The effect of the green class model on environmental knowledge and its retention

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Contents

Abstract

The purpose of the study is to investigate the effects of an applied environmental education project carried out using the green-class model on students' environmental knowledge and its retention. 101 7th grade students attending Nazim Akcan Primary School in the Altindag Province of Ankara participated in the study. The study was carried out in the form of pre-test post-test monitoring design. The Environmental Knowledge Test was used as a data collection instrument. For the analysis of the data, a two-way ANOVA for mixed measures was used. The post-test and monitoring test means of both the experimental groups were found to

be significantly higher than the control group. As a conclusion, the green-class model considerably enhanced the environmental knowledge of the students and its retention. It was able to make a great contribution to the environmental knowledge of the students residing in a low socio-economic neighbourhood. This project is an original study and can be implemented with different samplings.

Keywords: green class model, applied environmental education, environmental knowledge, sustainability

Introduction

With an increasing threat posed to the human health by environmental problems, environmental values have started to draw greater attention (Reid, 1995). With environmental problems lie the irresponsible and indifferent environmental behaviours (Bradley, Waliczek & Zajicek, 1999). Hence, the most important stage of the fight to overcome environmental problems at an early age is of great importance to enhance environmental knowledge of individuals (Gambro & Switzky, 1996). In the literature, there are many studies arguing that environmental education results in significant changes in the environmental knowledge level of students (Bradley, Waliczek & Zajicek, 1999; Palmberg & Kuru, 2000; Erten, 2001; Makki, A.E.Khalick & Boujaoude, 2003; Farmer, Knapp & Benton, 2007).

The traditional view of the purpose of the environmental education is to help students develop positive opinions on the environment and to protect the environment by learning the environmental values. However, today, it is seen in environmental education literature that learning about the environment, within natural settings and through experiences, has gradually gained more importance (Fien & Tilbury, 2002; Tilbury, 2004). In other words, for the environmental education to be effective, the school setting should not be viewed only as a teaching area, but also as an area where good applications can be performed (Hart, 1997). From this standpoint, students should learn about the environment by doing activities and living in it (Gayford, 1996). There are many studies in the literature reporting the positive results of this new student-based approach (Brisk, 2000; Erten, 2001; Nicol, 2002; Yilmaz, Morgil, Aktug & Gobekli, 2002; Aksoy, 2003; Sahin, Cerrah, Saka & Sahin, 2004; Fishman, 2005).

In recent years, new applications, often with different names such as green classroom (grüne Klassenzimmer), green school (grüne Schule) and ecological school (ökologiche Schule), where educational settings are intertwined with nature,

have been gaining greater importance in many countries, primarily in the European Union (Anonymous, 2003; Stroh & Sabel, 2005). Green learning applications based on the idea of providing activities, which help students use their brain, heart and hands simultaneously in an integrated manner, not only bring about opportunities for long-lasting and meaningful learning, but also rich educational experiences by improving the harmony and peace between human beings and nature (Stroh & Sabel, 2005). In such educational environments, students can directly observe nature and discover it with as many senses as possible. This leads to enriched experiences resulting in a synthesis for students. For this purpose, educational activities based on direct interaction with the natural elements should be put into practice to impart better understanding of phenomena, such as diversity of living and non-living things in the nature and mutual interactions, links between the non-living environment and living organisms and food and energy flow between them, matter transformation and diffusion to students (Illinois Environment Protection Agency, 2003; Tempel, 2005). In this way, teaching settings are transformed from places restricted by four walls to living areas where environmental events can be directly observed (Sterling, 2001).

In recent years, there have been green learning applications in many countries to help students learn faster and retain information longer. Some of these are the Environment and Schools Initiative (ENSI) Eco-Schools, Foundation for Environmental Education (FEE) Eco-Schools, Green Schools in China, the Green School Award in Sweden and Enviro-schools in New Zealand (Henderson & Tilbury, 2004).

When the related literature is reviewed, it is seen that majority of the studies in Turkey are descriptive in nature, and the number of studies looking at environmental knowledge at the elementary school level is very limited. Ulucinar Sagir, Aslan and Cansaran (2008) conducted a study among 7thand 8th graders and they investigated their environmental knowledge and attitudes in relation to various variables. Alp, Ertepinar, Tekkaya & Yilmaz (2006) aimed to determine students' environmental knowledge and attitudes, the effects of their gender and grade level on their environmental knowledge and attitudes, and investigate the relationship between positive environmental behaviors and intentions, feelings, knowledge and internal-external locus of control. Cabuk, Kaya and Turan (2005) investigated the knowledge level, knowledge sources and environmental sensitivity of the students from different schools (private and public). Atasoy and Erturk (2008) conducted a study to elicit the environmental attitudes and knowledge of the 6th, 7thand 8th

graders. In a study, Ozdemir (2003) attempted to determine environmental knowledge and environmental awareness levels of 8th graders, moreover, he tried to find out whether these variables exhibit significant differences due to socio-economic characteristics of the students.

