The effectiveness of the new 9th grade biology curriculum on students' environmental awareness

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Contents

Abstract

The aim of this study was to examine the effectiveness of a new 9th grade biology curriculum on students' environmental awareness. Participants included 91 ninth grade students in a high school in Balikesir during the spring semester of the 2008-2009 academic years. Two classrooms, including 22 and 24 students respectively, were randomly assigned to a control group, and two classrooms, including 22 and 23 students respectively, were assigned to an experimental group.

Three instruments were used in the study: The Environmental Awareness Questionnaire, a semi-structured observation form and a semi-structured interview form. The Environmental Awareness Questionnaire was administered to all students in the study as a pretest and as a posttest. While the experimental group received instructional methods used in the new 9th grade biology curriculum, the control group received traditional instructional methods. Observations were also performed according to a semi-structured observation form and notes were taken during the five-week treatment. After the treatment, 10 students from the experimental group were interviewed using a semi-structured interview form. The data was analyzed using descriptive statistics and independent samples t-test in SPSS 12.0 software. The results of the study revealed that the instructional methods used in the new 9th grade biology curriculum were more effective in increasing the ninth grade students' environmental awareness than compared to traditional instructional methods.

Keywords: Environmental awareness, environmental education, 9th grade biology curriculum

Introduction

Environmental Education

Environmental education is an ongoing process in our lives and is influenced by family, school and society factors. The major aim of environmental education is to increase individuals' environmental awareness and sensitivity; this can improve one's standard of living by fostering a healthier and safer environment (Altin, Bacanli, & Yildiz, 2002).

There has been a variety of research on environmental education. For example, Kuhlemeier, Van Den Bergh, & Lagerweij (1999) studied more than 9.000 ninth grade students in 206 individual Dutch secondary schools about their environmental knowledge, environmental attitudes and environmentally responsible behaviors. Students were generally willing to make financial sacrifices and apply environmentally responsible behavior in their daily lives. While nearly half of the students had a high level of positive attitudes toward the environment, all students had incorrect and/or insufficient knowledge about environmental problems and inadequate environmentally responsible behavior in general. Similarly, Pe'er, Goldman, & Yavetz (2007) examined the attitudes, knowledge and environmental behavior of 765 first year students in three teacher training

colleges in Israel. They reported that students' attitudes toward environment were positive, but their environmental knowledge was limited.

Students environmental attitudes may differ based on several variables such as grade level, gender and socioeconomic level, though there does not appear to be a consensus (Sama, 2003; Erol & Gezer, 2006; Ulucinar Sagir, Aslan, & Cansaran, 2008; Carrier, 2009; Coertjens, Boeve-de Pauw, De Maeyer, & Van Petegem, 2010). For example, Sama (2003) stated that the university students' grade levels, whether their first year or final year, did not have any impact on their environmental attitudes; yet, there was a significant difference in the attitudes of the students in the department of foreign languages.

The study results of Uzun & Saglam (2005) revealed that there was a significant difference in the average environmental consciousness among the socioeconomic status of 258 high school students: The middle socioeconomic group showed more environmental consciousness than the high and low socioeconomic groups. Erol & Gezer (2006) illustrated that 225 prospective elementary school teachers often had weak attitudes toward the environment and environmental problems. Students' environmental attitudes changed with age, and girls had better attitudes toward to environment than boys. Students' environmental attitudes did not change with their fathers' occupation, parent education level or their socio-economic status. The study of Ulucinar Sagir et al. (2008) reported that there was no significant difference between males and females or among the students' environmental knowledge with regard to their parents' education levels.

Toili (2007) found that few students within 22 secondary schools in Kenya participated in civic activities dedicated to improving the quality of their communities' environments. Many students expressed that insufficient environmental awareness contributed to their lack of enthusiasm or even to their ability to make a difference. Therefore, an environmental education curriculum that promotes environmental knowledge and environmental issues and/or problems would be quite beneficial in meeting the needs of its students and their communities.

An effective environmental education requires qualified teachers with adequate knowledge. If the teacher lacks sufficient knowledge and responsibility, then environmentally illiterate students cannot be trained (Cabuk & Karacaoglu, 2003; Denis & Genc, 2007).

