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Development and Implementation of an Instructional Design for Effective Teaching of Ecosystem, Biodiversity, and Environmental Issues*

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Abstract

This study aims to develop an instructional design whereby ecosystem, biodiversity, and environmental issues are addressed with a holistic approach that provides more efficient teaching as well as to test the effectiveness of this design. A literature review was carried out and need-assessment was firstly made using the Readiness Test. This review and analysis indicated that an instructional design was needed to achieve a better education on ecosystem, biodiversity, and environmental issues. In this regard, two guides in which various methods, techniques, and materials are used were developed for students and teachers on the basis of context-based learning to ensure holistic learning of the ecosystem, biodiversity, and environmental issues. This instructional design was then administered to 165 seventh grade students who formed four experimental groups ($N = 82$) and four control groups ($N = 83$) through the non-equivalent control group design, a quasi-experimental design. The achievement test (AT) and environmental attitudes scale (EAS) were administered to the experimental and control group students. Finally, the opinions of the teachers on the teaching process, teaching tools, and materials were obtained by means of the Material Evaluation Form, while the opinions of students on this topic were obtained by means of the Lesson Evaluation Form. The findings obtained from the AT and ETA showed that there were significant differences between the post-test AT and ETA scores in favor of the experimental groups ($p < .05$). The teachers and students had positive opinions about the instructional design that was developed and implemented by the researcher on the basis of context-based learning. It was concluded that the developed instructional design is more effective in increasing student levels of environmental knowledge and having them develop positive environmental attitudes in comparison to the currently implemented curriculum.

Keywords: Environmental education • Instructional design • Context-based learning • Ecosystem • Biodiversity • Environmental issues

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Ecological problems grow with each passing day. Therefore, more importance should be attached to educational activities about environmental subjects and concepts. Education plays a great role in implementing national and international policies for preventing environmental issues and achieving their targets aside from determining such policies. According to Özkan (2008a), all segments of society should be informed about protecting natural resources and ensuring environmental sustainability. Moreover, it is reported that if awareness of biodiversity and ecodiversity is not achieved, it will not be possible to put the acquired knowledge and conscience into practice (Özkan, 2008b). This being the case, environmental education, especially in the early years, is of vital importance for environmental protection and environmental awareness. It is evident that providing education on humanity and their environment will allow the development of positive environmental attitudes, environmental conscientiousness, and environmental awareness. According to Çepel (2006), environmental education provides students with environmental ethics, which may prevent the emergence of many ecological imbalances and environmental issues, and teaches them to feel conscientiously dutiful and compulsory by having them notice their personal responsibilities for the maintenance of an inhabitable environment.

Ecosystem, biodiversity, and environmental issues, which are among the basic concepts of environmental education, are covered in the 7th grade "Humanity and the Environment" unit within the Science and Technology Curriculum of 2005. This curriculum was revised in 2013, and the course name was changed to "Science." The above-mentioned subjects are still covered within the 7th grade "Humanity and the Environment" unit. The Science Curriculum of 2013 is being put into practice gradually. It will start to be implemented in the 7th grade as of the 2015-2016 academic year (Talim ve Terbiye Kurulu Başkanlığı [TTKB], 2013). Tables 1, 2, and 3 present the objectives associated with ecosystem, biodiversity, and environmental issues, which are three of the subjects covered within the 2005 and 2013 curricula.

