

## THE EFFECTS OF INSTRUCTION WITH VISUAL MATERIALS ON THE DEVELOPMENT OF PRESERVICE ELEMENTARY TEACHERS' KNOWLEDGE AND ATTITUDE TOWARDS GLOBAL WARMING

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### ABSTRACT

This study aimed to identify the erroneous knowledge and misconceptions of preservice elementary teachers about global warming and examine the effects of instruction with visual materials on rectifying these misconceptions and fostering a positive attitude towards the issue of global warming. Having a quasi-experimental design, the study made use of both quantitative and qualitative research methods. The participants of the study, which was conducted in 2008-2009 academic year in Giresun University's Education Faculty, were 47 preservice elementary teachers. Data were obtained by using open ended questions, the Global Warming Attitude Scale (GWAS) and semi-structured interview forms. The results showed that both experimental and control group individuals had knowledge gaps and certain misconceptions about the reasons underlying global warming. However, preservice teachers were more successful in rectifying the gaps and misconceptions via instruction with visual materials. After the intervention, the experimental group had higher global warming attitude scores. However, no meaningful relationship existed between the groups with respect to their attitude scores.

**Keywords:** Global warming, visual materials, preservice teachers.

### INTRODUCTION

Increased fossil fuel consumption in the developed and developing world results in the emission of hazardous gases into the atmosphere. Led by H<sub>2</sub>O (water vapor), CO<sub>2</sub> and CH<sub>4</sub>, these gases prevent radiation reflected from the earth from leaving the atmosphere and cause a greenhouse effect (IPPC, 2007). This causes gradual warming of the earth and is known as global warming. Caused by humans (scientific, political, economic and ethical fields) and resulting in climate change, global warming is the most serious environmental problem in the 21st century (Schreiner, Henriksen & Hansen, 2005). However, the effects of global warming are not limited to the countries that cause extensive emission of these gases. In the near past, powerful natural phenomena have occurred in many lands ranging from America to Europe, and from Asia to Antarctica. The increase in the number and intensity of hurricanes and typhoons in America and Japan, the rapid melting of polar ice, floods in the south of Asia, the unexpected damage caused by forest fires in Australia have led to thousands of casualties as well as billions of dollars in financial loss (Lynas, 2008). Faced with such destruction, joint movement of countries has become a necessity. Though they have been working to reduce emissions (Vienna Convention in 1985, Montreal Protocol in 1987, Rio Declaration in 1992, Kyoto Protocol in 1997, Buenos Aires Climate Summit in 1998, Marrakesh Agreement in 2001, Bali Climate Change Conference in 2007, and Ponzan Climate Conference in 2008, etc.), the lack of a strong collaboration, as was the case in ozone depletion, means that the increasing emission of these gases continues.

As much as the solution of environmental problems such as global warming relies on political, economic and technological remedies, it also requires more educated individuals who know about environmental problems and the measures needed to rectify them. As the future of our planet is in the hands of today's children, the "environmental education investment" to be made in children is an investment made in our planet (Atasoy & Ertürk, 2008; Bozkurt & Cansüngü, 2002; Yılmaz, Morgil, Aktug & Göbekli, 2002). Parallel to curriculum revision studies elsewhere in the world, various adjustments have been made in environmental education curricula in Turkey too. Environmental education started to be offered within the scope of formal education after 1991 (Erol & Gezer, 2006), was integrated into the science curriculum in 1993 (Demiröven, 1999), and its concepts became emphasized even more with the new science and technology curriculum that has been in effect since 2004 (Yılmaz, Tuncer & Aydemir, 2008). At the same time, global environmental problems were given a place in the elementary school science and technology curriculum in 2005-2006 academic year (Oluk & Özalp, 2007). Additionally the Turkish Ministry of Education published a circular letter in 2007-2008 academic year (dated 28.08.2007, article 7997, Global Warming Circular Letter 2007/66), which for the first time would be used as a guide in educating elementary and junior high school students about the precautions they should take for diminishing global warming. To do this, various visual materials were utilized. Besides, some schools arranged various environmentally friendly activities such as planting trees, photograph exhibitions, poetry, painting and project competitions (MEB, 2009).

### **Environmental Education and Teachers' Role**

According to National Science Education Standards, elementary school pupils should be aware of various natural phenomena. Therefore, teachers must equip students with these phenomena in the classroom and eliminate their misconceptions (Khalid, 2001). Previous studies have pointed out that instructional strategies and methods have a very important role in the elimination of misconceptions and the teaching of environment-related knowledge, attitudes and values (DiEnno & Hilton, 2005) and that student-centered strategies are needed rather than traditional instructional strategies (Demirkaya, 2009; Pekel, 2005; Andersson & Wallin, 2000; Kapyla & Wahlstrom, 2000). For instance, it has been pointed out that ensuring active student participation in all activities (Sağır, Aslan & Cansaran, 2008), giving them an opportunity to work in small collaborative groups (Andersson & Wallin, 2000), conducting related laboratory activities and field trips (Bozkurt & Cansungü, 2002) and introducing environmental problems through effective materials that trigger student curiosity and attract their attention (activities, diagrams, overhead projector, slide shows, etc.) (Darçın, Bozkurt, Hamalosmanoğlu & Köse, 2006; Lestera, Maa, Leea & Lambert, 2006) may have positive effects on developing knowledge, attitudes and behaviors related to environmental problems. However, well-equipped teachers are needed to fulfill these tasks (Moseley, Reinke & Bookout, 2002). Therefore, teachers need training in the first place so that student awareness can be raised about environmental problems (Hillman, Stanisstreet & Boyes, 1996). Otherwise, students will end up with the same deficient information or misconceptions about environmental problems. It is thus important to identify and rectify preservice teachers' misconceptions (Pekel, 2005; Khalid, 2003).