Campbell, Medina-Jerez, Erdogan, & Zhang (2009) made a comparison among 171 seventh and twelfth grade science teachers from the U.S., Bolivia and Turkey, according to their attitudes toward environmental education and instructional practices. They concluded that while the teachers' knowledge about global environmental issues and the teachers' rationales related to environmental education in their science classroom instruction showed a significant difference among three countries, technological and/or environmental problems in science classroom instruction did not show any significant differences among three countries. Therefore, teachers should be well-trained regarding environmental issues as they are a model to students of how to protect the environment for tomorrow; in addition, it would be best to integrate the importance of education for sustainable development in teaching of biology in schools (Noziran, 2010).

In order to raise environmentally-aware individuals, who can take responsibility to overcome environmental problems, students from the preschool level and above should be educated about these issues. Students could acquire the necessary awareness and responsibility about the environment by implementing instructional approaches, which make students more active, saves them from an unnecessary knowledge burden and improves their brain power (Sahin, Cerrah, Saka, & Sahin, 2004; Turkish Environmental Atlas, 2009).

Students' environmental knowledge and/or attitudes could be increased by several instructional techniques. For example, while instruction based on a conceptual change approach increased students' environmental understanding, it did not increase students' attitudes toward the environment and biology (Cetin, 2003). Students' environmental knowledge and attitudes could be increased by computer-assisted instruction (Aivazidis, Lazaridou, & Hellden, 2006). Paleoecology, the study of ancient ecosystems as a teaching tool can be used in a science curriculum to teach global environmental education quite effectively (Raper & Zander, 2009). Outdoor activities can also be useful to increase students' environmental awareness (Carrier, 2009).

The New 9th Grade Biology Curriculum in Turkey and Conscious Individual-Environment Unit

To increase students' achievement and attitudes, problem-solving skills, etc., the Turkish Ministry of Education began to revise the curricula of many courses from 1st to 10th grade after 2003-2004 academic years. For instance, the Turkish

Ministry of Education made some changes to the 9th grade biology curriculum, and that curriculum was implemented in 2008-2009 (Secondary 9th Grade Biology Curriculum, 2007). The new 9th grade biology curriculum was mainly developed by taking the following into consideration: Biology literacy of students, constructivist learning approach, spiral approach, students' mental and physical development levels and individual differences, parallelism and coherence between the curricula of biology and other related courses, and performance-based assessment and evaluation approach. The new 9th grade biology curriculum also required that teachers apply several instructional methods and techniques like constructivist approach, brainstorming, computer-assisted instruction and project-based instruction.

In the new 9th grade biology curriculum, the last unit is entitled 'Conscious Individual-Environment'. It has sub-units about environmental problems and Ataturk's approach toward nature and environment. The main goals of this unit include: to recognize the adverse effects of human activities on the environment; to develop solutions to these problems; to understand the impact of environmental problems on human health; to become biology literate (Secondary 9th Grade Biology Curriculum, 2007). Furthermore, this unit includes goals regarding science-technology-society-environment relations, scientific research and scientific process skills, communication skills and attitudes and values (See Appendix A). The basic concepts in the unit related to the environment were to be integrated with the subject content in accordance with a spiral approach by following the principles of moving from general to particular and from the known to the unknown.

The new 9th grade biology curriculum requested that teachers implement their instruction based on the new curricula so that all the curricula goals could be reached. When we interviewed with some teachers regarding the new curricula and its implementation in schools, they stressed that the new 9th grade biology curriculum could not be completely applied in schools.

The main reasons were because the new curricula required too many goals to be accomplished. In addition, biology textbooks were full of activities that were taking too much time to be completed by the end of the term. Finally, students would take the Student Selection and Placement System Exam, and the teachers' discovered that the curriculum and the exam did not complement each other entirely. Therefore, the activities were deemed to have lost valuable time were not seen as effective for improving students' achievement on their exams.

Although plentiful materials could be found regarding the new 9th grade biology curriculum on the Web, many teachers mentioned that was insufficient instructional support of the course implementation so that the course to be executed effectively. In other words, the teachers did not feel prepared to teach the new curriculum. Many of the teachers resolved their own traditional strategies in the classrooms because they believed the new 9th grade biology curriculum could not be applied effectively; thus, if they received adequate support, perhaps they could have modified their teaching strategy to better deliver the curricula to their students.