The literature contains research that shows there are problems with environmental education, which is expected to play an active role in the development of environmental knowledge, positive environmental attitudes, and positive environmental behaviors. There are few studies that indicate students have moderate knowledge of environmental concepts and environmental issues (Yurttaş & Sülün, 2010) while there are many studies showing that they have inadequate knowledge about them (Atasoy & Ertürk, 2008; Erduran Avcı & Darçın, 2009; Gökdere, 2005; Kuhlemeier, Bergh, & Lagerweij, 1999; Uluçınar Sağır, Aslan, & Cansaran, 2008). On the other hand, many studies report that students have misconceptions on subjects about the environment (Adeniyi, 1985; Bell, 1985; Griffiths & Grant, 1985; Munson, 1994; Özkan, Tekkaya, & Geban, 2004; Özata Yücel & Özkan, 2015), have low cognition of environmental concepts, and fail to correctly construct close relations between these concepts in their minds (Özata Yücel & Özkan, 2015). Kuhlemeier et al. (1999) stated that students do not have adequate, environmentally-responsible behaviors and Littledyke (2004) mentioned that students fail to comprehend basic ideas and relations which would allow them to make knowledge-based judgments on environmental issues. Uluçınar Sağır et al. (2008) said that students do not take part in environmental activities enough, do not have enough awareness of problems in their immediate environment, and fail to propose solutions to these problems. Aguirre-Bielschowsky, Freeman, and Vass (2012) found out that students cannot see the relationship of environmental problems with human activities or social events. Such lack of knowledge and interest among students poses an obstacle to a heightened development of environmental awareness (Erdoğan & Uşak, 2009).

For teachers, the main reasons for these problems are a lack of explanations, examples, materials, and activities on this subject, limited opportunities for trips, observations, and learning through experience, student disconnect from natural life, unpreparedness, and underestimation of the subject by students since it contains a complex network of relationships (Özata Yücel & Özkan, 2014a). In addition, mention is also made of deficiencies in the quality and scope of environmental education such as course contents not being sufficiently associated with the environment, and curricula, and textbook contents being unsuitable for the targets and objectives of environmental education (Atasoy & Ertürk, 2008). The difficulties facing an effective environmental education can be summarized as inconsistencies in explanations of the targets and principles included in curricula, the impossibility of carrying out environmental activities due to lack of materials, and the inexperience of teachers in environmental education (Gökdere, 2005).

Özsevgeç and Artun (2012) collected teacher opinions and determined that the Turkish Science and Technology Curriculum of 2005 contained few objectives on ecosystem, biodiversity, and environmental issues, and these objectives were complicated. They recommended the development of an effective environmental education. Similarly, Özata Yücel and Özkan (2014a) collected science teacher opinions and highlighted that the new goals and objectives should be added to the curriculum for cultivating individuals with a high environmental awareness and conscientiousness, textbooks should be revised in such a way that they give more coverage to current scientific knowledge, and examples from daily life should be featured. They also emphasized that the learning and teaching environment should be enriched with trips, observations, experiments, current news, and various visuals; evaluation activities should drive students to think, question, and search; and students should be provided with an opportunity to have more interaction with nature so that relevant subjects can be learned more effectively and permanently. To Erdoğan and Uşak (2009), even though various activities are carried out in schools, they are not enough to develop environmental awareness and conscientiousness. Gökdere (2005) stressed that some topics such as natural environment, energy resources, and environmental pollution should be added to curricula so that students' cognitive knowledge of environmental issues can be improved; such knowledge should be provided not only theoretically but also interactively and practically. Tanrıverdi (2009) argued that most objectives included in primary education curricula on the environment are for providing students with certain knowledge and attitudes yet fail to provide them with skills, understanding, and values.

It is known that lessons which have effective plans and drive students to participate, question, and think critically increase their knowledge of environmental issues while decreasing their misconceptions (Kahya, 2009; Marinoupoulas & Stavridou, 2002; Özkan et al., 2004; Öznacar, 2005). It is also known that the knowledge obtained improves environmental attitudes and increases environmentally responsible behaviors (Atasoy & Ertürk, 2008; Erdoğan, Bahar, & Uşak, 2012; Yılmaz, Boone, & Anderson, 2004). However, research shows that the environmental content and situations for learning that are included in the current curricula implemented in Turkey cannot achieve to high degree. All of the above-mentioned research results indicate a need for an instructional design whereby ecosystem, biodiversity, and environmental issues can be learned and implemented effectively. Moreover, most of the studies conducted so far have aimed to determine the current situation, but very few have been experimental or practical studies that attempt to eliminate the problems and deficiencies that were determined. No study has focused on the "Humanity and the Environment" unit or the ecosystem, biodiversity, and environmental issues using a holistic approach, and there is no instructional design for them.