In the literature review performed, it was found that apart from the green-class applications carried out by the researcher (Ozdemir & Uzun, 2006; Uzun, Saglam & Varnaci Uzun, 2008), there is no study dealing with green class activities in Turkey.

Due to importance of the issue, the present study aims to investigate the effects of applied environmental education conducted according to the green class model on students' environmental knowledge and its retention by the students.

Research questions

The study was guided by the following research question:

Do the environmental knowledge scores of the students vary as a result of teaching with the green class model?

Methods

Participant and application

The present study was carried out according to the pre-test–post-test–monitoring-test model with control and experimental groups. The present study continued throughout an entire school year, and the monitoring period includes three months during the summer holiday. The study group consisted of 101 students attending Nazim Akcan Primary School in the Altindag province, which is one of the provinces with a low socio-economic status in Ankara. In order to investigate the effects of the green class model applications on the 7th grade students' environmental knowledge, participants were assigned into one control and two experimental groups (Experimental 1 and Experimental 2). The use of the two experimental groups parallel to each other makes the study more objective.

In the science and technology curriculum of 7th grade, there is a human and environment unit, and within the framework of this unit, 6 activities are suggested. In this unit, students are informed about the concepts of ecosystem, species, population and habitat. Their awareness of the importance of bio-diversity is raised;

they are encouraged to understand environmental problems in the world and our country and to come up with cooperative solutions to save the endangered animals in our country and the world. The control and experimental groups are assumed to be equally affected from the objectives of the unit.

In the part of the study where the experimental groups were included and green classroom-based activities were used, theoretical information was given to the students from the beginning of the school year, and applied activities started during the spring due to weather conditions. In the applications, every student was provided with an opportunity to prepare a plant in the school garden, and then every student was assigned with the responsibility of growing the plant in the classroom. Among the plants, besides different types of flowers, students were encouraged to grow tomato, bean, pepper, strawberries, etc., to let them experience the sense of producing. During the growth periods of the plants, field trips were organized at places close to the school, and students watched CDs of other geographical regions of Turkey to gain another perspective of nature. Finally, the products obtained were displayed in June, in the final week of the school year at a nature exhibition. According to the performance they exhibited throughout the application, the majority of votes selected one group of students, and they were rewarded by being appointed as nature exhibition officers. In control groups, environmental education was traditionally given within the content and through methods stated in the curriculum.

Instrument

In order to collect data, the researcher developed an environmental knowledge test consisting of 13 items (Appendix 1). This scale was administered to the students as pre-test at the beginning of the study and as a post-test at the end of the study. The scores that can be obtained from the scale fall between 0 and 13. The validity and reliability of the scale were tested, and the Kuder-Richardson 21 reliability coefficient of it was found to be .87.

Data analysis

The statistical analyses of the data obtained were carried out through the SPSS program package. While calculating the environmental knowledge scores, 1 was assigned to the correct answer and 0 to the false answer, and in this way, the environmental knowledge score for each student was calculated.

A two-way ANOVA for mixed measures was used to determine whether there were significant differences among the pre-test, post-test and monitoring scores of the control and experimental groups. For multiple-comparisons, LSD was preferred. The Levene test was used to test the variance homogeneity of the groups to be compared, and Box's M statistics was employed to test the equality of covariance matrices.

Results

In this section, descriptive statistics of the students' environmental knowledge and the differences seen in the groups' the pre-test, post-test and monitoring scores are presented.

