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RESEARCH ARTICLE

INFLUENCE OF ENVIRONMENTAL EDUCATION MODULAR CURRICULUM ON ACADEMIC ACHIEVEMENT AND CONCEPTUAL UNDERSTANDING*

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Abstract

The purpose of this study was to examine the influence of the environmental education modular curriculum on secondary school students' academic achievements and on their conceptual understanding. In the study, the case study method was used. The research sample included a total of 23 7th grade students (12 male and 11 female) who were determined with the purposeful sampling method and who were attending a secondary school in the city center of Gümüşhane at the time of the study. In the study, as the data collection tool, achievement tests and semi-structured interview questions were used. In order to reveal whether there was a statistically significant difference between the pretest and posttest achievement tests, t-test, one of parametric tests, was applied. According to the results of the analyses, the environmental education modular curriculum had positive influence on the secondary school students' academic achievements as well as on their conceptual understanding.

Keywords: Modular curriculum, environmental education, conceptual understanding, academic achievement, secondary school student.

Introduction

Rapid development of technology leads to apparent effects on people's lives, and it could be stated that the development of technology damages the environment where people live. These negative changes also contribute to deterioration of the ecological balance and the environment (Gayford, 2002; Ramadoss and Poya-moli, 2011). In order to avoid these problems, countries throughout the world organize various meetings and conferences. The purpose of these meetings and conferences held in relation to environmental education is to raise people's environmental consciousness and to decrease environmental problems (Erdoğan, Kostova and Marcinkowski, 2009; Bruyere, Wesson and Teel, 2012). One way of doing so is the development of various curricula regarding environmental education (Erol and Gezer, 2006). It is possible to raising environmental consciousness and decrease the related problems if students are informed and trained; in this respect, formal education could be said to be of great importance (Bradley, Waliczek and Zajicek, 1999; Barraza, 2001). The reason is that effective environmental education to be given to students in formal ways will raise environmental consciousness and then help transfer a livable environment to future generations (Mancl, Carr and Morrone, 1999; Hsu, 2004; Mahidin and Maulan, 2010; İbrahim, Amin and Yaacob, 2011; Bruyere, Wesson and Teel, 2012). In order to achieve this, individuals should have questioning, research and problem solving skills (İnel and Balım, 2010; Tatar, Oktay and Tüysüz, 2010). On the other hand, in environmental education, students should be encouraged to think, discuss and provide various alternative solutions to problems, and permanent learning should be supported

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by applied and enriched student-centered in-class activities (Atasoy and Yüksel, 2006; Farmer et. al., 2007; Aktepe and Girgin, 2009; Balgopal and Wallece, 2009; Şimşekli, 2010; Veeravatnanond and Singseewo, 2010; Sadık and Sarı, 2010).

The traditional approach could be said to have serious deficiencies in teaching these processes and skills and thus to cause failure in environmental education (Ramadoss and Poya-moli, 2011; Manolas and Filho, 2011; Coca, 2013). In addition, students may not have the desired level of academic achievement in environmental education, and changes in their conceptual understanding may not be achieved as intended (Cutter-Mackenzie, 2009; Mahidin and Maulan, 2010). For this reason, it is necessary to activate modular curricula, which will have an important place in environmental education (Artun, 2013; Artun, 2016; Artun and Özsevgeç, 2015; Özsevgeç and Artun, 2012b). When the related literature is examined, it is seen that lack of a specific curriculum or a modular curriculum regarding environmental education constitutes the basis of the concerns mentioned above. In this respect, considering the need for a process which involves use of teaching methods appropriate to the nature of environmental education and which focuses on current environmental problems and on related solutions, it is obvious that the limited number of such curricula to meet that need is an important problem situation (Mastrilli, 2007; Eames et. al., 2008; Tanrıverdi, 2009; Artun and Özsevgeç, 2015; Özsevgeç and Artun, 2012c; Artun, 2013; Artun and Özsevgeç, 2016). In addition, it is a well-known fact that students have little knowledge about the concepts in environmental education; that they do not know the meanings of these concepts; and that they fail to understand these concepts fully (Meınhold and Malkus, 2005; Uzun, Sağlam and Uzun, 2008; Atasoy and Ertürk, 2008; Cutter-Mackenzie, 2009; Mahidin and Maulan, 2010; Özgen and Kahyaoğlu, 2011). Consequently, it could be stated that there should be modular curricula to increase students' conceptual understanding and their knowledge of concepts. Taking the above problem situations into consideration, the present study aimed at examining the influence of the environmental education modular curriculum on students' academic achievement and on their conceptual understanding.

Methodology

In the study, the case study method was used. The reason why this method was applied was the fact that it allows in-depth examination of students' academic achievements and their conceptual understanding of environmental education concepts.

Sample

The research sample included a total of 23 7th grade students (12 males and 11 female) determined with the purposeful sampling method from a secondary school in the city center of Gümüşhane. While determining the research sample, the criterion was that all the students would be similar in terms of mental competencies, academic achievement and socio-economic level.

Data Collection Tools

In the study, achievement tests and semi-structured interview questions were used as the data collection tools. The process of development of these data collection tools has been explained below.

Development of the Achievement Tests and the Related Validity-Reliability Study

In the study, in order to determine the influence of the environmental education modular curriculum on students' academic achievements, achievement tests for five lesson units were prepared. For this purpose, question pools related to each lesson unit were formed. All the questions were prepared by the researchers. The questions

were developed considering such points as students' academic achievement, including up-to-date issues, covering the learning outcomes of the lesson units and the research purpose. Following this, the language used in the questions, their readability, their being scientific and distraction quality of choices were all arranged in a way to allow the students understand the questions easily. The questions were of such question types as those suggested by alternative measurement and evaluation approaches as concept maps, structured grids and diagnostic branched trees.

The achievement tests were piloted with 29 7th grade students from a secondary school located in the city center of Gümüşhane. For the content validity of the achievement tests, one expert from the field of measurement and evaluation, one expert experienced in environmental education and five science and technology teachers were asked for their views. In line with their views, it was found that the achievement tests were valid and that they could be used in the study. The Cronbach Alpha internal consistency coefficients of the achievement tests were calculated as .72 for the lesson unit of "Environmental Consciousness", .76 for "Ecosystem", .91 for "Plants and Animals", .83 for "Environmental Phenomena" and .84 for "Environment and Human". It could be stated that the achievement tests had a good level of reliability coefficients and that they could be used in the study (Büyüköztürk, 2006; Çepni, 2010).

Development of the Interview Questions and the Related Validity-Reliability Study

In order to determine the influence of the environmental modular curriculum on students' conceptual understanding for each lesson unit, semi-structured interview questions were prepared regarding the concepts. The language used in the questions, their readability, their being scientific and distraction quality of choices were all arranged in a way to allow the students understand the questions easily. Eventually, eight semi-structured interview questions for the lesson unit of "Environmental Consciousness", eight for "Ecosystem", four for "Plants and Animals", six for "Environmental Phenomena" and four semi-structured interview questions for the lesson unit of "Environment and Human" were obtained.