### **Research about GW in Education**

Previous studies have shown that very few preservice teachers have an adequate level of information about environmental problems such as global warming, greenhouse effect, ozone layer depletion, and acid rain (Soran, Morgil, Yücel, Atav & Işık, 2000; Bahar & Aydın, 2002; Yılmaz, Morgil, Aktug & Göbekli, 2002; Erol, 2005; Pe'er, Goldman & Yavetz, 2007; Matkins & Bell, 2007; Desjean-Perrotta, Moseley, & Cantu, 2008; Demirkaya, 2008; Yılmaz, Tuncer & Aydemir 2008; Öztas & Kalıpçı, 2009; Bozdoğan, 2009b). Another noteworthy finding has been that preservice teachers have similar misconceptions. The most common misconception is to believe that there is a relationship between ozone layer depletion and global warming or greenhouse effect (Boyes & Stanisstreet, 1992; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994; Dove, 1996; Summers, Kruger, Childs & Mant, 2001; Khalid, 2001, 2003; Pekel, 2005; Michail, Stamou & Stamou, 2007; Matkins & Bell, 2007, Bozdoğan, 2009b). Other misconceptions include believing that using unleaded petrol decreases global warming (Boyes & Stanisstreet, 1992); exhaust gases deplete the ozone layer (Hillman, Stanisstreet & Boyes, 1996); greenhouse effect results from radioactive waste, acid rain and ozone layer depletion (Groves & Pugh, 1999); greenhouse effect causes skin cancer (Groves & Pugh, 1999; Khalid, 2001) and earthquakes (Groves & Pugh, 1999); and greenhouse effect results from CO<sub>2</sub> cycle failure (Bahar & Aydın, 2002).

At the face of global warming, preservice teachers were more knowledgeable about environmentally-friendly behaviors such as decreasing fossil fuel consumption, planting trees, using recycled products (Groves & Pugh, 1999; Yılmaz, Morgil, Aktug & Göbekli, 2002). On the other hand, despite their limited environmental knowledge, preservice teachers were found to know the importance of environmental education and have positive attitudes towards the environment (Lane, Wilke, Champeau & Sivek, 1994; Pe'er, Goldman & Yavetz, 2007). It has been shown through research that female students were generally more sensitive about environmental problems than male students and develop more positive attitudes (Şama, 1997; Erol & Gezer, 2006).

Considering that preservice teachers state print and visual media as their main source of information (Hillman, Stanisstreet & Boyes, 1996; Groves & Pugh, 1999; Khalid, 2001; Yılmaz, Morgil, Aktug & Göbekli, 2002; Pe'er, Goldman & Yavetz, 2007; Öztas & Kalıpçı, 2009; Hansen, 2009), the media has been blamed for these misconceptions (Hillman, Stanisstreet & Boyes, 1996; Khalid, 2001; Oluk & Özalp, 2007).

It has been suggested that in order to rectify the misconceptions, the curriculum of teacher education institutions should be revised (Mckeown-Ice, 2000) and both field and pedagogical knowledge and practice should be offered with the help of experts (Lane, Wilke, Champeau & Sivek, 1994; Summers, Kruger, Childs & Mant, 2001; Moseley & Utley, 2008; Kostova & Atasoy, 2008). Considering that traditional instructional methods may not be effective in teaching these problems (Pawlik, 1991), new methods and techniques where students are active should be used (Moseley, Reinke & Bookout, 2002; Paul & Volk, 2002; Oluk & Özalp, 2007) and interactive activities in laboratory and field work should be conducted (Pruneau et al., 2006; Matkins & Bell, 2007; Moseley & Utley, 2008). Previous studies have shown that teachers and preservice teachers did not know about the instructional strategies that may be used in the environmental education course and therefore needed help (Lane, Wilke, Champeau & Sivek, 1994; Moseley & Utley, 2008). In addition, experimental or quasi-experimental studies have shown that workshop studies on teaching environmental problems have positive effects on teachers (Paul & Volk, 2002), extracurricular activities increased preservice teachers' self-competencies in presenting

environmental problems in the classroom (Moseley, Reinke & Bookout, 2002), and various environmental education programs developed preservice teachers' awareness of and attitudes towards environmental problems (Pruneau et. al. 2006). In addition to these, it has been documented that methods and techniques such as problem solving, field trip, laboratory work and modeling bring better outcomes than teacher-centered instruction in environmental education (Kostova & Atasoy, 2008; Doğru, 2008). Last but not least, it has been suggested that teacher education programs are generally not sufficient in environmental education and that preservice teachers who are to teach environmental education do not have a systematic information flow (Mckeown-Ice, 2000, Yılmaz, Morgil, Aktug & Göbekli, 2002).

### **Visual Materials and Education**

Visual instructional materials include graphics, photographs, concept maps, Powerpoint presentations, films, computer and television images, etc. (Düzgün, 2000). Films are powerful visual tools that may visually present different places and events, offer unrivalled experiences, and facilitate learning (Norman, 2000). Another visual material, pictures and photographs are tools that make learning fun, motivate students to learn and enrich their imagination (Werff, 2003; Wright, 1989). DenBeste (2003) states that visual resources such as pictures and videos help the visualization of various situations in the classroom. He also adds that visual materials support written texts in all disciplines. Another visual material, Powerpoint presentations are also an ideal tool for course presentation. They allow teachers to collect important information in one single file and then present it. These interesting presentations teach them key concepts in particular, increase their attention in the lesson (Szabo & Hastings, 2000; James, Burke & Hutchins, 2006; Burke & James, 2008) and help them learn complex information in depth (Adams, 2006). They are also effective materials in offering students summary information about the topic (Butler & Mautz, 1996). Previous studies also show that courses taught via Powerpoint presentations yield better cognitive outcomes in students than traditional instructional methods (Butler & Mautz, 1996; Christine, 1998; Lowry, 1999; Sugahara & Boland, 2006; Cramer, Collins, Snider, & Fawcett, 2007). Another important feature of Powerpoint presentations is that it is easy to place them within various visual materials to be used in instruction (Bouchlaghem, Wilson, Beacham & Sher, 2002). However, the following points need to be considered when preparing Powerpoint slides (Burke, Ahmadi & James, 2009):