Instructional design has been defined by different researchers in different ways. Hodel (1997) defines it as the analysis, design, development, implementation, and evaluation of any teaching experience. Smith and Regan (1999) define it as the systematic and reflective process of translating the principles of learning and instruction into plans for instructional materials, activities, information resources, and evaluation. Fer (2009) defines it as planning the ways that allow an effective teaching process to guide learning based on the principles of didactics. In brief, instructional design refers to the processes of developing teaching tools, materials, and activities on the basis of learning theories in accordance with the relevant curricula, the learning and teaching, and assessment of learners.

Instructional design models allow preparation of an effective instructional design. These models are general structures that show the most appropriate composite of all possible elements concerning the conduct of teaching for integrally solving existing problems (Şimşek, 2009). The literature contains many instructional design models such as Gagne, Briggs, and Wagner's model; Dick, Carey, and Carey's model; the ADDIE model; Morrison, Ross, and Kemp's model; the ASSURE model; Keller's Model of Motivational Design (ARCS); Smith and Regan's model; Seels and Glasgow's model; and the Universal Design Model. Based on the general characteristics and common points of all these instructional design models, the instructional design model presented in Figure 1 was taken as a basis in the present study.

The present study aims to develop an instructional design whereby the ecosystem, biodiversity, and environmental issues covered in the science courses are addressed using a holistic approach which provides more efficient teaching, test the effectiveness of this design, and thus contribute to the learning of ecosystem, biodiversity, and environmental issues.

Method

The model in Figure 1 was developed by the researcher on the basis of the common points of various instructional design models and was used in developing the instructional design. The instructional design was prepared in three main steps: need assessment, development of the instructional design, and assessment. Sub-steps were then set for each main step. For need assessment, as stated in Dick, Carey, and Carey's model, the states of students having difficulty learning and the experiences of teachers were used. The instructional design involved technology-supported materials such as animations and slides. As emphasized in the ASSURE model, such materials were checked before use and a measure was taken against any possible problems by preparing a back-up plan.

Need Assessment

Need assessment started with a review of the literature about students' conceptual understanding of the environment as well as their environmental awareness and attitudes. In addition, teacher opinions addressed in research from the literature were taken into consideration. Additionally, the readiness of the students was assessed via the developed test.

Developing the Instructional Design for Ecosystem, Biodiversity, and Environmental Issues

Based on the need assessment, it was decided to develop an instructional design for effective environmental education. The following steps were followed in developing it.

Evaluating and Rearranging the Objectives: The objectives associated with ecosystem, biodiversity, and environmental issues, which are some of the subjects covered within the scope of the science curriculum, were firstly evaluated. Then some of these objectives were corrected, and new objectives for improving student environmental awareness and consciousness were added. The objectives were expressed more clearly (see Tables 1, 2, and 3).

Arranging and Textualizing the Content: Sub-titles were set for each subject on the basis of the objectives. The objectives, and thus the content, were arranged from simple to complex. Then the content was rewritten through enrichment by use of a wide variety of sources in light of the current scientific knowledge. Body text was supported with examples from daily life. In this way, an attempt was made to ensure that students associated the content with daily life, especially their own surroundings. In addition, while the objectives were being set and textualized, ultimate attention was shown to the formation of the objectives in such a way that