In line with the experts' views, the interview questions were found valid for use in the present study. An important point in relation to the interview questions was that they were all clear enough for the students to understand. In addition, special attention was paid to the storage of the audio and video records for the reliability of the data. The students were informed about the fact that the interviews were held just for research purposes. Also, in order to keep the participants' names confidential, they were represented with symbols. As for the analysis of the interview data, codes and themes were formed by two researchers from the field of science education, and the codes and themes that both researchers agreed on were used in the study. For the reliability of the interview data, the codes produced by the two researchers were examined to see whether they were harmonious or not. Cohen's Kappa Fitness Coefficient of the data was calculated as 0.65.

Data Analysis

The data obtained via the achievement tests were analyzed statistically with the package software of SPSS 20™. Since the study was conducted with a single group of participants (23 students), Shapiro-Wilk test was applied to the data to see whether the research sample demonstrated a normal distribution or not. The results revealed that the significance level of the data was found higher than 0.05 ($p>0.05$)'. Based on this, the data could be said to parametric. In order to determine whether the difference between the pretest and posttest achievement tests was statistically significant, t-test, one of parametric tests, was applied. In addition, one-way analysis of variance (one-

way ANOVA) was conducted to see whether there was a significant relationship between the posttest scores regarding the lesson units.

For the analysis of the interview questions, the students' responses were transmitted to the reader without making any changes in their statements. It is reported that such analyses are beneficial (Yin, 1994; Çepni, 2010). In the study, at the beginning and end of each lesson unit, pre- and post-interviews were held with the students. The students' responses during the interviews held in relation to their conceptual understanding were categorized as "Fully Understands", "Partly Understands" and "Fails to Understand" (Coştu, 2006; Artun, 2009). The data gathered were audio-recorded and then transcribed into written texts. Following this, the interviewees were asked to examine the written texts to achieve reliability of the data. The data collected were coded by two researchers from the field of science education.

Environmental Education Modular Curriculum and Its Content

The environmental education modular curriculum had a structure specific to itself in its own field. This curriculum was developed by the researchers. Details regarding the environmental education modular curriculum are also present in related literature (Artun, 2013; Artun and Özsevgeç, 2015; Artun and Özsevgeç, 2016).

Findings

The findings obtained in the study have been presented in two sections: those obtained via the achievement tests and those obtained via the semi-structured interview questions.

Findings Obtained via the Achievement Tests

In order to determine whether the difference between the pretest and posttest achievement tests applied to the research sample was statistically significant, dependent t-test was applied on the data. The results of the analysis can be seen in Table 1.

Table 1.

Dependent t-test results regarding the achievement tests

Lesson Unit	Group	N	Mean Score	Std Devi.	sd	t	p
Environmental Consciousness	Pretest	23	59.21	8.11	22	-9.11	.000
	Posttest		74.65				
Ecosystem	Pretest	23	52.82	8.49	22	-7.36	.000
	Posttest		65.86				
Plants and Animals	Pretest	23	69.78	2.54	22	-5.29	.000
	Posttest		83.26				
Environmental Phenomena	Pretest	23	58.78	9.19	22	-8.37	.000
	Posttest		74.82				
Environment and Human	Pretest	23	65.13	12.89	22	-4.80	.000
	Posttest		78.04				

As can be seen in Table 1, there was a statistically significant difference between the pretest and posttest scores of the students in favor of the posttest (Environmental Consciousness; $t_{(22)}$= -9.11, p<0.05), Ecosystem; ($t_{(22)}$= -7.36, p<0.05); Plants and Animals; ($t_{(22)}$= -5.29, p<0.05); Environmental Phenomena; ($t_{(22)}$= -8.37, p<0.05); Environment and Human; ($t_{(22)}$= -4.80, p<0.05).

For the purpose of determining whether there was a statistically significant difference between the posttest scores regarding the lesson units, one-way analysis of variance (one-way ANOVA) was conducted. For this purpose, first, the posttest scores were examined to see if they had variance homogeneity (homogenous variance). According to the test of variance homogeneity, Levene Statistic= .216, sd1= 4, sd2= 110 and p= .929. It was found that the posttest scores had variance homogeneity (p>.05) and that they could be compared using ANOVA. Table 2 presents the table of ANOVA regarding the posttest scores.

Table 2.

One-way analysis of variance regarding the posttest scores

	Sum of Squares	Degree of Freedom (sd)	Mean Square	F	P
Between Groups	3690.92	4	922.73	3.84	.006
Within Groups	26392.52	110	239.93		
Total	30083.44	114			

According to Table 2, a statistically significant difference was found between the posttest scores ($F_{(4;\ 114)}$ = 3.84, p<0.05). In order to determine which tests caused this difference, Post Hoc test (Tukey HSD) was applied on the data. The results obtained via Post Hoc test (Tukey HSD) are presented in Table 3.

Table 3.

Post Hoc analysis (Tukey HSD) regarding the posttest

Lesson Units	Lesson Units	Mean Difference	Standard Error	P
Environmental Consciousness	Ecosystem	8.782	4.567	.312
	Plants and Animals	-8,608	4.567	.332
	Environmental Phenomena	-0.173	4.567	1.000
	Environment and Human	-3.391	4.567	.946
Ecosystem	Environmental Consciousness	-8.782	4.567	.312
	Plants and Animals	-17.391*	4.567	.002
	Environmental Phenomena	-8.956	4.567	.292
	Environment and Human	-12.173	4.567	.066
	Environmental Consciousness	8.608	4.567	.332

Plants and Animals	Ecosystem	17.391*	4.567	.002
	Environmental Phenomena	8.434	4.567	.352
	Environment and Human	5.217	4.567	.784
Environmental Phenomena	Environmental Consciousness	.1739	4.567	1.000
	Ecosystem	8.956	4.567	.292
	Plants and Animals	-8.434	4.567	.352
	Environment and Human	-3.217	4.567	.955
Environment and Human	Environmental Consciousness	3.391	4.567	.946
	Ecosystem	12.173	4.567	.066
	Plants and Animals	-5.217	4.567	.784
	Environmental Phenomena	3.217	4.567	.955

* Mean difference is significant at the significance level of 0.05.

According to the results of Post Hoc test in Table 3, when the posttest scores were compared, it was seen that there was no significant difference between the first lesson unit and the other lesson units; that there was a significant difference between the second lesson unit and just the third lesson unit; that there was a significant difference between the third lesson unit and just the second lesson unit; that there was no significant difference between the fourth lesson unit and the other lesson units; and that there was no significant difference between the fifth lesson unit and the other lesson units.

Findings Obtained via the Semi-Structured Interview Questions

The findings obtained via the semi-structured interview questions are presented for each lesson unit separately.

Findings Obtained via the Interviews Regarding the Lesson Unit of "Environmental Consciousness"

In relation to the lesson unit of Environmental Consciousness, pre- and post-interviews were held with the students. Table 4 presents the findings obtained via these interviews.