1. Color contrast needs to be adjusted so that the background is easy to see (For instance, dark font colors used against a light background color may be read with more ease).
2. There should not be too many colors in the slides (three different colors are usually enough; one for the background, one for the text and one for emphasis).
3. There should not be too much information in one single slide. Each slide should have just enough information. What needs to be shown is important points about the topic, and not the entire lesson.
4. Too many slides in one lesson suffocate students. Therefore, teachers should use each single slide for a good reason. The main topic should first be identified and slides should revolve around the important aspects of this topic. Also, familiar information for the students should not be included in the slides.
5. There should not be a timer in the slides because each slide requires a different amount of time.
6. If possible, well-designed diagrams or graphics need to be used. These can explain much more than text.
7. Pre-designed slides by other people or publishers should be avoided because these slides may be too limited or too comprehensive (Either prepare your own slides or adapt pre-designed slides for your own topic).
8. Slides should not be allowed to substitute the lesson. They should be used as complimentary materials, not as the sole lesson. Slides may also be used to initiate class discussions for important topics.

As can be seen, visual materials with their many different forms may be used for instruction, enhance teacher and student performance (Greenberg, Raphael, Keller & Tobias, 1998) and enable easier learning than texts (Bouchlaghem, Wilson, Beacham & Sher, 2002). In addition, visual materials enable students to have fun as they learn (Butler & Mautz, 1996; Cramer, Collins, Snider, & Fawcett, 2007; Oluk & Özalp, 2007). These materials help students focus on the topic and make connections with "real life" problems (Hoffman & Ritchie, 1997). This is caused by the light, colors, movement and sounds of visual materials (such as video, pictures, diagrams, etc.), which develop learning behaviors (Yalçın et. al., 2003). A previous study stated that well-designed visual materials can deliver a more effective message than dozens of written pages, achieve aims in a shorter time, and thus should be used so that teachers can learn issues about the subjects they teach more easily and permanently (Düzgün, 2000).

The present study examines the effects of instruction with visual materials on preservice elementary teachers' deficiencies and misconceptions in global warming, on their amendment, and on giving the preservice teachers a positive attitude towards global warming. It was thought that this would reveal whether instruction with visual materials is sufficient in educating more qualified teachers in global warming. Previous comprehensive studies have shown that visual materials are powerful tools of education for teachers to use (Thompson & Wiegmann,

1993). A survey of the literature showed that computer assisted instruction and instruction with visual materials (video, pictures, ppt, etc.) were effective in rectifying misconceptions, ensuring permanent learning and increasing academic success in the fields of biology (Yakışan, Selvi & Yürük., 2007; Dubowy et. al., 2006; Köse, Ayas & Taş, 2003), physics (Düzgün, 2000), chemistry (Dori & Barnea, 1997), mathematics (Dursun & Peker, 2003) and geography education (Yaşar, 2004), as well as psychology (Cramer, Collins, Snider, & Fawcett, 2007) and economics (Blaclock & Montgomery, 2005). A study about global environmental problems is especially noteworthy. In this study, Oluk and Özalp (2007) showed that the use of cartoons and comics gave more effective results on elementary level than the use of traditional instructional methods in the teaching of environmental problems such as global warming, ozone layer depletion and acid rain. Cartoons and comics were observed to facilitate the teaching of these problems, drew students' attention to the topic and brought an element of fun to classes. The preference of visual materials in the present study results from the successful outcomes obtained in previous studies in the field of education as well as other disciplines and the relatively few numbers of tertiary level studies concerned with instruction with visual materials, particularly in the issue of global warming.

## PURPOSE

Answers to the following questions were sought with the present study:

1. Does instruction with visual materials have an effect in rectifying preservice teachers' deficient knowledge and misconceptions about global warming?
2. Does instruction with visual materials have an effect in changing preservice teachers' environmentally friendly behaviors adopted to curb global warming?
3. Does instruction with visual materials have an effect on the attitudes of preservice teachers towards global warming?
4. Does instruction with visual materials have an effect in changing the daily habits of preservice teachers to curb global warming?

## METHODOLOGY

### Research Model

Qualitative and quantitative research methods have been used jointly in this study. The quantitative method of experimental-control group pretest-posttest experimental design and the qualitative technique of semi-structured interview was utilized. Before and after the study, the participating preservice teachers were given demographic information questionnaires, 2 open-ended questions and the Global Warming Attitude Scale (GWAS) designed by the researcher (Bozdoğan, 2009a). In addition, a 4-item semi-structured interview was held at the end of the study with 6 students randomly selected from among the experimental group students (n=23). While traditional instructional methods (lecturing and question-answer) were used in the control group during the study, class activities (hand-on activities, work-shop) and instruction with visual aids were used in the experimental group.

### Sample

The study was conducted in Giresun University, Faculty of Education, Department of Elementary School Education in Turkey. The sample included preservice teachers in their 6<sup>th</sup> semester of study, who had previously taken the course "Environmental Education" between September 2007 and January 2008 (during their 4<sup>th</sup> semester of study) and passed the course successfully. The Environmental Education course was scheduled as two hours per week and the total contact hours were 28. In this course, the basic concepts of global warming were introduced in a unit entitled "ecological problems", which lasted 4 hours. Traditional methods of education (lecturing, discussion, question and answer) were used. The course included two examinations: one midterm and one final. A total of 98 preservice teachers took the course and 9 failed the midterm and final exams. When the examination papers of these 9 candidates were analyzed, their answers about the basic concepts of global warming were seen to be unsatisfactory and they were thus excluded from the study. The 89 preservice teachers were given the demographic information questionnaires, the 2 open-ended questions and the GWAS. When the experimental and control groups were formed, GWAS pretest total scores (experimental group  $\bar{X} = 3.58$ , control group  $\bar{X} = 3.60$  and  $t_{(45)} = 0.167$ ,  $p > .05$ ), areas of interest (physics, chemistry, biology, astronomy, etc.), and their sources of information about global warming were considered. Equivalent control and experimental groups were formed from the 47 preservice teachers whose ages ranged between 20 and 23. The demographic features of experimental and control groups are given in the table below.