In summary, although the Turkish Ministry of Education mandated a student-centered constructivist approach to the changes inherent within the 9th grade biology curriculum during the 2008-2009 academic years, many teachers have still taught biology courses in a traditional manner, applying a teacher-centered instructional approach instead. Therefore, this study aimed to examine the effectiveness of the new 9th grade biology curriculum on students' environmental awareness, comparing a teacher-centered traditional instructional approach and a student-centered instructional approach in high school.

Problem

What was the effectiveness of the new 9th grade biology curriculum on ninth grade students' environmental awareness?

Method

Participants

Participants in the study were comprised of 91 ninth-grade students enrolled in a total of four classrooms in a Balikesir high school during the spring semester of the 2008-2009 academic years. Two classrooms were randomly selected as the control group and contained 44 students (48.4%), and the others were selected as the experimental group, consisting of 47 students (51.6%). Of the 91 students, 54 were female (59.3%) and 37 were male (40.9%).

Data collection and data analysis

Study data was collected by three data measuring tools: The Environmental Awareness Questionnaire (EAQ), a semi-structured observation form and a semi-structured interview form.

Environmental Awareness Questionnaire: The Environmental Awareness Questionnaire was used to assess students' environmental awareness. The original version of the questionnaire developed by Cabuk & Karacaoglu (2003) consisted of 21 questions using a three-point Likert type. The questionnaire only included 18 items since three items were removed since they were deemed not applicable. The aim of the questionnaire was to obtain students' opinions about whether they were environmentally aware and whether environmental education was adequate in formal education institutions. The EAQ was administered to all students both as a pretest and a posttest. The EAQ duration was about 20 minutes.

The EAQ data was analyzed according to descriptive statistics and independent samples t-test that were evaluated using SPSS 12.0 statistical software. The student responses for the items in the EAQ were scored from 1 to 3 (Never, Sometimes, Always). Possible average scores on the EAQ ranged between 1 to 3 with higher scores indicating positive attitude and lower scores indicating negative attitude. The reliability of the EAQ in the study of Cabuk & Karacaoglu (2003) was Cronbach alpha of .81. While the EAQ pretest reliability coefficient was Cronbach alpha .77, the EAQ posttest reliability coefficient was Cronbach alpha .80 in the present study.

Observation: Observation is a method used to describe in great detail a behavior originating from any environment or institution. Observation provides verifiable, highly valid and detailed information about the assessed individuals. A researcher can employ the observation method if s/he seeks to obtain a detailed and comprehensive picture over time of a particular behavior occurring in any environment (Ysseldyke & Olsen, 1997). The types of observation include non-systematic, semi-systematic and systematic observations. To support the data of the study, observations in the control and experimental groups were performed based on a semi-structured observation form (Appendix B) by the second author of the paper and observation notes were taken. Observations were performed over a four-week treatment; in addition, the types of the instruction of 'Conscious Individual-Environment Unit' were used in the control and experimental groups as

well as the students' performance in each group. No interventions were made in regards to the course instructors or to the actual instruction in any way during the treatment.

The observation data were descriptively analyzed for both the experimental and control groups. The data in the experimental and the control groups were categorized under appropriate themes and sub-themes.

Interview: Interviews can be described as a mutual and interactive production process based on asking and answering questions for a specified purpose (Yildirim & Simsek, 2005). Types of interviews include non-structured, semi-structured and structured interviews. To support the data of the study, 10 students from the experimental group were interviewed after the treatment. Interviews were performed based on a semi-structured interview form (Appendix C) by the second author of the paper and interview notes were taken. Each student was interviewed for about 20 minutes.

The interview data was descriptively analyzed too. Student responses to each question in the interview form were categorized under appropriate themes and sub-themes. Striking interview comments were noted using direct quotations.

Treatment

The Biology course is taught two hours per week, with each course session lasting 40 minutes typical of a classroom in Turkey. 'Conscious Individual-Environment Unit' was applied at the end of the term. This study was a quasi-experimental study and the treatment duration was five weeks (12 hours). Before the treatment, the EAQ pretest was administered to all ninth grade students in nine classes in a high school in Balikesir in Turkey. The high school had two biology teachers, one male and one female. After analyzing the pretests by using independent sample t-test, only four classes with a total of 91 students were assumed equal. Two classrooms, including 22 and 24 students, were randomly assigned as a control group, and two classrooms, including 22 and 23 students, were assigned as an experimental group. The female teacher instructed the Conscious Individual-Environment Unit to the experimental group, while the male teacher taught the same unit to the control group. Although it would have been better if each teacher would have been designated one control classroom and one experimental classroom, the female teacher was selected as the experimental group teacher. The female teacher had

previously used similar teaching methods proposed by the new 9th grade biology curriculum in her classes, while the male teacher had already used traditional methods in his classes. The teachers participated in the study voluntarily.