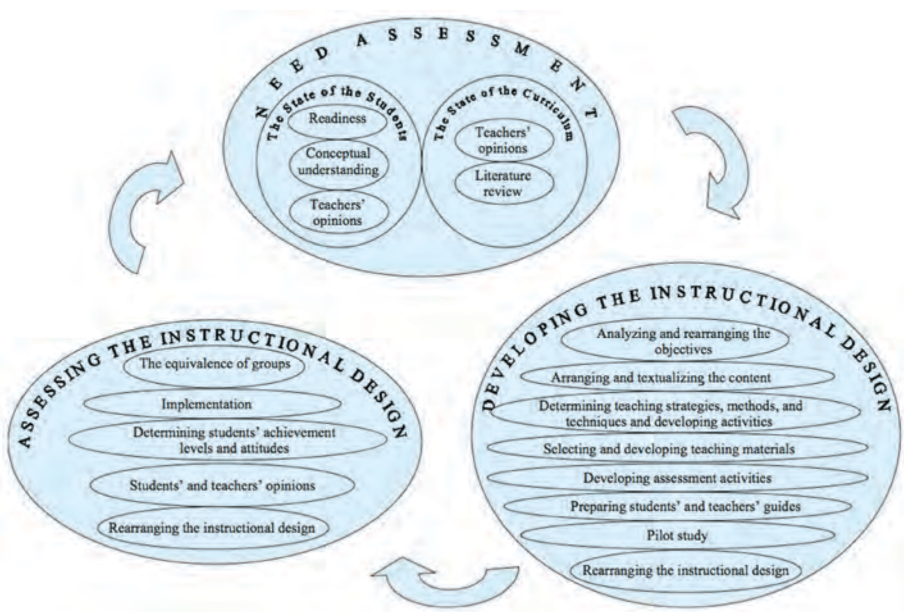

Figure 1: The model used for developing the instructional design for ecosystem, biodiversity, and environmental issues.

the students could holistically comprehend their surroundings and nature.

Determining Teaching Strategies, Methods, and Techniques and Developing Activities: By the nature of the subjects addressed, it was considered that "context-based" learning would be appropriate and effective for having students achieve the intended learning and level of consciousness. Learning environments which put the students at the center and allowed them to learn by doing and experiencing as much as possible were created, though the teachers had to be at the center from time to time. All methods and techniques needed in any teaching environment were used (for example, demonstration and lecturing where the teacher is at the center; problem-solving, doing an experiment, and preparing a poster where students are at the center; question and answer, group work, case, drama, and field trips where teacher and students interact continuously; and so on). Some activities were prepared by the researcher while others were developed by using various sources. The activities set in association with the objectives are given in Tables 1, 2, and 3.

Selecting and Developing Teaching Materials: An approach addressing all of the students' senses was adopted in selecting and developing teaching materials. Therefore, written materials such as books, posters, and worksheets; visual materials such as photos, figures, charts, and maps; auditory materials such as sound recordings; and technology-supported materials such as videos, slide-shows, and animations were used.

Developing Assessment Activities: Assessment activities were planned in such a way that they would allow determination of the degree to which students could be provided with the objectives, enabling the students to notice and immediately eliminate their deficiencies and achieve deep learning. By this means, assessments throughout the process were made to replace result-oriented assessment, and an attempt was made to turn the assessment process into a learning process. The assessment activities were designed in such a way that the students' environmental attitudes, behaviors, feelings, and thoughts as well as their conceptual understanding of the environment would be shown. The titles of some assessment activities were "Let's Pose a Question," "Let's Create Our Own Ecosystem," and "If We Were in Charge."

Preparing Students and Teachers' Guides: The first version of the students' guide was created by enriching the body of text formed on the basis of the objectives with such visual materials as pictures, charts, and tables. Then the activities as well as worksheets and assessment activities about them were placed in appropriate places within the text. In this way, it was aimed to make the guide serve both as a scientific source and as an implementation guide for the students. The teachers' guide on the other hand contained the objectives, time to be allocated for these objectives, and flowcharts indicating the time and way the activities would be carried out. After the guides were prepared, they were submitted to a biology faculty member and a science and technology teacher for examination. In this way, the guides were finalized by the scientific and pedagogical corrections made to them.

Plot Study and Making Necessary Corrections: The "Humanity and the Environment" unit containing ecosystem, biodiversity, and environmental issues was planned to be covered in the first four weeks of May according to the yearly plan for the 7th grade. The pilot study was conducted between the 12th of March and 7th of April, 2012. After that, the following corrections were made:

1. The concept maps and pictures in the student guide were revised and rearranged, and misspellings were corrected.
2. Some activities were modified, others were removed, and some new activities were added.
3. End-of-unit assessment questions were added.
4. Time allocated for the activities was evaluated and re-arranged as situations required.
5. Measures were taken against possible problems that could be experienced during the activities (For example, the protista was too small to see in the microscopic environment so it was difficult to achieve a high degree of perception of biodiversity. For that reason, images that were recorded by microscopes with a greater magnifying power were used to demonstrate the great diversity of life.)
6. A table indicating the time to be allocated for each subject and matching each objective with a relevant activity was added to the teachers' guide.