Table 1: *Demographic information of experimental and control group preservice teachers (f)*

Demographic information	Control Group	Experimental Group
Gender		
Boys	10	7
Girls	14	16
Interest		
Biology	10	10
Physics-Astronomy	11	9
Chemistry	2	3
Mathematics	1	1
Information Source		
Tv	7	8
Internet	3	3
Magazine-Newspaper	4	3
School-Course Books	2	1
No source	8	8
Total	24	23

### Implementation Process

**Week 1 (50'x3):** During the first week, the same process was followed in both experimental and control groups. Three different tests were implemented to form the experimental and control groups. The first one was the demographic information questionnaire (age, gender, areas of interest, following the news about global warming, etc.), the second was the 2 open-ended questions, and the third was the GWAS. Analyses of total scores from the demographic information questionnaire and the GWAS helped the allocation of preservice elementary teachers to the experimental and control groups.

**Week 2 (50'x2):** The experimental group preservice teachers were made to watch an approximately 80-minute documentary film giving information about the reasons and results of global warming. After the film, a short 20-minute evaluation was held with the students. With the control group preservice teachers, traditional instructional methods (lecturing, question-answer, etc.) were used to give information in a 2-hour session about the reasons of global warming. During this, the teacher had an active role.

**Week 3 (50'x2):** In the experimental group, the researcher gave a ppoint presentation about the environmentally-friendly behaviors needed to curb global warming individually in and outside the home. Experimental group students were divided into 8 to form workshop groups. These workshop groups were then asked to analyze a minimum of 5 visual materials displaying the effects of global warming (photographs, animations, cartoons, comics, etc.) and prepare them as a ppoint presentation for the following week. Each student group was also asked to prepare posters related to the topic. In the control group, the preservice teachers were given a 2-class-hour session about the results of global warming using traditional methods (lecturing, question-answer etc.). During this session, the teacher had an active role.

**Week 4 (50'x3):** In the experimental group, ppoint presentations prepared by the workshop groups were presented. Each group was given 15 minutes. The visual materials used in presentations treated the topic of global warming in a reason-result relationship. For the evaluation of visual materials, techniques such as class discussions and brain storming were used. Later, the workshop groups presented their posters about global warming and they were voted in the classroom. The most voted posters were displayed on bulletin boards around the faculty. In the control group, traditional instructional methods (lecturing and question-answer) were used once again by the researcher to inform the students about the environmentally friendly behaviors that may be used to curb global warming individually in and outside the home. Then, question-answer was used for an evaluation.

**Week 5 (50'x2):** Posttests were implemented in both the experimental and control group. During this process, the two open-ended questions in the pretest and the GWAVS were implemented again.

**Week 6 (50’x2):** Semi-structured interviews were held with 6 randomly selected preservice teachers (3 females, 3 males) from the experimental group. These individuals were asked 4 questions. During this week, nothing was done with control group students.

### Data Collection

Data were collected in four stages.

1. In the first stage, demographic information questionnaires were utilized. This part aimed to identify gender, age, area of interest (biology, physics, chemistry, astronomy, etc.), and sources of information about global warming.

2. In the second stage, two open-ended questions were asked to measure students’ global warming information levels. These questions were *1. How do you define Global Warming?* and *2. What do you think about the actions we can take individually at home and outside to curb Global Warming? What kinds of precautions do you take?*

3. In the third stage, the GWAS, which was developed by the researcher (Bozdoğan, 2009a), was implemented to identify students’ global warming attitudes and value levels. Consisting of 37 items, this was a Likert type scale with the following scores: 1 “Disagree completely”, 2 “Disagree”, 3 “Undecided”, 4 “Agree” and 5 “Agree completely”. The KMO value of the scale was 0,928 and the Barlett value 5980,243. Total correlation values of the items ranged between 0,468-0,757. Factor load values of items gathered in the first factor and the factor load values of the 37 items were 0,476 and higher. The Cronbach Alfa reliability coefficient of the scale was  $\alpha = 0.94$ .

4. In the fourth stage, semi-structured interviews were held with 3 female and 3 male students selected randomly from the experimental group. The questions asked were: *1. Did the experimental study with visual materials change your perspective on global warming? How? 2. Has a change occurred in your process of following global warming news? How? 3. Have you given up any habits to curb the effects of global warming? Can you exemplify? 4. What sort of work will you undertake to raise your students’ awareness when you start to teach?*

### Data Analysis

Data obtained were analyzed by using quantitative and qualitative data analysis techniques. The former included frequency, t-test and Covariance analyses, while the latter included the two open-ended questions measuring students’ level of information about global warming and focus group interviews. Data obtained from these qualitative analysis techniques were classified and grouped independently by 3 different researchers. These groups were then coded and compared under the same roof. Frequency distributions (f) were obtained from the data and preservice teacher views supporting the analysis results were included.

## RESULTS

### Part 1: Analyses of Preservice Teachers’ Answers to the Open-ended Questions

In this part of the study, preservice teachers’ answers to the two open-ended questions were analyzed to identify their global warming information levels.

Question 1. *How do you define Global Warming?*

Experimental and control group preservice teachers’ answers to the questions were analyzed and the table below was compiled.

Table 2: *Distribution of answers given to open-ended questions by the control group (f)*

Group	Pretest			Posttest			TOTAL
	Correct Knowledge	Misconception	Erroneous Knowledge	Correct Knowledge	Misconception	Erroneous Knowledge	
Control group	5	10	7	8	9	5	24
Experimental group	5	14	4	14	6	3	23
TOTAL	10	24	11	22	15	8	47

In the present study, the number of control group preservice teachers who had misconceptions about the reasons for global warming was 10. With the study, the number decreased only to 9. Similarly, the number of those with deficient knowledge decreased from 7 to 5. However, the outcomes in the experimental group were rather different. The number of preservice teachers who had misconceptions about the reasons for global warming decreased from 14 to 6. The number of those with deficient information decreased from 4 to 3. These results

show that instruction with visual materials was better than the use of traditional instructional methods in rectifying the misconceptions of preservice teachers about the reasons for global warming.