The research design was given in Table 1. As seen in Table 1, the EAQ as pretest was administered to the students in the experimental and the control groups before the treatment. The control group received the traditional instructional methods including direct lecturing, question-answer methods and note taking. The experimental group received the instructional methods of the new 9th grade biology curriculum in which brainstorming, discussion, experimenting, preparing posters and projects were used in addition to direct lecturing and question-answer methods. 9th grade biology textbooks were also used in the experimental and control groups during the treatment. Biology textbooks were prepared based on constructivism and multiple intelligence approaches according to aims and goals of the new 9th grade biology curriculum. It had several activities, including posters and projects to be created by the students.

Table 1. *Research Design*

Group	Before Treatment	Treatment	After Treatment
Control Group	EAQ	Traditional instructional methods Observation	EAQ
Experimental Group	EAQ	Instructional methods of the new 9th grade biology curriculum Observation	EAQ Interview

EAQ: Environmental Awareness Questionnaire

The instruction followed the steps below in the control group:

1. Before the course sessions, students were assigned preliminary questions related to the subject as homework and they were asked to prepare this homework. The aim was for the students to have some advance insight regarding the subject.

2. At the beginning of the course sessions, questions like 'What is environment?' were first asked to peak the students' curiosity related to the subject.

3. In the development part of the course sessions, the teacher gave the students a summary of the subject from the biology textbook using the direct lecturing method to reinforce their understanding. The students were also shown pictures about the subject.

4. At the end of the course sessions, the questions in the textbook had been assigned as homework to increase comprehension about the subject.

5. The teacher asked the students to take notes about the subject summaries at the end of each course session.

6. Furthermore, the students were advised to read texts about the environment in their biology textbook.

The experimental group was taught the environmental subjects by following the order and activities in the new 9th grade biology textbook (Secondary 9th Grade Biology Curriculum, 2007).

The instruction followed the steps below in the experimental group:

1. Before the course sessions, the students were assigned preliminary questions on the subject as homework and they were asked to prepare their homework since the goal was for each student to acquire insight in regards to the subject in advance.

2. Then, the students were asked some questions about daily life in order to motivate them during the class. For instance, 'What is global warming?' Some relevant pictures complemented the questions in order to initiate a discussion about them.

3. The students completed all the activities in their biology textbook in order.

4. The students also prepared two projects from the biology textbook (Appendix D).

5. Furthermore, the students were asked to read texts about the environment found in their biology textbook.

The second author of the study performed some observations and took notes during the treatment, but there were no intervention to the instructions of either the control or the experimental groups. After the treatment, the EAQ was administered as a posttest to the students in the experimental and the control groups. Finally semi-structured interviews with 10 students in the experimental group were administered after the treatment.

Results

Environmental Awareness Questionnaire

The pretest and posttest scores of the experimental and the control groups on the Environmental Awareness Questionnaire were analyzed using descriptive statistical analyses. Table 2 presents the results of descriptive statistics.

Table 2. *Results of Descriptive Statistics of Environmental Awareness Questionnaire*

Group	N	EAQ Pretest		EAQ Posttest	
		Mean	SD	Mean	SD
Control Group	44	2.06	.336	2.16	.257
Experimental Group	47	2.02	.283	2.35	.315

EAQ: Environmental Awareness Questionnaire

As seen in Table 2, participants of the study were 91 students: The control group had 48.4% and the experimental group had 51.6%. The difference between the EAQ pretest mean scores of the control and the experimental groups was .04 before the treatment. The difference between the EAQ posttest mean scores of the control and the experimental groups was .19 after the treatment, in favor of the experimental group. There was a .10 increase between the EAQ pretest and posttest mean scores of the control group, while the experimental group displayed a .33 point increase between their EAQ pretest and posttest mean scores.

Independent samples t-test analysis was performed for the EAQ pretest and EAQ posttest scores of the control and the experimental groups. Table 3 shows the results of independent samples t-test analysis.