Table 4.

Frequencies of the Students' Responses Regarding the Lesson Unit of Environmental Consciousness

Questions	Pretest				Posttest			
	Fails to Understand		Partly Understands		Partly Understands		Fully Understands	
	F	S	F	S	F	S	F	S
What does 'Environment' mean to you? Please explain it briefly?	6	$S_{Ü1}$, $S_{Ü2}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	2	S_{A1}, S_{A2}	4	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2}
What is Environmental Consciousness? Please explain it briefly	5	$S_{Ü2}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	1	$S_{Ü1}$	2	$S_{Ü2}$ S_{O2}	4	$S_{Ü1,}$ S_{O1} S_{A1}, S_{A2}
What should be done to raise people's consciousness of the environment?	4	$S_{Ü2}$ S_{O1}, S_{O2} S_{A2}	2	$S_{Ü1}$ S_{A1}	1	S_{A2}	5	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}
What is environmental pollution? What causes it?	3	S_{O1}, S_{A1}, S_{A2}	3	$S_{Ü2}$, $S_{Ü1}$ S_{O2}	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
What should be done to prevent environmental pollution?	2	$S_{Ü2}$ S_{A1}	4	$S_{Ü1}$ S_{O1}, S_{O2} S_{A1}	4	$S_{Ü2}$ S_{O1}, S_{O2} S_{A2}	2	$S_{Ü1}$ S_{A1}
What are environmental wastes? How can we prevent waste materials in our environment?	1	S_{A2}	5	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}	1	$S_{Ü2}$	5	$S_{Ü1}$ S_{O1}, S_{O2} $S_{A1,}$ S_{A2}
What does recycling remind you of? Why is it important? Please explain briefly.	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
What are the characteristics of a healthy and clean environment? Please explain them.	2	S_{A1}, S_{A2}	4	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2}	1	S_{A1}	5	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A2}

As can be seen in Table 4, it was found that all the students belonged to the category of "Fails to Understand" regarding the first question related to the definition of environment in the pre-interview while four students ($S_{Ü2}$, $S_{Ü1,}$ S_{O1}, S_{O2}) belonged to the

category of “Fully Understands” and two students (S_{A1}, S_{A2}) to the category of “Partly Understands” in the post-interview. In addition, three students (S_{O1}, S_{A1}, S_{A2}) belonged to the category of “Fails to Understand” regarding the fourth question related to the definition of environmental pollution and the other three students ($S_{Ü2}$, $S_{Ü1,}$ S_{O2}) to the category of “Partly Understands” in the pre-interview, while all the students belonged to the category of “Fully Understands” in the post-interview. In relation to the seventh question regarding the concept of recycling and its importance, all the students belonged to the category of “Fails to Understand” in the pre-interview and to the category of “Fully Understands” in the post-interview. Regarding the first question in the post-interview, one student coded $S_{Ü2}$ responded as follows:

> $S_{Ü2:}$ Environment reminds me of living beings, recycling, growing population, factories, waste materials, global warming, plants, animals, non-living things, environment, water, soil and air pollution.

a- *Findings Obtained via the Interviews Regarding the Lesson Unit of “Ecosystem”*

In relation to the lesson unit of “Ecosystem”, pre- and post-interviews were held with the students. Table 5 presents the findings obtained via these interviews.

Table 5.

Frequencies of the Students' Responses Regarding the Lesson Unit of "Ecosystem"

Questions	Pretest				Posttest			
	Fails to Understand		Partly Understands		Partly Understands		Fully Understands	
	F	S	F	S	F	S	F	S
What can you say about species, population, habitat and ecosystem?	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	1	S_{A2}	5	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}
What does food web remind you of? Please explain it.	5	$S_{Ü2}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	1	$S_{Ü1}$	-	-	6	$S_{Ü2}$, $s_{Ü1}$ S_{O1}, S_{O2} S_{A1}
There are living and non-living factors in ecosystem. What kind of relationship do you think exists between these factors? Please explain it.	3	S_{O2} S_{A1}, S_{A2}	3	$S_{Ü2}$ $S_{Ü1}$ S_{O1}	1	S_{O2}	5	$S_{Ü2}$, $S_{Ü1}$ S_{O1} S_{A1}, S_{A2}
What is energy flow in ecosystem? How does it occur? Please explain it briefly.	6	$S_{Ü2}$, $S_{Ü1}$ s_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	1	S_{O2}	5	$S_{Ü2}$, $s_{Ü1}$ s_{O1} S_{A1}, S_{A2}
What do competition and cooperation between living beings mean?	3	$S_{Ü2}$ S_{O1} S_{A2}	3	$S_{Ü1}$ S_{O2} A_{A1}	-	-	6	$S_{Ü2}$, $S_{Ü1}$ s_{O1}, S_{O2} S_{A1}
There are many factors influential on ecosystem. What do you think about them?	4	$S_{Ü2}$ S_{O1}, S_{O2} S_{A2}	2	$S_{Ü1}$ S_{A1}	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
What is biological diversity? What can you say about the biological diversity in your region?	6	$S_{Ü2}$, $s_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	2	S_{O1} S_{A2}	4	$S_{Ü2}$, $S_{Ü1}$ S_{O2} S_{A1}
What are natural sources in your environment? What kind of relationship exists between biological diversity and natural sources?	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}

According to Table 5, it was seen that all the students belonged to the category of "Fails to Understand" regarding the first question related to the definition of ecosystem, habitat, population and species in the pre-interview while one student (S_{A2}) belonged to

the category of "Partly Understands" and five students ($S_{Ü2}$, $S_{Ü1}$, S_{O1}, S_{O2}, S_{A1}) to the category of "Fully Understands" in the post-interview. In relation to the second question related to food web, five students ($S_{Ü2}$, S_{O1}, S_{O2}, S_{A1}, S_{A2}) belonged to the category of "Fails to Understand" and the other one student ($S_{Ü1}$) to the category of "Partly Understands" in the pre-interview, while all the students belonged to the category of "Fully Understands" in the post-interview. In addition, it was seen that all the students belonged to the category of "Fails to Understand" regarding the eighth question related to the relationship between biological diversity and natural sources in the pre-interview while they all belonged to the category of "Fully Understands" in the post-interview. Regarding the second question in the post-interview, one student coded S_{O2} responded as follows:

> S_{O2}: It is a structure formed by different food chains. To illustrate, the grasshopper eats grass; the frog eats the grasshopper; and the snake eats the frog. This is a food chain, and food chains gather and form food webs.

b- *Findings Obtained via the Interviews Regarding the Lesson Unit of "Plants and Animals"*

In relation to the lesson unit of "Plants and Animals", pre- and post-interviews were held with the students. Table 6 presents the findings obtained via these interviews.

Table 6.