Data Collection Tools

Readiness Test (RT): The RT was prepared to test prior knowledge providing a basis for the "Humanity and the Environment" unit to be covered in the 7th grade. Firstly, a table of specifications was formed on the basis of the objectives associated with ecosystem, biodiversity, and environmental issues for the 4th, 5th, and 6th grades. The first version of the RT was prepared based on this table. The draft RT was examined by a biology professor and a science teacher in terms of language, scope, and appropriateness to the students' level. Then the RT was administered to 201 seventh grade students as a pilot study. The test, whose final version contained 20 items, was put into the Test Analysis Program (TAP) (Brooks & Johanson, 2003). The Kuder - Richardson 20 (KR-20) reliability coefficient calculated by considering the bottom and top 27% was found to be .714. Average item difficulty was found to be .561 and average item discrimination was found to be .469. Every correct answer was worth 5 points. The lowest possible score in the test could be 0 while the highest score could be 100.

Achievement Test (AT): The AT was developed for evaluating the cognitive effectiveness of the developed instructional design. A table of specifications was formed on the basis of the objectives included in the instructional design. The draft AT was created by getting the opinions of a biology professor and a science teacher. The AT was then administered to 336 eighth grade students as a pilot study. The test, whose final version contained 27 items, was put into the Test Analysis Program (TAP) (Brooks & Johanson, 2003). Its KR-20 reliability coefficient was found to be 0.82. Average item difficulty was found to be .597 and average item discrimination was found to be 0.487. Every correct answer was worth 3.7 points. The lowest score in the test could be 0 while the highest score could be 100.

Table 1
The Objectives and Activities Associated with Ecosystem Proposed and Included in Curricula

Curriculum 2005		Curriculum 2013	Proposed/Used in the Study	
Objectives	Activities in the Curriculum/ Textbook	2013 Objectives	Objectives	Activities/Experiments/ Animations
Explaining the concepts of species, habitat, population, and ecosystem with examples.	From species to ecosystem Living spaces/ where is the habitat? Different ecosystems/forest ecosystem Let's compete in the food web Who eats who? Relations between species	Defining the concepts of ecosystem, species, habitat, and population and giving examples.	Explaining the concepts of species, habitat, and population with examples.	Species, habitat, population (Activity) I am discovering the ecosystem (Activity) The elements of the ecosystem (Power Point) Relations in the ecosystem (Concept map) Does difference in color of light have any influence on the growth of plants? (Experiment) Rainfall forecast based on annual tree rings (Observation)* Food relations among species (Video) Food chain and food web (Animation) Who lives in the water? (Experiment) Different living spaces and their characteristics (Reading Text) Desert ecosystem (Video) Forest ecosystem (Video) Let's create our own ecosystem (Activity) Let's compare ecosystems (Activity) Let's pose a question
			Explaining the concept of ecosystem.	
Explaining the relations between living organisms in an ecosystem with one another and with non-living elements.			Discussing the continuously working and interdependent order of an ecosystem.	
			Exemplifying the living and non-living elements of an ecosystem.	
Making guesses about the life that may exist in different ecosystems			Exemplifying species that may exist in different ecosystems.	
			Exemplifying relations in an ecosystem.	
			Making correct guesses about the food chain and food web in an environment.	
Comparing ecosystems in terms of the diversity of life they contain and climatic characteristics			Discussing the possible results of extinction of a species in the food chain.	

*Activity added after implementation.

Table 2
The Objectives and Activities Associated with Biodiversity Proposed and Included in Curricula