The pretest answers of control group preservice teachers showed that 8 held the misconception that “*global warming happens due to ozone layer depletion*”. Of the other 2 preservice teachers, one stated that “*a decrease in river flow rate causes global warming*”, while the other one said that “*global warming occurs when the Sun’s rays reaching the earth cannot be kept but reflected*”. The posttest answers of control group preservice teachers showed that 5 continued their misconception that “*global warming happens due to ozone layer depletion*”. Out of the other 4 preservice teachers, one insisted that “*a decrease in river flow rate causes global warm*”, and another one that “*global warming occurs when the Sun’s rays reaching the earth cannot be kept but reflected*”. Another preservice teacher stated that “*global warming occurs when poisonous gases released into the air cause atmosphere depletion and when more of the Sun’s rays reach the earth*”. The last preservice teacher’s answer is worth noting: “*global warming happens when nitrogen in the atmosphere increases and the earth temperature rises*”.

The pretest answers of experimental group preservice teachers showed that they had similar misconceptions as the control subjects. Ten of the preservice teachers held the misconception that “*global warming happens due to ozone layer depletion*”. Of the remaining 4 preservice teachers, 3 said that “*global warming happens due to the temperature differences between day and night*”, while the remaining one stated that “*global warming occurs because more of the Sun’s rays reach the earth due to atmosphere depletion*”. The posttest answers of these preservice teachers revealed that 4 persisted in their misconception that “*global warming happens due to ozone layer depletion*”. Two others still said that “*global warming happens due to the temperature differences between day and night*”.

Question 2. *What do you think about the actions we can do individually at home and outside to decrease Global Warming? What kinds of precautions do you take?*

Answers of the 22 preservice teachers in the experimental and control groups were analyzed and their views were tabulated as follows.

Table 3: *Distribution of individual environmentally friendly behaviors (f) of experimental and control groups to combat global warming*

Group	Tests	do						TOTAL
		I don't do anything	I save water	I save energy	I don't litter the environment	Educational activities	Others	
Control group	Pretest	7	14	14	6	2	9*	52
	Posttest	4	13	16	8	3	10*	54
Experimental group	Pretest	5	15	14	2	---	4**	40
	Posttest	---	23	23	2	3	11**	62

\* *Using recycled products, following news items about global warming, avoiding waste in food consumption, becoming a member of environmental organizations, planting trees.*

\*\**Planting trees, using recycled products, making use of solar energy, using mass transportation.*

Not much difference is observed between the control group’s pretest and posttest answers concerning behaviors to combat global warming. In the pretest, 14 preservice teachers mentioned water consumption (limiting shower time, turning taps off while brushing teeth or shaving, etc.) and energy consumption (using energy-saving light bulbs, unplugging electronic tools such as TV or computer and not leaving them on stand-by, not using too much fuel for heating, making use of solar energy, etc.). The results of the posttest resembled those of the pretest. Thirteen of the preservice teachers said they took care in water consumption, while took care in energy consumption. In addition, control group individuals were found to display behaviors related to avoiding environmental littering (pretest 6 people; posttest 8 people) and to educational activities (pretest 2 people, posttest 3 people). While the pretest showed that 7 preservice teachers did not exhibit environmentally friendly behaviors, the number decreased to 4 in the posttest.

The answers of experimental group preservice teachers showed a different situation. While 15 of the preservice teachers said they took care with water consumption in the pretest, this number increased to 23 at the end of the experimental study. The case with energy consumption was also similar (pretest 14 people, posttest 23 people). Therefore, it may be said that the experimental study contributed to the development of more thoughtful behaviors about global warming, and particularly about water and energy consumption, in all preservice teachers. Other behaviors displayed by the experimental group preservice teachers did not vary significantly. These included not littering the environment (pretest 2 people, posttest 2 people) and educational activities (posttest 3 people). While 5 of the experimental group preservice teachers never displayed any environmentally friendly behaviors prior to the experimental study, this situation was entirely rectified afterwards.

### Part 2: Analyses of Preservice Teachers' Responses to the GWAS

This section analyzes and tabulates experimental and control preservice teachers' responses to the GWAS scale.

Table 4: *T-test results of related samples concerning experimental group pretest - posttest scores*

Measurement	N	$\bar{X}$	S	sd	t	p
Pretest	23	3.58	0.36			
Posttest	23	3.82	0.32	22	-4.445	.000

Table 4 shows that the mean pretest total score of the experimental group was ( $\bar{X} = 3.58$ ), while their mean posttest total score was ( $\bar{X} = 3.82$ ). This difference between pre and posttest scores was statistically meaningful and in favor of the posttest ( $t_{(22)} = -4.445$ ,  $p < .001$ ). Correlation between the pre and posttest scores of the experimental group was 0.732, and impact factor was  $d = 0.93$ . According to this finding, the experimental study can be said to have a significant effect on the development of attitudes against global warming among preservice teachers.

Table 5: *T-test results of related samples concerning control group pretest - posttest scores*

Measurement	N	$\bar{X}$	S	sd	t	p
Pretest	24	3,60	0.47			
Posttest	24	3,70	0.37	23	-1.647	.113

Table 5 reveals that the mean pretest total score of the control group was ( $\bar{X} = 3,70$ ), while their mean posttest total score was ( $\bar{X} = 3,60$ ). This difference between pre and posttest scores was not statistically meaningful ( $t_{(23)} = -1.647$ ,  $p > .05$ ). Correlation between the pre and posttest scores of the control group was 0.761, and impact factor was  $d = 0.33$ . These results imply that traditional instructional methods did not have a meaningful effect in developing attitudes against global warming in the control group.