Frequencies of the Students' Responses Regarding the Lesson Unit of "Plants and Animals"

Questions	Pretest				Posttest			
	Fails to Understand		Partly Understands		Partly Understands		Fully Understands	
	F	S	F	S	F	S	F	S
What are the factors influential on plants and animals? How do these factors influence plants and animals?	5	$S_{Ü2}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	1	$S_{Ü1}$	1	S_{A2}	5	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}
What are natural disasters influential on plants and animals? How do these factors influence plants and animals?	4	$S_{Ü1}$ S_{O2} S_{A1}, S_{A2}	2	$S_{Ü2}$ S_{O1}	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
Why are water, air and clean environment important for plants and animals? Please explain it.	4	S_{O1}, S_{O2} S_{A1}, S_{A2}	2	$S_{Ü2}$ $S_{Ü1}$	1	$S_{Ü2}$	5	$S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
Why should we love and protect plants and animals? Please explain it briefly.	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}

As can be seen in Table 6, regarding the first question related to the human factors influential on plants and animals, five students ($S_{Ü2}$, S_{O1}, S_{O2}, S_{A1}, S_{A2}) belonged to the category of "Fails to Understand" and one student ($S_{Ü1}$) to the category of "Partly Understands" in the pre-interview, while five students ($S_{Ü2}$, $S_{Ü1}$, S_{O1}, S_{O2}, S_{A1}) belonged to the category of "Fully Understands" and one student (S_{A2}) to the category of "Partly Understands" in the post-interview. Regarding the fourth question related to the protection of plants and animals, all the students belonged to the category of "Fails to Understand" in the pre-interview, while they all belonged to the category of "Fully Understands" in the post-interview. In relation to the third question in the post-interview, one student coded S_{O1} responded as follows:

> $S_{O1:}$ Yes, it is important because plants and animals use the water and air, and unless we use filters for factory chimneys and as long as factories throw their dirty waters into rivers, these living beings will be poisoned, which will eventually influence us badly. Also, in case of this, many living beings will die, and living areas will disappear. The number of endangered species is increasing. I mean even living beings which are not currently in danger of extinction will gradually become extinct.

c- *Findings Obtained via the Interviews Regarding the Lesson Unit of "Environmental Phenomena"*

In relation to the lesson unit of "Environmental Phenomena", pre- and post-interviews were held with the students. Table 7 presents the findings obtained via these interviews.

Table 7.

Frequencies of the Students' Responses Regarding the Lesson Unit of "Environmental Phenomena"

Questions	Pretest				Posttest			
	Fails to Understand		Partly Understands		Partly Understands		Fully Understands	
	F	S	F	S	F	S	F	S
What is greenhouse effect? What kinds of changes occur in your environment due to greenhouse effect? Please explain it giving examples.	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
What does global warming remind you of? How does global warming influence our environment? Please explain it giving examples.	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	1	$S_{Ü2}$	5	$S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
Why does climate change occur? What are the factors influential on climate change? Please explain it.	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
Please explain how do radiation, UV (ultraviolet) ray and chemical drugs damage the environment.	3	S_{O1} S_{A1}, S_{A2}	3	$S_{Ü2}$, $S_{Ü1}$ S_{O2}	1	S_{A1}	5	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A2}
How does use of technological devices influence our environment? Please explain it briefly.	2	S_{A1}, S_{A2}	4	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2}	2	$S_{Ü2}$, $S_{Ü1}$	4	S_{O1}, S_{O2} S_{A1}, S_{A2}
What are renewable and non-renewable energy sources? What can you say about the effects of these sources on the environment?	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	-	-	6	$S_{Ü2}$, $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}

According to Table 7, regarding the first, third and sixth questions related to greenhouse effect, climate change and renewable and non-renewable energy sources, all the students belonged to the category of "Fails to Understand" in the pre-interview, while they all belonged to the category of "Fully Understands" in the post-interview. In addition, it was seen that regarding the second question related to global warming, all the students belonged to the category of "Fails to Understand" in the pre-interview while five students ($S_{Ü1}$, S_{O1}, S_{O2}, S_{A1}, S_{A2}) belonged to the category of "Fully

Understands" and the other one student ($S_{Ü2}$) to the category of "Partly Understands" in the post-interview. In relation to the second question in the post-interview, one student coded $S_{Ü1}$ responded as follows:

> $S_{Ü1:}$ Global warming occurs as a result of greenhouse effect. When global warming occurs, the weather becomes hotter leading to a warmer climate. Glaciers start melting, the sea level increases, biological diversity decreases, and some species become extinct.

d- *Findings Obtained via the Interviews Regarding the Lesson Unit of "Environment and Human"*

In relation to the lesson unit of "Environment and Human", pre- and post-interviews were held with the students. Table 8 presents the findings obtained via these interviews.

Table 8.

Frequencies of the Students' Responses Regarding the Lesson Unit of "Environment and Human"

Questions	Pretest				Posttest			
	Fails to Understand		Partly Understands		Partly Understands		Fully Understands	
	F	S	F	S	F	S	F	S
What kind of relationship exists between the human and environment? Please explain it giving examples.	5	$S_{Ü2}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	1	$S_{Ü1}$	-	-	6	$S_{Ü2,}$ $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
How do people influence their environment? Please explain it.	6	$S_{Ü2,}$ $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	1	$S_{Ü2}$	5	$S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
What are effects of environmental pollution on human health? Please explain it briefly.	4	S_{O1}, S_{O2} S_{A1}, S_{A2}	2	$S_{Ü2,}$ $S_{Ü1}$	-	-	6	$S_{Ü2,}$ $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}
What can you say about the effects of population growth on environment?	6	$S_{Ü2,}$ $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}	-	-	-	-	6	$S_{Ü2,}$ $S_{Ü1}$ S_{O1}, S_{O2} S_{A1}, S_{A2}

According to Table 8, regarding the first question related to the relationship between the human and environment, five students ($S_{Ü2,}$ S_{O1}, $S_{O2,}$ S_{A1}, S_{A2}) belonged to the category of "Fails to Understand" and the other one student ($S_{Ü1}$) to the category of "Partly Understands" in the pre-interview, while all the students belonged to the category of "Fully Understands" in the post-interview. Regarding the fourth question related to the effects of population growth on the environment, all the students belonged to the category of "Fails to Understand" in the pre-interview and to the

category of “Fully Understands” in the post-interview. In relation to the fourth question in the post-interview, one student coded S_{O2} responded as follows:

> $S_{O2:}$ As the population grows, environmental pollution increases. If there are a number of conscious people in a population, then there will not be much pollution at all. There will be more needs, and population growth results in polluted environment. For example, Villagers do not pollute the environment as much as people living in urban areas do because not many people live in a village. However, as there are many people in city centers, pollution occurs.

Discusion

In this section, first the quantitative findings and then the qualitative findings obtained regarding each lesson unit in the study have been discussed.