Table 1. *Descriptive Statistics Concerning the Environmental Knowledge Pre-test, Post-test and Monitoring Scores of the Students in the Control and Experimental Groups*

	Grups	N	Mean	Std. Deviation
Pre-test	Control	36	7.75	1.872
	Experimental 1	35	7.25	1.686
	Experimental 2	30	7.46	2.255
	Total	101	7.49	1.926
Post-test	Control	36	8.66	1.690
	Experimental 1	35	10.20	1.745
	Experimental 2	30	10.00	1.701
	Total	101	9.59	1.834
Monitoring test	Control	36	8.33	1.414
	Experimental 1	35	9.77	1.733
	Experimental 2	30	9.56	1.794
	Total	101	9.19	1.755

As can be seen in Table 1, the environmental knowledge pre-test scores of the students are close to each other ($\bar{X}_{(control)}$=7.75, $\bar{X}_{(Experimental\ 1)}$=7.25 and $\bar{X}_{(Experimental\ 2)}$=7.46). The environmetal knowledge post-test scores of the students are $\bar{X}_{(Experimental\ 1)}$=10.20, $\bar{X}_{(Experimental\ 2)}$=10.00 and $\bar{X}_{(control)}$=8.66. Monitoring

test scores of the students are $\bar{X}_{(Experimental\ 1)}$=9.77, $\bar{X}_{(Experimental\ 2)}$=9.56 and $\bar{X}_{(control)}$=8.33. Profile plots more explicitly exhibit the changes in the environmental knowledge scores resulting from the applications of green class model are presented below.

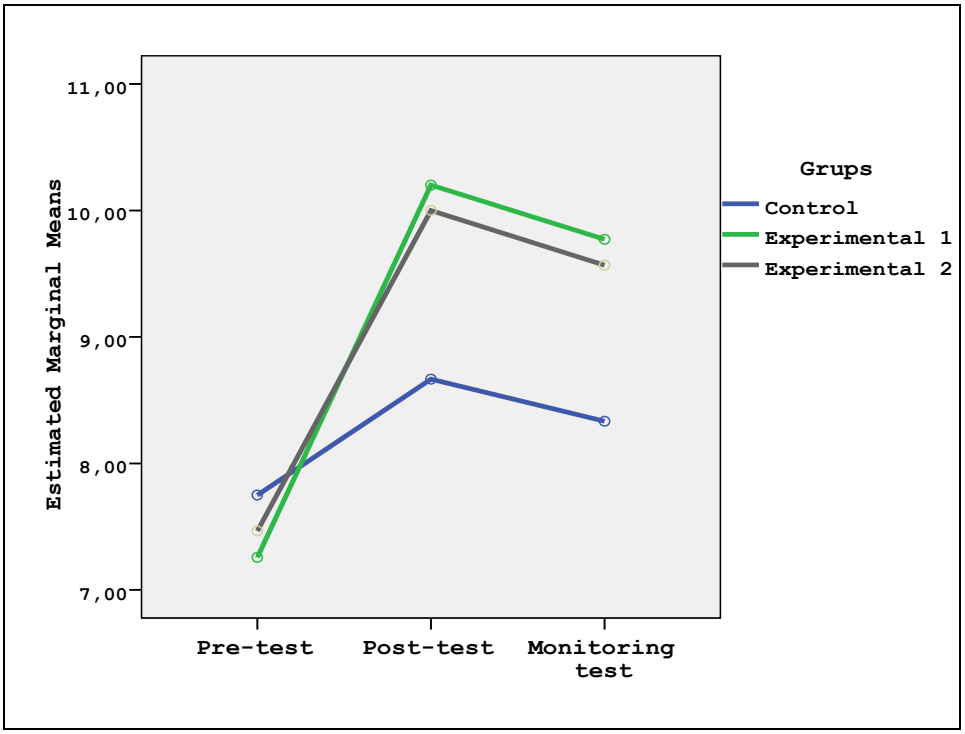

Figure 1. *Profile Plots showing the environmental knowledge pre-test, post-test and monitoring test scores of the control and experimental students*

As can be seen above, throughout the study the environmental knowledge scores of the three groups increased. Yet, a higher score increase favouring the experimental groups can clearly be seen in Figure 1. Scores of the monitoring test administered three months after the study ended indicate little decrease in the scores of the three groups. To determine whether the score differences among the groups are statistically significant, a two-way ANOVA for mixed measures was employed and the results are presented below.

The covariance homogeneity of the groups was tested to determine the suitability of the variance analysis aiming to elicit the significance of the changes in the scores, and covariances were found to be homogenous ($F_{(12\text{-}43777,\ 077)}$=1.197; p>.05) (Table 2).

Table 2. *The Results of Box's Test of the Equality of Covariance Matrices*

Box's M	15.037
F	1.197
df1	12
df2	43777.077
Sig.	.278

Results of Levene statistics were examined to test the hypothesis of the equality of the variances belonging to the groups, and for three variables the hypothesis was confirmed ($F_{(2\text{-}98)}$=1.096, .014 and .559; p>.05, respectively).