Table 6: *Descriptive statistics of experimental and control preservice teachers' GWAS pretest- posttest attitude scores*

Groups	N	Tests	Total Means		Estimated Means		Marginal
			$\bar{X}$	sd	$\bar{X}_e$	sd	
Control Group	24	Pre-test	3,60	0.47			
		Post-test	3.70	0.37	3.70	0.05	
Experimental Group	23	Pre-test	3.58	0.36			
		Post-test	3.82	0.32	3.83	0.05	

$\bar{X}_e$  : Estimated posttest means

Table 7: *ANCOVA results of posttest scores adjusted according to pretest in both groups*

Source	Type III Squares	Sum of Squares	df	Mean Square	F	p	D
Pretest	3.103		1	3.103	55.977	.000	
Group	.193		1	.193	3.482	.069	
Error	2.439		44	5.544E-02			
Corrected Total	5.699		46				

R Squared = .572 (Adjusted R squared = .553)



Analysis of covariance results showed that when pretest total scores were controlled, it was not meaningful with respect to posttest adjusted mean scores [ $F_{(1,44)}=3.48$ ,  $p>.05$ ]. Although a meaningful difference did not exist between the posttest mean scores of the groups, the mean of the experimental group ( $\bar{X}=3.83$ ) was higher than that of the control group ( $\bar{X}=3.70$ ). According to this, the experimental study partially developed preservice teachers' attitudes against global warming when compared to traditional instructional methods.

### Part 3. Results of Semi-Structured Interview with Experimental Group Preservice Teachers

In this part of the study, interviews held with preservice teachers were analyzed.

Question 1. *How did the experimental process supported by visual materials change your outlook on global warming?*

All of the preservice teachers who were interviewed stated that global warming was a more serious and sensitive topic than they thought it to be, and that they now had a larger perspective on the reasons and results of global warming. All of the preservice teachers emphasized that visual materials had a significant effect on this process. Some preservice teacher views were as follows:

*Orkun: I had some rough idea about global warming. With this study, I learnt the reasons for global warming. I learned that it occurs due to CO<sub>2</sub> emissions. I actually didn't know that. From now on, I will be more responsible.*

*Ahmet: I had some rough idea. For instance, that the polar ice was melting. But I had never been visually presented such information. Obviously, we came to see the grimness of the issue. As our earlier environmental education sessions covered global warming only via lecturing, we didn't get really interested in the issue. But the documentaries we watched and the photographs we saw enabled us to see the issue from a larger perspective. I now have a much better idea about how the polar ice is melting and why polar bears are threatened.*

*Arzu: We had theoretical information about the issue. But such information does not usually grab your interest. When we see visual information, we start to think about it. In short, I learnt that everything is in the hands of humans.*

*Elmas: I thought global warming was a recent problem. But the documentary showed me that global warming has actually been around since the 1950s, as evidenced by various studies. I also only thought about the reasons-results of global warming in Turkey. But I noticed that certain countries significantly cause global warming and this is a worldwide problem.*

Question 2. *What can you say about following news articles about global warming after the experimental study?*

Preservice teachers' answers to this question showed that all 6 preservice teachers who were interviewed sometimes followed news stories about global warming in print and visual media before the experimental study but did not take them seriously; they became more careful and conscious afterwards and were upset about negative results. Some of the opinions of preservice teachers were as follows:

*Durali: I now follow this issue more consciously and I worry. From recent scientific studies about the earth, I can see that there are serious problems.*

*Orkun: Previously I sometimes followed news items about state policies but now I'm more selective about news on energy saving.*

*Ahmet: To be honest, I previously did not take this issue seriously and did not think that it was an important issue. But I became more curious as a result of the study. What is happening? What country is doing it? Why don't these countries reduce their CO<sub>2</sub> emissions? Now I have more interest in these issues.*

*Halime: Previously, I wouldn't stop to think about global warming. But now I understand the gravity of the situation, I listen to news stories with more attention and I get really upset when I read negative stories about global warming.*

*Elmas: I used to follow news stories about global warming every now and then. For instance, I heard it that Holland was going to be submerged in water. But now I also follow issues about particularly consumption, for instance energy saving air-cons, lightbulbs and fridges.*

Question 3. *Have you given up any habits in order to curb the effects of global warming? Can you exemplify?*

Four of the interviewed preservice teachers admitted that they previously had habits that contributed to CO<sub>2</sub> emissions, and that they gave up on them. Two preservice teachers said that they did not have any habits that

increased CO<sub>2</sub> emissions but they still became more careful in their electricity and water use. Below are some views from the preservice teachers:

**Ahmet:** *Previously, I never used to unplug the computer or TV, I even took naps in front of the TV. But now I take utmost care about these.*

**Halime:** *In addition to saving energy and water, I also take care about raising the awareness of people around me. For instance, as my mother is pedantic about cleaning, a lot of water is wasted for excessive cleaning at our home. I talk to my family and warn them. I now notice my mother saving significant amounts of water, which makes me very happy.*

**Elmas:** *I used to use a night lamp. I was scared of the dark and I also liked its colors. But now I've given up altogether. Also, I look for the recycle logo when I go shopping. I also try to set a good example for others with my actions.*

**Arzu:** *Every time there is an interesting class at university, I always share it with my room mates at the dormitory. For instance, I make my mates turn the lights off when not needed at the dorm. I even set limits on their bath times. They tell me it's enough but I stand firm and I emphasize the dangerous results of global warming. They've got used to me now.*

Question 4. *When you become a teacher, what types of work will you undertake to raise your students' awareness?* Five of the preservice teachers stated that, similar to this experimental study, they were going to use visual materials (videos, photos, etc.) and make room for social activities (student clubs, campaigns in the city, etc.). The views of 6 preservice teachers are given below:

**Ahmet:** *First, I plan to support social activities. I want to be a leader in establishing clubs about these topics and organizing social activities. In addition, I will use visual materials to demonstrate the seriousness of the topic. But I believe the most permanent will be games and drama. We still remember the games we used to play when we were 5, don't we? Therefore I'd like to organize such activities.*

**Halime:** *I will prefer field trip and observation activities. If I work in an industrialized area, I may take students to these sites, show them the fumes from the chimneys and discuss their effects on the environment. They can then see the results for themselves. I will support this by using visual materials showing other sources of CO<sub>2</sub> emissions.*

**Durali:** *I'll give information by using visual materials and make them bring news items and photos from visual print media to the classroom and discuss them. I will display these news items or other visual materials that I prepare on school bulletin boards. I will therefore try to use these boards actively.*