Discussion for the Lesson Unit of Environmental Consciousness

Based on the statistically significant difference found between the students’ pretest and posttest scores in favor of the posttest as a result of the analysis of the pretest and posttest regarding the achievement test for the lesson unit of Environmental Consciousness (See Table 1), it could be stated that the modular curriculum led to an increase in the students’ levels of academic achievement in this lesson unit. In addition, according to the students’ responses during the post-interview regarding this lesson unit, their conceptual understanding demonstrating an increase from the category of “Fails to Understand” to the category of “Fully Understands” revealed that the modular curriculum was influential on their conceptual understanding (See Table 4).

The modular curriculum provided the students with the opportunity to conduct research on such subjects as environment, environmental pollution and prevention of environmental pollution and to share the results of their research in class. In the following process, the modular curriculum also allowed them to receive feedback from their peers as well as from their own group mates. Moreover, it could be stated that the curriculum, which provided the students with the opportunity to produce ideas about what would happen in the event of both protections of the environment and prevention of air pollution, led to a positive change in their conceptual understanding. In the post-interview, one student coded S_{A2} responded as follows:

> “To prevent environmental pollution, we should make people conscious. We should use filters in factory chimneys and refine factory wastes. We shouldn’t throw garbage around, and we should give importance to recycling.”

Another important concept related to environment, environmental pollution and prevention of environmental pollution is recycling (Atasoy and Ertürk, 2008; Şimşekli, 2010; Sağır et.al., 2008). The modular curriculum associates the concept of recycling with several concepts such as environment, environmental pollution, causes of environmental pollution and wastes; therefore, the curriculum could be said to help students understand the concept of recycling better and to contribute to their conceptual understanding. In relation to this, one student coded S_{A1} responded in the post-interview as follows:

> “Recycling allows reusing materials whose lifetime has expired. Through recycling, our environment will live longer, and we will be able to lead a better-quality life. Lack of recycling will result in bad-quality life, and we will leave a worse world for future generations. We will have to cut our

> trees, and the life of the nature will be shorter. If we don't recycle our garbage but burn it, we will damage the nature and cause air pollution. Because people are not conscious of this, they do not give importance to recycling and they throw their garbage everywhere. If we give more importance to recycling, we will have a better and richer country. Also, the air, soil and water will not be polluted, and we will not use up our raw material."

The modular curriculum allowed the students to do a project regarding the concept of recycling, and this might have increased their conceptual understanding and their academic achievement. The project of "Recycling Bin" conducted within the framework of the modular curriculum might have raised students' interest by addressing their mental and psychomotor skills and raised their awareness of the related concept. In addition, the project allowed the students to produce solutions to environmental problems and to make use of what they had learned. In this respect, it could be stated that the curriculum allowed the students to transfer their concept learning into practice, which helped increase the permanency of their learning. Based on the fact that the students gained experience and transmitted their experience to other peer groups, it could be stated that the students learned to conduct scientific research via individual and group works in the project process and that their active participation in the process increased their conceptual understanding (Mahidin and Maulan, 2010; Darçın et.al., 2006; Cutter-Mackenzie, 2009; Uzun et.al., 2008). Moreover, appropriateness of the activities to the 5E learning model and the activity of "Let's Recycle" carried out in the phase of exploration might have helped the students understand the concept of recycling. In another step, the elaboration phase, the videos that the students watched in relation to recycling might have helped reinforce the activity carried out in the phase of exploration and understand the concepts better (Orgill and Thomas, 2007; Artun, 2009; Çalık, Okur and Taylor, 2011; Artun and Coştu, 2013).

Discussion for the Lesson Unit of Ecosystem

A statistically significant difference was found between the students' pretest and posttest scores in favor of the posttest as a result of the analysis of the pretest and posttest regarding the achievement test for the lesson unit of Ecosystem (See Table 1). Depending on this finding, their conceptual understanding demonstrating an increase from the category of "Fails to Understand" to the category of "Fully Understands" could be said to reveal that the modular curriculum was influential on their conceptual understanding (See Table 5).

The modular curriculum might have increased the students' conceptual understanding via effective presentation of the concept of biological diversity in the lesson unit of Ecosystem thanks to the activities appropriate to the 5E learning model. In relation to this, one student coded $S_{Ü1}$ responded in the post-interview as follows:

> "Biological diversity refers to abundancy of plants and animals. In short, we can say it means variety of living beings. In general, it is more prevalent in rural areas because there are no places in city centers for animals to live in. No attention is paid to them; thus, rural areas are more appropriate to biological diversity. Also, if forests are damaged, biological diversity decreases"

In addition, the fact that the outcomes related to biological diversity and natural sources in the modular curriculum are consistent with one another could be said to be the reason why the students understood these concepts better. This might have resulted in an increase in the students' conceptual understanding. Accordingly, it could

be stated that the student-oriented activities contributed to the process of learning the concepts and that designing the activities in a way to draw students' attention and to help elaborate the concepts supported this learning process. In addition, it could also be stated that the modular curriculum maximized the students' mental functions and thus contributed to their learning and that effective use of the steps of the 5E learning model increased conceptual understanding (Taş and Seçken, 2009; Artun and Coştu, 2013). Also, thanks to this finding, it could be stated that use of alternative teaching methods and techniques is more effective when compared to traditional teaching methods (Ramadoss and Poya-molı, 2011; Lındemann-matthıes, 2002; Coca, 2013; Manolas and Filho, 2011).

The modular curriculum could be said to increase awareness of such concepts as species, population, habitat, ecosystem, food web, food pyramid, competition and cooperation since the curriculum covers all these concepts as a whole, and this awareness might have increased the students' conceptual understanding. In relation to this, one student coded $S_{Ü2}$ responded in the post-interview as follows:

> "Species: it refers to reproductive living beings that have an ancestor. Population: it is a community formed by living beings of the same species; for example, rabbit population: Habitat: it refers to the living area for living beings. The living area for rabbits is the forest. Ecosystem: it is a place where living beings and non-living beings are in interaction with each other."

The modular curriculum is thought to provide students with the opportunity to develop their critical thinking skills and to find solutions to problems. Depending on this, it could be stated that a good learning environment plays an important role in students' learning related concepts and increase their conceptual understanding (Bukova-Güzel, 2008; Tafrova-Grigorova, Boiadjieva, Emiiov and Kirova, 2012). In other words, the curriculum decreases the factors likely to hinder students' learning and gives special attention to the importance of constructivist environment. For instance, in the activities titled "Towards Ecosystem" and "Let's Form a Food Pyramid", the students had the opportunity to form their own food pyramids with the help of cut-and-paste applications, which allowed to students to concretize the related concepts and which might have led to a positive change in their conceptual understanding (Hoban, Loughran and Nielsen, 2011). In addition, the students learned theoretical information about the subject via the activity titled "Let's Form a Food Pyramid" and had the opportunity to transfer their theoretical knowledge into practice (She, 2002, 2004). Similar to many other studies reported in related literature (Çokadar and Yılmaz, 2009; Sezer and Tokcan, 2003; Okur, Yalçın-Özdilek and Şahin, 2011; Veeravatnanond and Singseewo, 2010; Balgopal and Wallece, 2009; Welsh, 2012), the present study revealed that development of the modular curriculum on student-centered basis resulted in an increase in students' conceptual understanding.