Table 3. *The Results of Levene's Test of Equality of Error Variances*

	F	**df1**	**df2**	**Sig.**
Pre-test	1.096	2	98	.338
Post-test	.014	2	98	.986
Monitoring test	.559	2	98	.574

As can be figured out in Table 4, the environmental knowledge scores of the experimental groups trained according to green class model and those of the control group students exhibited significant changes from the beginning of the study to the end of monitoring process; that is, the effects of the model were found to be significant ($F_{(4\text{-}196)}$=7.227; p<.001). On the other hand, $F_{(2\text{-}196)}$=72.532 value is significant at the level of 0.001, indicating that there are significant differences among the environmental knowledge scores of the students obtained before the study, after the study and after the monitoring process.

Table 4. *The Results of Tests of Within-Subjects Effects*

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Factor1	Sphericity Assumed	257.622	2	128.811	72.532	.000
	Greenhouse-Geisser	257.622	1.156	222.907	72.532	.000
	Huynh-Feldt	257.622	1.185	217.461	72.532	.000
	Lower-bound	257.622	1.00	257.622	72.532	.000
Factor1 * Grups	Sphericity Assumed	51.341	4	12.835	7.227	.000
	Greenhouse-Geisser	51.341	2.311	22.212	7.227	.001
	Huynh-Feldt	51.341	2.369	21.669	7.227	.001
	Lower-bound	51.341	2.000	25.671	7.227	.001
Error (Factor1)	Sphericity Assumed	348.078	196	1.776		
	Greenhouse-Geisser	348.078	113.262	3.073		
	Huynh-Feldt	348.078	116.098	2.998		
	Lower-bound	348.078	98.00	3.552		

Besides the findings presented above, the results of the within-subjects effects tests show that there are significant differences between the total score mean (sum of pre-test, post-test and monitoring test scores) of the experimental groups and the control group, stemming from the environmental education given to the experimental groups in line with green class activities and the environmental education given to the control group ($F_{(2\text{-}98)}$= 3.792; $p<.05$).

Table 5. *The Results of Tests of Between-Subjects Effects*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	23203.629	1	23203.629	3975.706	.000
Grups	44.262	2	22.131	3.792	.026
Error	571.963	98	5.836		

The results of LSD multiple-comparison test were used to find the source of the environmental knowledge score differences between the groups. The results are presented in Table 6.

Table 6. *LSD Analysis-based Multiple-comparison Results Concerning the Environmental Knowledge Scores of the Control and Experimental Groups.*

(I) Grups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.
Control	Experimental 1	-.826(*)	.331	.014
	Experimental 2	-.761(*)	.344	.030
Experimental 1	Control	.826(*)	.331	.014
	Experimental 2	.065	.347	.852
Experimental 2	Control	.761(*)	.344	.030
	Experimental 1	-.065	.347	.852

* The mean difference is significant at the .05 level.

According to the results of the multiple-comparison test, the environmental knowledge score means of experimental group 1 and experimental group 2 are significantly better than that of the control group students (Table 6). The difference between the environmental knowledge mean scores of the experimental groups was not found to be significant. These results show that the environmental education given according to green class model is more effective in enhancing the environmental knowledge and its retention.

Conclusion and suggestions

The present study investigated the effects of the green class model, which has an important place in environmental education where active learning methods and techniques are used for students' environmental knowledge and retention. In the present study, conducted according to the pre-test-post-test-monitoring test design, the data was collected through the environmental knowledge test developed by the researcher. In this respect, changes in the environmental knowledge scores of the randomly determined control and experimental groups were tested throughout the school year. Through the monitoring test, the changes in the environmental knowledge of the students were determined within a three-month period in the summer holiday.

The findings of the present study revealed pre-test scores close to each other for the control and experimental groups. It is clearly seen in both the descriptive statistics table and profile plots, that the changes occurring in the post-test scores favour the experimental groups. The monitoring test administered three months after the study revealed a small decrease for all the three groups. However, the monitoring test scores are higher than the pre-test scores.

The two-way ANOVA for mixed measures was used to test whether the score differences were statistically significant. Environmental knowledge scores of the experimental groups trained according to the green class model and those of the control group students exhibited significant changes from the beginning of the study to the end of monitoring process. The effects of the model were found to be significant. In addition, there are significant differences between the total mean score of the experimental groups and the control group, stemming from the environmental education given to the experimental groups in line with the green class model and the environmental education given to the control group.

According to the results of the multiple-comparison test used to find the source of the score differences, the environmental knowledge mean scores of experimental group 1 and experimental group 2 are significantly better than those of the control group (Table 6). The difference between the environmental knowledge mean scores of the experimental groups was not found to be significant. These results show that the environmental education given using the green class model is more effective in enhancing the environmental knowledge and its retention.