**Orkun:** *If we can give young children positive attitudes about this issue, it will become their lifestyle. I know that we have responsibility in this issue. Therefore, as a person who believes in the permanence of information presented through visuals, the first thing I'll do will be to explain the gravity of the situation with photos and documentaries. I will establish a discussion environment using these visuals and critical thinking. By using thought-provoking questions such as "What should we do in these circumstances?", I will make my students understand this concept.*

**Arzu:** *I would like to raise my students' awareness by organizing various activities. For instance, I will prepare brochures and posters, establish student clubs, and use social interaction more to make students aware. Also, various campaigns need to be organized in the city or town. For instance, awards may be given to students and schools who collect the biggest number of en disposed batteries. Another way to raise awareness may be to make elementary pupils play games and participate in drama activities.*

**Elmas:** *My first deed as a teacher will be to divide the waste bin into 3. Therefore students will get into the habit of separating glass-plastic and paper waste. Then, I would definitely like to use visual materials to show my students the reasons and results of global warming. They will achieve more permanent learning and be more aware. In addition, as the issue of global warming is a contemporary one, it may also be linked to other courses such as life studies, social studies and Turkish, and different activities may be possible.*

## DISCUSSION AND CONCLUSION

This study compared instruction with visual materials and traditional instructional methods in improving preservice teachers' global warming information levels, rectifying their deficient information and misconceptions, developing environmentally friendly behaviors against global warming, and increasing their attitudes towards global warming. Although the preservice teachers in the experimental and control groups were given 4 hours of global warming instruction using traditional methods (lecturing, question-answer) during the environmental

education course of the previous year and they all passed this course, both groups were found to have information deficiencies or hold misconceptions before the study. The most common misconception both in the control (8 people) and experimental (10 people) groups was that “*global warming happens due to ozone layer depletion*”. This misconception is rather common in tertiary level studies (Boyes & Stanisstreet, 1992; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994; Dove, 1996; Groves & Pugh, 1999; Summers, Kruger, Childs & Mant, 2001; Khalid, 2001; Pekel, 2005; Michail, Stamou & Stamou, 2007; Matkins & Bell, 2007). This study also found misconceptions that are less frequent in the literature. Among the control group, other misconceptions were “*a decrease in river flow rate causes global warming*” (1 person), “*global warming occurs when the Sun’s rays reaching the earth cannot be kept but reflected*” (1 person), “*global warming occurs when poisonous gases released into the air cause atmosphere depletion and when more of the Sun’s rays reach the earth*” (1 person) and “*global warming happens when nitrogen in the atmosphere increases and the earth temperature rises*” (1 person). In the experimental group too, certain uncommon misconceptions were spotted: “*global warming happens when nitrogen in the atmosphere increases and the earth temperature rises* (3 people)” and “*global warming occurs because more of the Sun’s rays reach the earth due to atmosphere depletion*” (1 person). In the present study, success in the control group where traditional instructional methods were used to rectify the information deficiency and misconceptions about the reasons for global warming was approximately 12%. On the other hand, in the experimental group where visual materials were used, it was approximately 40%. It thus follows that instruction by visual materials yields more successful results in rectifying the information deficiency and misconceptions about the reasons for global warming.

The environmentally friendly behaviors adopted against global warming were similar in the two groups before the study. The control group individuals were seen to be mostly concerned with water (14 people) and energy (14 people) use. In the experimental group too, the biggest concern was water (15 people) and energy (14 people) consumption. It is believed that preservice teachers took measures about energy use as it causes global warming, and they took measures about water use as global warming depletes water resources. At the end of the study, the two groups still exhibited the same behaviors, but with a difference in the total distribution. An approximate increase of 4% was seen in the environmentally friendly behaviors in the control group, while the rate of increase in the experimental group was 65%. These results reveal that when preservice teachers are instructed with visual materials as opposed to traditional methods, they consider the future effects of global warming and behave more consciously. Both control and experimental group members were actually observed not to have any deficient information or misconceptions about the behaviors exhibited for curbing global warming. These behaviors by preservice teachers parallel the findings of Groves and Pugh’s 1999 study and Yılmaz, Morgil, Aktug and Göbekli’s 2002 study. It is noteworthy that although both experimental and control group preservice teachers had many deficiencies in information and misconceptions according to the pretest results of the present study, they possessed adequate and accurate ideas about the behaviors needed to curb global warming.

This was attributed to print and visual media in previous studies. In these studies, preservice teachers mentioned print and visual media as their top source of information about global warming and other environmental problems (Hillman, Stanisstreet & Boyes, 1996; Shanahan, Morgan, & Stenbjerre, 1997; Khalid, 2001; Yılmaz, Morgil, Aktug & Göbekli, 2002; Öztas & Kalıpçı, 2009; Hansen, 2009). However, reporters with deficient and insufficient information may cause question marks in the minds of the public. The media may also exaggerate the issue in an unscientific way and thus misguide the audience (McBean & Hengeveld, 2000; Schreiner, Henriksen & Hansen, 2005). For instance, although CH<sub>4</sub> is a more dangerous greenhouse effect inducing gas than CO<sub>2</sub>, the media do not mention it much. Therefore, when preservice teachers utilize print and visual media to complete their shallow and deficient information about the environmental problems that are intertwined in complex ways, misconceptions arise. Indeed, a previous study showed that some students did not remember their classroom education but behaved in line with the information they gathered from the press (Khalid, 2001). This was the case in the present study, too. Both groups of preservice teachers mostly used print and visual media as their information resource about global warming. However, the posttest responses of the experimental group showed an improvement in their deficient information and misconceptions. This is thought to be caused by using visual resources (pictures, photographs and video images) in the classroom, which draw students’ attention and are used by the visual media to inform the society. It is thus believed that instruction with visual materials, which draw the attention of preservice teachers, may be useful in rectifying deficient information and misconceptions. Certain studies recommended that cooperative learning, problem-based learning, critical thinking based instruction techniques (McBean & Hengeveld, 2000; Khalid, 2001; Schreiner, Henriksen & Hansen, 2005; Doğru, 2008) and specially prepared environmental education programs may be used to rectify these misconceptions and offer a more effective education to preservice teachers about environmental problems (Shin, 2000).