Discussion for the Lesson Unit of Plants and Animals

A statistically significant difference was found between the students' pretest and posttest scores in favor of the posttest as a result of the analysis of the pretest and posttest regarding the achievement test for the lesson unit of Plants and Animals (See Table 1). Depending on this finding, the modular curriculum could be said to increase the students' academic achievement in this lesson unit. In addition, their conceptual understanding demonstrating an increase from the category of "Fails to Understand" to the category of "Fully Understands" could be said to reveal that the modular curriculum was influential on their conceptual understanding (See Table 6).

In literature, the number of studies conducted to find solutions to problems in relation to plants and animals is quite limited (Atasoy and Ertürk, 2008). This limited number of studies on this fairly important subject with respect to environmental education is an important deficiency in terms of determining the extent to which students understand the concepts related to plants and animals. The modular curriculum could be said to increase the students' conceptual understanding since it involved multifaceted activities regarding plants and animals. The activity "Let's Share Our Observations" carried out in relation to plants and animals allowed the students to observe the characteristics of various plants and animals in their environment like a scientist, to take related notes and to share these notes in class. It could be stated that thanks to this activity, the students' conceptual understanding increased. Regarding this, one student coded $S_{Ü1}$ responded in the post-interview as follows:

> "When we go on a picnic, we leave our ash there, which causes forest fires. Also, our garbage damages the environment. Factories, industrial wastes, garbage and domestic wastes are all dangerous for the environment. These are all fatal for plants and animals, and eating these plants or animals is not healthy for people's lives. Industrial wastes are poisonous for plants and animals. Chemical wastes and forest fires wipe out plants and animals, which decreases biological diversity."

The modular curriculum might have developed students' conceptual understanding by allowing them not only to carry out observation-based activities but also to share the results of their observations in class. In addition, this curriculum could be said to provide the students with the opportunity to acquire scientific process skills by doing observations. The fact that the process for the development of the "observation skills" included in the scope of the activities carried out as appropriate to the 5E learning model was a part of the scientific process skills, that the class environment where the observation results were shared was supported with visual materials and videos and that an effective learning environment was established might have had positive influence on the students' conceptual understanding (Bukova-Güzel, 2008). One of the most important features of the modular curriculum was that it constantly made the students active throughout the learning process and helped them take active part in the observations and in-class discussions. In this respect, the curriculum could be said to contribute to the students' conceptual understanding by leading to their active participation in classes.

Discussion for the Lesson Unit of Environmental Phenomena

A statistically significant difference was found between the students' pretest and posttest scores in favor of the posttest as a result of the analysis of the pretest and posttest regarding the achievement test for the lesson unit of Environmental Phenomena (See Table 1). Depending on this finding, the modular curriculum could be said to increase the students' academic achievement in this lesson unit. In addition, their conceptual understanding demonstrating an increase from the category of "Fails to Understand" to the category of "Fully Understands" and their providing correct definitions of the concepts found in the lesson unit could be said to reveal that the modular curriculum was influential on their conceptual understanding (See Table 7).

The fact that the modular curriculum covering the outcomes regarding air pollution that we frequently encounter with in our environment established associations between the phenomena related to air pollution and that it provided in-depth details in relation to the causes of air pollution might have increased the students' conceptual understanding. In addition, the development of the curriculum in a way to make associations between such concepts as greenhouse effect, global warming, climate change and renewable and non-renewable energy sources could be said to increase the students' interest in

such concepts that they increasingly meet in their environment and to provide them with the opportunity to suggest solutions to the problems regarding these concepts. In other words, the fact that the outcomes of the modular curriculum drew the students' attention, included up-to-date concepts and encouraged the students to research, examine and investigate could be said to be influential on their conceptual learning. As a support to this positive change, one student coded $S_{Ü1}$ responded in the post-interview as follows:

> "Global warming occurs as a result of greenhouse effect. When global warming occurs, the weather becomes hotter than usual, climate change and we live in warmer climates. The glaciers melt, the sea level increases, biological diversity decreases, and some species become extinct."

Various activities included in the modular curriculum allowed the students to recognize environmental phenomena more concretely (Dağ and Kırıkkaya, 2012). For instance, the applications of "Let's Learn Greenhouse Effect" and "Global Warming" found in the phase of exploration could be said to provide the students with the opportunity to concretize the abstract concepts of greenhouse effect and global warming thanks to the activity of "Modelling a House", which helped clarify their ideas about the concepts. In the modular curriculum aimed, the intention was to allocate a sufficient amount of time to each concept, to increase active participation of the students in all the activities, to let them reach the information on their own, to support the process with in-class and group discussions and to raise students' environmental consciousness. The fact that the modular curriculum allowed interactive learning (Čižkova, Čtrnactova and Nečesana, 2009; Mork, 2011; Sarıay, 2008) might have caused the positive change in the students' conceptual understanding.

Discussion for the Lesson Unit of Environment and Human

A statistically significant difference was found between the students' pretest and posttest scores in favor of the posttest as a result of the analysis of the pretest and posttest regarding the achievement test for the lesson unit of Environment and Human (See Table 1). Depending on this finding, the modular curriculum could be said to increase the students' academic achievement in the lesson unit. Also, their conceptual understanding demonstrating an increase from the category of "Fails to Understand" to the category of "Fully Understands" could be said to reveal that the modular curriculum was influential on their conceptual understanding (See Table 8).

The relationship between environment and human is one of the least known subjects in relation to environmental education. In literature, the number of related studies is quite limited, and the present ones failed to reveal the degree of conceptual understanding of the relationship between environment and human. The modular curriculum could be said to overcome the related deficiency by mentioning the studies related to these concepts. It could obviously be stated that these subjects were those which the students did not know well but should learn. It could also be stated that differences occurred in the students' conceptual understanding as the applications titled "Let's Discuss" and "Let's Share Our Thoughts" allowed the students to investigate the phenomena involving the human and the environment and to take active part in the process. As a support to this positive change, one student coded S_{A1} reported in the post-interview as follows:

> When the environment is polluted, human beings are influenced badly. Their life quality decreases. When there is air pollution and when people breathe this polluted air, they get poisoned, and they are more likely to be at risk of lung cancer. Also, water pollution has bad influence directly on fish and indirectly on people who eat the fish. However, if the water is

not polluted, there will be no such danger. Oxygen is necessary for us to live, but when we pollute the air, we breathe carbon dioxide and get poisoned. As a result, we damage our health.

In addition, the modular curriculum supported the relationship between human and environment and allowed students to produce solutions to related problems thanks to their knowledge. This was another cause of the positive change in the students' conceptual understanding.