Table 3. *Results of Independent Samples t-test Analysis*

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Dif.	Std. Er. Dif.	95% Conf. Int. of the Dif. Lower	Upper
EAQ Pretest	Equal var. assumed	.079	.779	.550	89	.584	.036	.065	-.093	.165
	Equal var. not assumed			.547	84.354	.586	.036	.065	-.094	.166
EAQ Posttest	Equal var. assumed	2.976	.088	-3.145	89	.002	-.190	.060	-.310	-.070
	Equal var. not assumed			-3.166	87.431	.002	-.190	.060	-.310	-.071

EAQ: Environmental Awareness Questionnaire

Table 3 shows that there was no statistically significant difference between the Environmental Awareness Questionnaire pretest mean scores of the control and the experimental groups before the treatment ($p > .05$). Thus, the control and the experimental groups were assumed to be equivalent. After the treatment, there was a statistically significant difference between the Environmental Awareness Questionnaire posttest mean scores of the control and the experimental groups ($p < .05$), in favor of the experimental group.

Observation

Treatment duration was five weeks (12 hours). The second author of the paper observed the instruction of the experimental and the control groups and observation notes were taken during the study. There was no interruption to the instruction in either the experimental or the control groups. The experimental group was taught by the instructional methods of the new 9th grade biology curriculum while the

control group received traditional instructional methods. Table 4 gives a comparison of the observation data for the experimental and the control groups.

Table 4. *Comparison of the Observation Data for the Experimental and the Control Groups*

Control Group	Experimental Group
• The duration of course sessions were sufficient for teaching the environmental subjects. • The classroom environment, its formal structure and in-class interaction was appropriate. • The lessons were taught in order in the 9th grade biology textbook. • The lessons were teacher-centered. • No activity was performed in classes.	• The duration of course sessions were sufficient for teaching the environmental subjects. • The classroom environment, its formal structure and in-class interaction was more appropriate. • The lessons were taught in order in the 9th grade biology textbook. • The lessons were student-centered. • Various activities were performed in classes, including discussions and the project work recommended in the biology textbook.

As seen in Table 4, both the experimental and control group applied the instruction of the new 9th grade biology curriculum by following the order of the biology textbook. In the control group, only a few students raised their hands when the teacher asked questions. Students did not show much interest to the course even though the teacher was quite active in the classroom. However, the experimental group was taught with various instructional techniques such as discussions, experiments and projects apart from lecturing and question-answer techniques. The students in the experimental group engaged in more research and they were more active than the students in the control group. One of the striking findings related to the experimental group was that the students had more interest in the course from the beginning to the end of the class sessions. During class sessions, they often raised hands, asked questions about the subject and exhibited enthusiasm towards the course. They did not have any difficulty forming groups for the assigned projects and enjoyed working on their projects very much.

Interview

The findings of the interviews with 10 students in the experimental group supported the observation findings in this study. The semi-structured interview form was used to get the experimental group students' opinions about the instructional methods of the new 9th grade biology curriculum in this study. Here are some examples of the interview findings, noted below:

Interviewer: What did you think when environmental subjects were taught?

All of the 10 students indicated that the unit was taught in a different way than the other units in the biology course and the students said that they found the courses to be enjoyable. For instance,

> "In the biology course, we had not been as active when we were learning other subjects. But now we were more active in class and can freely express our opinions." (Student 4)

> "While learning these subjects, I discovered that I enjoyed the new method more." (Student 7)

> "I really liked this unit and I believed that it would be the most remembered unit." (Student 9)

The students in the experimental group stated that all of the activities of the 'Conscious Individual-Environment Unit' were performed during the treatment, but the activities found in the other units in the biology textbook had not been fully executed. Nine of the students described the activities that were completed as very enjoyable. The opinions of two students are quoted below:

> "The activities were very nice and fun. We were relieved from writing; yet, we also understood the subjects taught." (Student 1)

> "We also performed group work while we were doing the activities. All of us had duties in the group. When we performed these duties, we also exchanged information and achieved retention of information." (Student 3)

Five of the students stated that being prepared for classes was more effective in understanding the subjects. For example,

> "I used to get bored with researching, but I did the research assigned by our teacher for this unit and realised that I understood more easily. Also, when I participated in class, my interest in the course increased and I felt happy. I started discovering information." (Student 5)

On the other hand, Student 2 stated that the new instructional methods and the traditional instructional methods could be deemed the same. The student argued that if the two methods were properly implemented, the results would be the same; the only difference would be the way in which the information was transmitted.