The findings of the present study concur with those of the study conducted by Uzun, Saglam and Varnaci Uzun (2008), who reported significant increases in environmental awareness of the 6th, 7th and 8th graders due to green class model applications. In their study among pre-school students, Ozdemir and Uzun (2006) found that science and nature activities performed in a green class setting, based on direct interaction with living things, considerably improved children's environmental awareness. This clearly reveals that science and nature activities performed in a green class environment are more effective than those performed in a traditional class environment. Again, the findings of the present study comply with those of Wilson, Kimler and Krauerhase (1996), who reported that active participation of children and environmental education based on direct experiences are effective in the formation of the environmental awareness. Additionally, children's active experiences in natural elements has a great contribution to cognitive and moral development (Environment Protection Authority, 2003).

According to Ozdemir and Uzun (2006), it is of great importance to investigate the effects of teaching settings called a green class where the students can observe different organisms and their interactions in a natural learning environment. Moreover, Fien & Tilbury (2002) and Tilbury (2004) draw the attention to the importance of conscious learning within the nature and experience-based learning. Hart (1997) argues that schools are places of application, and Gayford (1996) emphasizes the importance of learning by living and doing in nature. In addition, a steadily increasing number of the studies draw attention to the importance of student-cantered applied education (Brisk, 2000; Erten, 2001; Nicol, 2002; Aksoy, 2003; Sahin, Cerrah, Saka & Sahin, 2004; Fishman, 2005).

As a conclusion to the study, it is believed that the green class model, where active learning method and techniques are employed, students who are central to the process and teachers who assume the role of guide will have great contributions to the environmental knowledge within the framework of environmental education. When the study group consists of primary school students, the study becomes more important. At this level of education, the positive results obtained will lay the basis of effective environmental education at higher levels of education. Hence, green class applications should be carried out at other levels of education with different variables.

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Appendix 1:

Environmental knowledge test

1. Which of these is an absolute requirement for a plant to generate its own food?

I- Sun light II- Water III- Carbon dioxide IV-Oxygen

a) I and II b) I, II and III c) I, II and IV d) All

2. Of the following, which dissociates the fastest in the soil?

a)Glass b)Plast c)Apples d)Cloth

3. Which of the following is a development approach that supports the idea that the natural sources should be used in such a way that they can survive for the use of future generations?

a) Global development

b) Economic development

c) Sustainable development

d) Environmental development

4. Which of the following actions would not be taken by an individual with sophisticated environmental awareness?

a) Plants trees and encourages his/her friends to do the same

b) Promotes the use of non-renewable energy resources

c) Prefers recyclable products

d) Tries to make more use of solar energy

5. Increasing the amount of which of the following gases leads to the green-house effect?

a) Oxygen b) Helium c) Nitrogen d) Carbon dioxide

6. Which of the following is not one of the factors leading to erosion?

a) Plowing slopped areas vertical to the slope

b) Cutting trees and destroying forests

c) Overgrazing

d) Unsystematic rural settlement

7. Which one of the following is the product of photosynthesis?

a) Carbon dioxide b) Glucose c) Nitrogen d) Water

8. Which is the most important factor leading to the emergence of environmental problems?

a)Fast consumption of natural sources as a result of rapid population increase

b)Overgrazing and destruction of natural flora

c)Air pollution resulting from the consumption of low-quality coal

d)Pesticides' leading to water pollution

9. Which is/are the main objective(s) of the environmental education?

I- Protection of natural, historical and cultural values by raising the public awareness

II- Creating positive behavioral changes and sensitivity to the environment.

III-Encouraging active participation in the solution of environmental problems

a) Only I b) I and II c) II and III d) All

10. Which one of the following is not one of the elements polluting the soil?

a) Organic wastes

b) Pesticides and herbicides used for agricultural purposes

c) Irregular and excessive use of fertilizer

d) Heavy metals used in the industry

11. Which of the following is endangered due to tourism development in the southern coast?

a) Flamingos b) Hermit ibis c) Mediterranean seals d) Turtle

12. When is World Environment Day?

a) 5th of May b) 5th of June c) 5th of October d) 5th December

13. Which of the following statements are among the necessary measures to protect the environment?

I- Enhance the usability of fossil fuel energy sources

II- Consume materials and services without creating waste

III-Use scientific approaches to create solutions for problems

IV- Make sustainable development a reality

a) I and II b) I and III c) II, III and IV d) All