed)	N	Sig. (2-tailed)
Definition	Change	33	0.00*	25	0.01*
	Weather conditions	33	0.00*	25	0.01*
	Long period of time	33	0.00*	25	0.00*
Causes	Name of the gases	33	0.00*		
	Sources of the gases	33	0.00*	25	0.02*
	Natural causes	33	0.03*	25	0.00*
	Forest devastation	33	0.01*	25	0.02*
	Industrialization			25	0.03*
Consequences	Glacier melting	33	0.04*		
	Destroying habitats	33	0.02*		

Solutions	Renewable energy	33	0.00*	25	0.01*
	Saving natural sources	33	0.02*		
	Individual efforts	33	0.00*	25	0.00*
	Public transportation	33	0.00*	25	0.04*
	Green buildings	33	0.03*		
	Forestation			25	0.02*
	Organizations			25	0.00*

*p<0.05

Table 7 shows the Chi-square analysis of the categories that emerged from the participants' post-reflections. Pearson chi-square value was used to analyze the data for the categories of the names of the gases and individual efforts. Continuity correction value was utilized to interpret the result of the category of irregular urbanization because observed value was less than 5 in one of the cells in the analysis of this category. Table 7 reveals that the number of the participants who attended the exhibition visit is significantly higher than those who did not in terms of the knowledge of names of the greenhouse gases, and irregular urbanization as a factor affecting climate change and suggesting individual efforts for the solution of this environmental problem.

Table 6. Chi-square test results for pre-reflections between visitors and non-visitors

Pearson Chi-square	Value	df	Asympt. Sig. (2 sided)
Organizations	5.25	1	0.02

Table 7 Chi-square test results for pre-reflections between visitors and non-visitors

Cause – Names of the gases			Cause – Irregular urbanization			Solution – Individual efforts		
Pearson chi-square value	df	Asympt. Sig. (2 sided)	Continuity correction value	df	Asympt. Sig. (2 sided)	Pearson chi-square value	df	Asympt. Sig. (2 sided)
9.54	1	0.00	9.15	1	0.00	4.58	1	0.03

*p<0.05

Insights from the Reflections

Apart from the quantitative findings, the reflections include some invaluable phrases that enable to make comparisons between pre-and post-reflections. Firstly, it should be noted that the pre-service teachers were free to utilize any reliable resources from both internet and books. As indicated with statistical tests, the participants seemed to learn from the EE course and their essays reflect their learning. The pre-reflections include several direct and in-direct quotations from various resources, while the post-reflections include their own statements with fewer references. The post-reflections of the visitor group especially refer to the exhibition while giving information on climate change.

In addition to selection of references, identification of the four categories is another issue between the pre-and post-reflections. Definitions, causes, consequences, and suggestions can be identified clearly in the post-reflections. This might be another reason for the frequency differences on Table 5. As a complex environmental problem, it is hard to understand the structure of climate change, identify the causes and consequences because they are nested. On post-reflections, there are clear statements like *"Global warming is not a cause, but a consequence of climate change."* that might represent their understanding about climate change. The terminology they selected changed from the pre- and the post-reflections. Some participants mentioned about GHGs as "harmful gases" on their pre-reflections, while there was no phrase as "harmful gases" on the post-reflections.

The difference between post-reflections of the visitors and non-visitors lies on the suggestions they made. The suggestions of the visitors seem to be diverse and more individual-oriented. They included constructing green buildings, consuming thrifty bulbs, insulation of apartments, consuming less hot water, using non-plastic bags for shopping, consuming less, riding bicycles, and preferring vehicles operating with renewable energy sources. Besides, the case for coral reefs was only mentioned on some of the post-reflections of the visitors. They also

mentioned about how they were impressed with the coral reef model at the exhibition. Table 8 represents the attracting themes at the exhibition mentioned by the visitors.

Table 8 Impressions about exhibition

Themes	Visitors (%)
Polar bears	63.64
Models	48.48
Green buildings	18.18
Energy platforms	15.15
Polar fox	12.12
Recycled materials	12.12
CO_2 graph	9.09
Pressing the button	9.09
Other	33.33
Not identified	12.12

CONCLUSION

Today we all know the fact that EE has a crucial role for educating environmentally literate citizens. For achieving this aim, most of the teacher education curricula have incorporated EE courses into their programs. There is also growing literature in the research on EE. However, there's also a need of researches investigating the impacts of some methods and activities conducted in EE courses. The study presented here aims to fulfill this requirement.

The results of this study revealed that the EE course, focusing on informing about ecological concepts, presenting and discussing various environmental problems, seem to have an impact on pre-service elementary teachers' understanding of climate change. The pre-service elementary teachers also seem to have benefited from this course regarding the suggestions for the solutions of the climate change. They seem to have improved their understanding the importance of the usage of renewable energy resources, various individual efforts to be made, and public transportation throughout the course. This result is consistent with the literature emphasizing impacts of EE on various learning outcomes (Hungerford and Volk, 1990; Grotzer and Basca, 2003; Doğança, 2013).

The most distinctive aspect of the study presented here is organization of an exhibition visit and to ask the volunteer visitors to write reflections after the visit, although all the pre-service elementary teachers wrote reflections before and after the course. Comparison of the reflection of the visitors and non-visitors reveal that the exhibition visit contributes to the increased understanding in terms of naming the greenhouse gases, negative consequences of climate change, such as destroyed habitats, the importance of natural sources, and constructing green buildings for the solution of climate change. Attending exhibition visit also seem to have an impact on the awareness of the negative effect of the irregular urbanization on climate change and the importance of the individual efforts for the solution of this environmental problem.

Another finding of this study was related to attributing solutions of environmental problems to organizations, foundations, and governments. This attribution might have a negative influence on attending informal learning environments, thereby to take an action against any of the environmental problems. For this reason, students' beliefs should also be taken into account for designing EE curricula. Moreover, continuing efforts must be taken to overcome students' negative beliefs for the solution of environmental problems.

The pre-service elementary teachers' reflections indicated that affective content of the representations attracted most of the participants' attention more than the intellectual one. This result can be interpreted that informal learning environments, such as exhibitions presenting models and pictures that create dramatic effect on people

can be more instructive than the intellectual ones. This finding can also be explained by the background of the participants of this study. These participants have limited background of science and EE and most of them chose to answer the questions of language and social part of the university entrance exam. These participants' background may have affected the content of the exhibition that attracted their attention. Further study, conducted on different samples and investigating affective outcomes may bring light to this issue.

The data of this study were participants' reflections. Interviews with some of the participants might have brought a deeper insight on their understanding of the climate change. Further research examining the effect of different methods implemented in EE courses on various outcomes in different grade levels is needed.

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