> *Interviewer: What kind of difficulties did you have when this method was implemented?*

All of the 10 students stated that they had a lot of difficulties in obtaining the necessary equipment when this method was implemented. For instance, their families had modest financial means and they were unable to purchase items needed for the courses. Student 9 stated the following regarding the issue:

> "I had difficulty in obtaining all the materials needed for the course because we were not in a good financial position. But I did my best to obtain them. Because it increased my participation in class and I learnt more easily."

> *Interviewer: Are you satisfied with the way your teacher implemented the method?*

Nine of the students indicated that they were satisfied with the new method during the treatment and their non-biology courses were not taught in this same way. Student 1 said that:

> "We were not taught this way in other courses. In the biology course we were always active; thus, I thought that our teacher implemented the methods very well. Also, the activities were performed more in this course and this made retention of what we learnt easier."

> *Interviewer: In implementing this method, did project work enhance your achievement?*

In response to this question, all of the 10 students stated that they enjoyed completing the project-based assignments for the course; they felt excited about

creating new products of their own and this was more effective in enhancing their satisfaction with the course. For example,

> "In this course, we brought to class more materials or created new products as project work. By project work, we not only repeated the subject as a whole, but also interacted with our friends. For example, we wrote a newspaper for the project work about environment. I really enjoyed the project and I was more sensitive towards environmental problems. Whenever I heard something about environment, it captured my attention and I read and research." (Student 3)

Conclusions and recommendations

The present study examined the effectiveness of the new 9th grade biology curriculum on ninth grade students' environmental awareness. The study results revealed that the instructional methods of the new 9th grade biology curriculum applied in the experimental group were more effective in promoting and enhancing students' environmental awareness when compared to the traditional instructional methods used in the control group.

The findings of the observation and interview in the study supported the results of the EAQ. As the students in the experimental group performed the activities, they were more active and enjoyed the courses more than the students in the control group, according to the observation results (Sahin et al., 2004; Turkish Environmental Atlas, 2009). The results of the interviews with the students in the experimental group showed that they were content with the new instructional methods in general. Most of the students also stated that the new instructional methods enhanced their environmental awareness and that they enjoyed the classes. The students shared that the information they learned was easy to remember and that they were more comfortable expressing themselves; in addition, they were excited about creating new products by participating in project-based assignments.

In conclusion, the current study was an evaluation of the effectiveness of the new 9th grade biology curriculum based on a constructivist approach supported by activities that explored students' environmental awareness. This study illustrated that the new instructional methods, which were conducted as recommended in the new 9th grade biology curriculum, were effective at enhancing students' environmental awareness and that students enjoyed their ecology courses more.

The study recommended that using the new instructional methods including outdoor activities (Carrier, 2009) for learning and teaching biology courses would help improve students' skills and students' attitudes toward biology. It should be noted that teachers play a crucial role in promoting students' interest in biology (Prokop, Tuncer, & Chuda, 2007). If the students had experienced a low level of participation during environmental activities, they were unprepared at identifying and recommending solutions for the environmental problems in their surroundings (Ulucinar Sagir et al., 2008). Therefore, it is suggested that teachers, rather than relying on traditional instructional methods, apply new methods and effective techniques throughout their biology curriculum. Environmental education curriculum could include environmental knowledge, awareness and communities specific environmental issues and/or problems (Toili, 2007). It should be noted that student' prior experiences and the content of their textbooks also impacted their knowledge about the environment (Paraskevopoulos, Padeliadu, & Zafiropoulos, 1998).

In this context, it is necessary that in-service and pre-service teachers are informed about the new methods, techniques and instructional technologies for biology instruction. Factors like individual differences, becoming biology literate, and using alternative assessment and evaluation methods also play a critical role in the implementation of the new 9th grade biology curriculum. In-service courses should be given to teachers. On the other hand, the content of the Student Selection and Placement System exam for university entrance should be revised in accordance with the new curricula in Turkey.

The study could be repeated with a larger sample size in order to validate the results. The effectiveness of the new 9th grade biology curriculum should be studied in terms of students' achievement on several biology topics and students' logical thinking styles beyond the students' environmental awareness.

Furthermore, data for future studies can be collected by data triangulation and exploring other mediums that support environmental study, such as field trips, taking photographs, free association grids, fortune lines techniques, drawing and writing techniques and/or creating an ecology web page. To use different kinds of techniques in the implementation of the new 9th grade biology curriculum would benefit more conscientious students who take care of their environment and are enthusiastic to tackle environmental problems.