Conclusions

1- As the modular curriculum allowed understanding concepts related to environmental education more easily and clearly, positive changes occurred in students' conceptual understanding and in their academic achievement.
2- It was revealed that the students gave more importance to current environmental problems covered by the modular curriculum and that they provided solutions to these problems. This shows a positive change in their conceptual understanding and academic achievement.
3- It was found that doing various projects regarding environmental education within the framework of the modular curriculum provided the students with the opportunity to get detailed information about the concepts related to environmental education and contributed to the development of their related critical thinking skills. Consequently, a positive change occurred in their conceptual understanding and academic achievement.
4- The fact that the modular curriculum established between the concepts related to environmental education allowed learning these concepts and the related associations better. Accordingly, a positive change occurred in the students' conceptual understanding and academic achievement.

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References

Aktepe, S. and Girgin, S. (2009). Comparison of eco-schools and other primary schools in terms of environmental education. *Elementary Education Online,* 8(2), 401-414.

Artun, H. (2009). Developing and evaulating of teaching material concerning diffusion and osmosis concepts based on 5E model. *Master Thesis*, Karadenız Technical Univercity, Institute of Science & Technology, Trabzon.

Artun, H. (2013). Investigating effectiveness of environmental education modular instruction curriculum designed for grade 7th students. *Doctoral Thesis,* Karadeniz Technical Univercity, Institute of Education Science, Trabzon.

Artun, H. and Özsevgeç, T. (2016). A study on the evaluation of the applicability of an environmental education modular curriculum. *International Journal Of Environmental & Science Education*, 11(15), 7318-7348.

Artun, H. and Özsevgeç, T. (2015). Evaluation of secondary students' attitudes towards environment education. *YYU Journal Of Education Faculty,* 7(1), 29-50.

Artun, H. and Coştu, B. (2013). Effect of the 5E model on prospective teachers' conceptual understanding of diffusion and osmosis: A mixed method approach. *Journal of Science Education and Technology*, 22(1), 1-10.

Özsevgeç, T. and Artun, H. (2012b). Environmental education cause must have a separate curriculum? *XI. National Teaching Education Symposium*, 24-26 Mayıs, Rize.

Özsevgeç, T. and Artun, H. (2012c). "Human and Environment Unit of the" difficulties faced by the teaching of science and technology teachers. *X. National Science and Mathematics Education Congress*, 27-30 Haziran, Niğde.

Atasoy, E. and Ertürk, H. (2008). A field study about environmental knowledge and attidudes of elementary scool students. *Erzincan Univercity Journal of Education Faculty,* 10(1), 105-122.

Atasoy, E. and Yüksel, S. (2006). The role and effects of elementary environmental education and environmental consciousness during globalization in Turkey. *International Scientific Conference "Global Changes and Regiopnal Challenges" St. Kliment Ohridski University of Sofia,* 28-29 April, Sofia, Bulgaria.

Balgopal, M. M. and Wallece, A. M. (2009). Decisions & dilemmas: Using writing to learn activities to increase ecological literacy. *The Journal Of Environmental Education,* 40(3), 13-26.

Barraza, L. (2001). Environmental education in mexican schools: The primary level. *The Journal of Environmental Education*, 32(3), 31-36.

Bradley, J.C., Walıczek, T.M. and Zajıcek, J.M. (1999). Relationship between environmental knowledge and environmental attitude of high school students. *Journal of Environmental Education*, 30(3), 17-21.

Bruyere, B.L., Wesson, M. and Teel, T. (2012). Incorporating environmental education into an urban after-school program in New York City. *International Journal of Environmental & Science Education,* 7(2), 327-341.

Bukova-Güzel, E. (2008). The effect of constructivist learning approach on mathematics student teachers' mathematical thinking processes. *e-Journal of New World Sciences Academy,* 3(4), 678-688.

Buyukozturk, Ş. (2006). *Data analysis for social sciences handbook*. 7th edition, PegemA publishing, Ankara.

Coca, D. M. (2013). The influence of teaching methodologies in the learning of thermodynamics in secondary educatıon. *Journal of Baltıc Science Education,* 12(1), 59-72.

Coştu, B. (2006). Determining students' conceptual change levels: Evaporation, condessation and boiling. *Doctoral Thesis,* Karadenız Technical Univercity, Institute of Science & Technology, Trabzon.

Cutter-Mackenzie, A. (2009). Multicultural school gardens: creating engaging garden spaces in learning about language, culture, & environment. *Canadian Journal of Environmental Education*, 14,122-135.

Çalık, M., Okur, M. and Taylor, N. (2011). A comparison of different conceptual change pedagogies employed within the topic of "sound propagation". *Journal of Science Education and Technology*, 20, 729-742.

Çepni, S. (2010). *Introduction to research and project studies*. Fifth Edition, Celepler Publishment, Trabzon.

Čižkova, V., Čtrnactova, H. and Nečesana, T. (2009). Increasing the effectiveness of ecological education through interactive tasks. *Journal of Baltic Science Education,* 8(2), 110-119.

Çokadar, H. and Yılmaz, G.C. (2009). Teaching ecosystems and matter cycles with creative drama activities. *Journal of Science Education and Technology,* 19, 80-89.

Dağ, F. and Kırıkkaya, E.B. (2012). Preparation of web-based teaching materials for natural processes in 8th grade: Different views on the material of professionals. e-*Journal of New World Sciences Academy,* 7(1), 212-229.

Darçın, E.S., Bozkurt, O., Hamalosmanoğlu, M. and Köse, S. (2006). Misconceptions about Greenhouse Effect. *Internatinal Journal Of Environmental and Science Education,* 1(2), 104-115.

Eames, C., Cowie, B. and Bolstad, R. (2008). An evaluation of characteristics of environmental education practice in New Zeal& schools. *Environmental Education Research*, 14(1), 35-51.

Erdoğan, M., Kostova, Z. and Marcinkowski, T. (2009). Components of environmental literacy in elementary science education curriculum in Bulgaria and Turkey. *Eurasia Journal of Mathematics, Science and Technology Education*, 5(1), 15-26.

Erol, G. H. and Gezer, K. (2006). Prospective of elementary school teachers' attitudes toward environment & environmental problems. *International Journal Of Environmental & Science Education*, 1(1), 65-77.

Farmer, J. Knapp, D. and Benton, G.M. (2007). An elementary school environmental education field trip: long-term effects on ecological and environmental knowledge and attitude development. *The Journal of Environmental Education*, 38(3), 33-42.

Gayford, C. (2002). Controversial environmental issues: A case study for the Professional development of science teachers, *International Journal of Science Education*, 24(11), 1191-1200.

Hoban, G., Loughran, J. and Nielsen, W. (2011). Slowmation: preservice elementary teachers representing science knowledge through creating multimodal digital animations. Journal of Research in Science Teaching, 48(9), 985-1009.

Hsu, S. J. (2004). The effects of an environmental education program on responsible environmental behavior and associated environmental literacy variables in Taiwanese college students. *The Journal of Environmental Education*, 35(2), 37-48.