Another result of the present study was that traditional instructional methods had a weak effect [ $t_{(23)} = -1.647$ ,  $p > .05$ ;  $d = 0.33$ ] while education supported by visual materials had a strong effect [ $t_{(22)} = -4.445$ ,  $p < .05$ ;  $d = 0.93$ ] on

the development of global warming attitudes in preservice teachers. In addition, analysis of covariance results showed that when pretest total scores were controlled, the groups were not meaningful with respect to adjusted mean posttest scores [ $F_{(1,44)}=3.48, p>.05$ ]. Although a meaningful difference did not exist between the mean posttest scores of the two groups, the higher mean score obtained by the experimental group ( $\bar{X}=3.83$ ) than the control group ( $\bar{X}=3.70$ ) suggests that the experimental study improved students' global warming attitudes more than traditional instructional methods did. Considering that short-term experimental studies may not be sufficient for students to develop permanent attitudes towards environmental issues (Hart & Nolan, 1999), the small difference between the attitude total scores of the control and experimental groups in the present study may be attributed to its 3 week duration (7 class hours). Longer-term studies may be conducted to clarify these issues. All 6 of the randomly selected preservice teachers from the experimental group said in the semi-structured interviews that the issue of global warming was a more serious and sensitive issue than they thought and they now had a larger perspective on the causes and effects of global warming. All 6 preservice teachers who were interviewed also emphasized that visual materials had been rather influential in this process. At the same time, all preservice teachers said that they followed the news stories about global warming in the print and visual media with more attention and awareness, and worried seriously about the negative consequences. Four of the preservice teachers who were interviewed stated that they used to have certain habits that contributed to CO<sub>2</sub> emissions (using night lamps, taking a nap in front of the TV, etc.) but they gave them up. Five of the preservice teachers also said that, similar to the present experimental study, they are going to use visual materials (videos, photos, etc.) when they become teachers and stress the importance of social activities (student clubs, campaigns in the city, etc.). As can be seen, the answers of preservice teachers to interview questions reveal the effects of instruction with visual materials on them.

The present study showed that, when compared to traditional instructional methods, instruction with visual materials led to a partial increase in preservice teachers' information and attitude levels about global warming. In addition, it also seemed to draw preservice teachers' attention in the topic. In off-the-record talks with preservice teachers after classes, they stated that such visual materials made learning more fun and meaningful, increased their interest in the topic, and other classes should also incorporate the use of visual materials. Indeed, previous studies also found similar findings (Butler & Mautz, 1996; Cramer, Collins, Snider, & Fawcett, 2007; Oluk & Özalp, 2007). Seen from this perspective, the experimental study may be considered a success as it increased the interest of preservice teachers in the issue. More interest may encourage preservice teachers to gather more conscious and careful information from informal learning environments, and it may as a result increase their information and attitude levels and make the learning of the topic in the classroom more effective. Previous studies also revealed that preservice teachers who are interested in environmental issues have higher information and attitude levels than others (Pe'er, Goldman & Yavetz, 2007) and when they have better subject area information, they also have more equipped pedagogical information (Kaya, 2009). In addition, during the process of instruction with visual materials, preservice teachers prepared several visual presentations, which gave them an opportunity to prepare and present visual materials. This gave them potential for the future to more effectively present units about environmental problems with the support of visual materials. Taber and Taylor (2009) conducted an 8-week study in Australia with 29 elementary pupils and revealed that individual activities and effective visual education tools significantly improved students' information levels about global warming and climate change. They also found that activities and visual education tools had a positive effect on student skills related to the topic. In another study, Darçın, Bozkurt, Hamalosmanoğlu & Köse (2006) stated that, in order for elementary pupils to meaningfully learn global environmental problems which include abstract concepts like greenhouse effect, they need to learn by doing and their instruction needs to be enriched by encouraging, curiosity-raising and interesting materials (overhead projector, slides, etc.).

In order to raise more aware generations, it is essential to make preservice teachers understand the gravity of global warming, which is ignored by most people due to its gradually appearing effects. Teachers or preservice teachers have a critical place with respect to environmental education. They are key agents that develop and disseminate new educational practices (Kapyla & Wahlstrom, 2000). The present study showed that visual materials, which were shown to be effective in other fields (Dori & Barnea, 1997; Düzgün, 2000; Dursun & Peker, 2003; Köse, Ayas & Taş, 2003; Yaşar, 2004; Dubowy et. al., 2006; Yakışan, Selvi & Yürük, 2007), also had an important function in revealing global warming. Therefore, educating preservice teachers in the matter of global warming by using visual materials (documentaries, photographs, ppt presentations, etc.) at university may have positive consequences. In addition to this, various social activities may be organized at education faculties (preparing posters and t-shirts, establishing student clubs, etc.). Lestera, Maa; Leea & Lambert (2006) stated in a study that social activities may help raise more aware individuals about global warming. Visual materials may also be used at the schools where preservice teachers perform their teaching practice to raise students' awareness.

### IMPLICATIONS FOR FURTHER STUDY

In addition to the present study, which was conducted to reveal the effects of instruction with visual materials on global warming, multiple data are necessary. Extending the current study over a longer period of time will particularly help the achievement of positive attitudes. In addition, this experimental study which was conducted with preservice elementary teachers may be replicated with preservice teachers from other departments such as Science Education, Turkish, Preschool Education. Such studies may also include inservice elementary teachers to obtain a larger perspective.

### LIMITATIONS

As the sample size of the study was small, it needs to be supported by larger-scale studies to reveal the effects of instruction with visual materials.

### ACKNOWLEDGEMENT

My heartfelt thanks to Asst. Prof Dr. Ahmet Kılınc and Research Assist. Kasım Yıldırım for their invaluable feedback.

### NOTE

This study was supported by Giresun University Scientific Research Projects Unit. Project Code 08/02.

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