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Appendix

Appendix A

Goals and Examples of the Activity of Conscious Individual-Environment Unit (from Secondary 9th Grade Biology Curriculum, 2007)

Unit	Goals	Examples of Activities	Explanations
Conscious Individual –Habitable Environment	1. With regard to environmental problems, students; 1.1 Evaluate the adverse effects of human activities on environment using examples from their environment (SRP 3, 4, 7; STSE 23, 25, 29; CAV 1, 17). 1.2 Explain the causes and possible effects of current environmental problems (SRP 7, 12; STSE 25). 1.3 Question their role as individuals in causing current environmental problems (SRP 1, 3, 4; STSE 28, 31; CAV 20). 1.4 Exemplify the impacts of current environmental problems on human health (SRP 3, 7; STSE 1, 9, 12, 13).	Activity 1. The Relation in Nature (Goals: 1.1, 1.2, 1.4) Activity 2. Fire Disaster (Goals: 1.1 - 1.4) Activity 3. Let us Protect our Environment (Goals: 1.1 - 1.6) Activity 4. Recycling (Goal: 1.5) Activity 5. Ataturk's Notion of Nature and Environment (Goal: 2.1)	■«—m 1.2 The current environmental problems are described as air, water, soil, radiation, noise and food pollution, erosion, acid rains, global warming, destruction of wild life, threats against natural living spaces and forest fires, etc. 0 The unit is linked to the learning domain "Environment and Society" in the ninth grade Geography course. **[!]** 1.2 The possible effects of global warming on biological diversity

	1.5 Offer suggestions to solve current environmental problems (SRP 3, 4, 13; STSE 1, 23 - 27; CAV 6, 7, 8, 11). 1.6 Actively involve in studies to solve environmental problems (CAV 1, 3, 4, 6, 8, 9, 16; STSE 23). 2. With regard to Ataturk's notion of nature and environment, students; 2.1 Provide examples about Ataturk's efforts, opinions, ideas, and memories concerning nature and environment.		are also underlined. **[!]** 1.3 Ecologic footprint and carbon footprint are underlined. **[!]** 1.4 Allergy is also underlined.

SRP: Scientific Research and Scientific Process Skills; STSE: Science-Technology-Society-Environment Relation; CAV: Communications Skills, Attitudes and Values

■«—m: Constraints; **0**: Links to Other Courses; **[!]**: Warning

Appendix B

Observation Form

1. How was knowledge transmitted to the students in the classroom?

2. How did the students participate in classroom activities?

3. How did the students participate in the methods, such as discussions and brainstorming, in the classroom?

4. Did the students actively use the information learnt from their teachers?

5. Were the purposes and outcomes of in-class interaction forms related?

6. How did the students' environmental awareness change?

7. Was full participation in the environmental activities achieved?

8. Did the project work enhance environmental awareness and had positive effects on the students?

9. Were the lessons taught in accordance with the curriculum? Was the duration of course sessions sufficient for the teaching the subjects?

Appendix C

Interview Form

1. What did you think when the environmental subjects were taught?

2. What kind of difficulties did you have when this method was implemented?

3. Were you satisfied with the way of your teacher implemented the method?

4. Did the project work contribute to your achievement during the implementation of this method?

Appendix D

Projects

Project 1. Environmental Pollution

Purpose: To enhance environmental awareness and fight environmental pollution.

Time: 2 weeks.

Steps:

1. Form groups.
2. Make a project plan for cooperation.
3. Investigate environmental pollution and its causes.
4. Present your research to the class as a written report.
5. Select one of the types of environmental pollution.
6. Start research on the selected type of environmental pollution.

Using your research results, you can produce a simple game, model, slide presentation, poster or newspaper drawing upon your imagination and creativity.

Project 2. Recycling

Purpose: To investigate waste recycling, and the biological and economical importance of recycling.

Time: 2 weeks.

Steps:

1. Form groups.
2. Make a project plan for cooperation.
3. Describe recycling and identify the types of waste that can be recycled.

4. Present your research to the class as a written report.

5. Enumerate the types of waste that can be recycled and select one for your study.

6. Start research on the selected type of recycling.

Using your research results, you can produce a simple game, model, power point presentation or newspaper drawing upon your imagination and creativity. You can also make a poster out of your project's research and product development stage and exhibit it at school.

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