İbrahim, R., Amin, L. and Yaacob, M. (2011). Promoting environmental literacy through general education at the university level: UKM's experience. *The International Journal of Learning*, 17(12), 151-160.

İnel, D. and Balım, A.G. (2010). Students' views about the use of problem based learning method ın science & technology education. *Western Anatolia Journal of Educational Sciences,* 1(1), 1-13.

Lındemann-Matthıes, P. (2002). The influence of an educational program on children's perception of biodiversity. *The Journal of Environmental Education*, 33(2), 22-31.

Mahidin, A. M. M. and Maulan, S. (2010). Understanding children preferences of natural environment as a start for environmental sustainability. *Procedia - Social & Behavioral Sciences*, 38, 324 – 333.

Manolas, E. and Filho, W. L. (2011). The use of cooperatıve learnıng ın dıspellıng student mısconceptıons on clımate change. *Journal of Baltic Science Education,* 10(3), 168-182.

Mancl K., Carr, K. and Morrone, M. (1999). Environmental literacy of Ohio adults. *Ohio Journal Science*, 3, 57-61.

Mastrilli, T. (2005). Environmental education in Pennsylvania's elementary teacher education programs: A Statewide Report. *The Journal Of Envıronmental Education*, 36(3), 22-30.

Meınhold, J.L. and Malkus, A.J. (2005). Can knowledge, attitudes, and self-efficacy make a difference? *Envıronment And Behavıor,* 37(4), 511-532.

Mork, S.M. (2011). An interactive learning environment designed to increase the possibilities for learning and communicating about radioactivity. *Interactive Learning Environments,* 19(2), 163-177.

Okur, E., Yalçın-Özdilek, Ş. and Şahin, Ç. (2011). The common methods used ın bıodıversıty educatıon by prımary school teachers (Çanakkale, Turkey). *Journal of Theory & Practice in Education,* 7(1), 142-159.

Orgill, M. and Thomas, M. (2007). Analogies and the 5E model. The Science Teacher, January 40-45.

Özgen, N. and Kahyaoğlu, M. (2011). Perception of primary school students residingiın the settlement units wıth diverse functional features on environmental problems

& solution recommendations: A phenomenographic research. *Electronic Journal of Social Sciences,*10(38), 136-157.

Ramadoss, A. and Poya-moli, G. (2011). Biodiversity conservation through environmental education for sustainable development - A case study from puducherry, India. *International Electronic Journal of Environmental Education*, 1(2), 97-111.

Sadık, F. and Sarı, M. (2010). Student teachers' attitudes towards environmental problems & their level of environmental knowledge. *Çukurova Univercity Journal of Education Faculty,*3(39), 129-141.

Sağır, Ş. U., Aslan, O. and Cansaran, A. (2008). The examination of elementary school students' environmental knowledge & environmental attitudes with respect to the different variables. *Elementary Education Online*, 7(2), 496-511.

Sarıay, M. (2008). A study on developing a teaching program concerning impulse & momentum at the level of upper middle class. *Master Thesis*, Dokuz Eylül Univercity, Institute of Education Science, İzmir.

Sezer, A. and Tokcan, H. (2003). The effect of cooperative learning on academic achievement in geography course. *Gazi Univecity Gazi Journal of Education Faculty,* 23(3), 227-242.

She, H. C. (2002). Concepts of a higher hierarchical level require more dual situated learning events for conceptual change: A study of air pressure and buoyancy. *International Journal of Science Education*. 24 (9), 981-996.

She, H. C. (2004). Fostering radical conceptual change through dual-situated learning model. *Journal of Research in Science Teaching.* 41 (2), 142-164.

Şimşekli, Y. (2010). The original activities for environmental education & their effects on students (A Case Study in Bursa). *Elementary Education Online*, 9(2), 552-560.

Tafrova-Grigorova, A., Boiadjieva, E., Emiiov, I. and Kirova, M. (2012). Scıence teachers' attıtudes tdwards cdnstructıvıst envıronment: A Bulgarian case. *Journal of Baltic Science Education,* 11(2), 184-193.

Tanrıverdi, B. (2009). Analyzing primary school curriculum in terms of sustainable environmental education. *Education & Science,,* 34(151), 89-103.

Tatar, E., Oktay, M. and Tüysüz, C. (2010). Advantages & disadvantages of problem based learning ın chemistry education: A case study. *Erzincan Univercity Journal of Education Faculty,* 11(1), 95-110.

Taş, G. and Seçken, N. (2009). The effect of constructivist approach to the teaching of the unit journey to the inner structure of matter. *e-Journal of New World Sciences Academy,* 4(2), 520-533.

Uzun, N., Sağlam, N. and Uzun, F.V. (2008). The effect of the green class model based applied environmental education project on environmental consciousness and its retention. *Ege Educational Journal,* 9(1), 59-74.

Veeravatnanond, V. and Singseewo, A. (2010). A developmental model of environmental education school. *European Journal of Social Sciences,* 17(3), 391-403.

Welsh, A.J. (2012). Exploring undergraduates' perceptions of the use of active learning techniques in science lectures. *Journal of College Science Teaching,* 42(2), 80-87.

Yin, R.K. (1994). *Case Study Research Design & Methods*, Second Edition, SAGE.

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RESEARCH ARTICLE

ÇEVRE EĞİTİMİ MODÜLER ÖĞRETİM PROGRAMININ AKADEMİK BAŞARI VE KAVRAMSAL ANLAMA ÜZERİNDEKİ ETKİSİ*

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Özet

Bu çalışmanın amacı, çevre eğitimi modüler öğretim programının ortaokul öğrencilerinin akademik başarıları ve kavramsal anlamaları üzerindeki etkisinin incelenmesidir. Çalışmada özel durum metodolojisinden yararlanılmıştır. Çalışmanın örneklemini amaçlı örnekleme yolu ile seçilen Gümüşhane ili merkez bir ortaokulun 7B şubesinde öğrenim gören 23 öğrenci (12 erkek - 11 kız) oluşturmaktadır. Çalışmada, veri toplama aracı olarak başarı testleri ve yarı-yapılandırılmış mülakat soruları kullanılmıştır. Başarı testlerinin ön ve son testleri arasındaki farkın istatistiksel olarak anlamlı olup olmadığını belirlemek için parametrik testlerden bağımlı t-testi uygulanmıştır. Ünitelerin son test puanları arasında anlamlı bir ilişki olup olmadığı tek yönlü varyans analizi (one-way ANOVA) ile irdelenmiştir. Mülakat sorularının analizinde ise mülakata verilen cevaplar "Tam Anlama", "Kısmen Anlama" ve "Anlamama" olarak kategorilendirilmiştir. Elde edilen analizler sonucunda çevre eğitimi modüler öğretim programının ortaokul öğrencilerinin akademik başarılarında ve kavramsal anlamalarında olumlu yönde etkili olduğu tespit edilmiştir.

Anahtar Kelimeler: Modüler öğretim programı, çevre eğitimi, kavramsal anlama, akademik başarı, ortaokul öğrencisi

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