Curriculum 2005		Curriculum 2013	Proposed/Used in the Study	
Objectives in the Curriculum 2005	Activities in the Curriculum/ Textbook	Objectives	Objectives	Activities/Experiments/ Animations
Noticing biodiversity in the ecosystem and highlighting its importance.	Biodiversity Biodiversity and life	Questioning the importance of biodiversity for natural life.	Noticing biodiversity in the ecosystem.	Different trees have different leaves (Observation) How many different species are there? (Field Survey) Who lives in the soil? (Experiment)* Biodiversity in Turkey (Slide-show) Biodiversity is important (Activity)
		Discussing the factors threatening biodiversity based on research data and offering solutions.	Noticing the biodiversity and richness of species in Turkey.	
		Searching and exemplifying plants and animals that have become extinct or are in danger of extinction both in Turkey and worldwide.	Exemplifying biodiversity in Turkey.	
			Discussing the importance of biodiversity.	
			Explaining that the decrease or disappearance of biodiversity in an ecosystem disrupts the integrity of the ecosystem.	
Exemplifying the plants and animals that are in danger of extinction both in Turkey and worldwide.			Exemplifying the plants and animals that are in danger of extinction both in Turkey and worldwide.	Let's make a poster (Activity) Let's pose a question
Offering suggestions for the protection of plants and animals that are in danger of extinction both in Turkey and worldwide.			Offering suggestions for the protection of the plants and animals that are in danger of extinction in Turkey and worldwide.	
Treating plants and animals in the area fondly.	Plants and animals are our friends Let's love living beings		Treating plants and animals around fondly.	If we were in charge (Drama)

*Activity added after implementation.

Environmental Attitudes Scale (EAS): The change in environmental attitudes of the students was determined through the EAS developed by Özata Yücel and Özkan (2014b). The scale consists of two sub-scales: *Behavior* and *Feeling, Thought, and Willingness to Act*. The behavior sub-scale which had only one dimension (Cronbach's alpha = .845) was a 5-point Likert-type scale (never, rarely, often, usually, and always). The second sub-scale was also a 5-point scale (I strongly disagree, I slightly agree, I agree somewhat, I agree, I strongly agree). It was made up of three dimensions: feeling (7 items, Cronbach's alpha = .815), thought (8 items; Cronbach's alpha = .750), and willingness to act (6 items, Cronbach's alpha = .706).

Material Evaluation Form (MEF): This form was created to obtain teachers' positive and negative opinions about the effectiveness of the students and teachers' guides, the clarity of these guides, their suitability for students, the value of interest for them, and the time allocated for activities.

Lesson Evaluation Form (LEF): This form, which consisted of 4 open-ended questions, was created to obtain the opinions of the experimental-group students about how beneficial and amusing they found their lessons. With this form, student opinion with regard to the three activities they liked most and the three activities they liked least, the students' guide that was prepared for them, and the conduct of the lessons in comparison to that of previous science lessons were obtained.

Implementation and Assessment (Process)

The developed instructional design was implemented in 16 course hours (4 weeks) as set forth in the current curriculum. 12 course hours were allocated to cover the subjects, one week for pretesting, one for post-testing, and two to make-up for any time lost due to unforeseen problems.

The non-equivalent control group design, a quasi-experimental design, was employed. The instructional design was implemented in 4 schools (two located in

Table 3
The Objectives and Activities Associated with Environmental Issues Proposed and Included in Curricula

Curriculum 2005		Curriculum 2013	Proposed/Used in the Study	
Objectives	Activities in the Curriculum/Textbook	Objectives	Objectives	Activities/Experiments/ Animations
Collecting and presenting information about one of the environmental issues in Turkey and worldwide then discussing its results.	Our country and our world are in danger What affects life? How does it affect life? Acid rain Let's solve our problems Ozone layer depletion/Soil pollution and erosion Let's protect our forests Biological weapons Let's put our thinking caps on	Though this unit in the curriculum does not contain objectives under a separate title, the objective of the unit involves the expression "questioning the causes and results of environmental issues"	Discussing the causes and results of water pollution as well as the measures that can be taken.	Ecological crisis (Video) Environmental issues in our region and their effects (Project work)* Water pollution (Activity) The effects of waste in the soil (Experiment) Air pollution kills (News from a Newspaper) Dilovası is like Chernobyl (Video) Let's measure the acidity of rain water (Experiment) * Greenhouse effect and global warming (Power point) Climate change (Animation) Ozzy ozone (Animation) * Noise pollution (Activity) Bright night (Reading Text) Chernobyl spread map (Video) Let's think (Question-answer) * What can we do? (Brainstorming)* Let's think, let's produce ideas (Metaphor)* Let's pose a question
			Discussing the causes and results of soil pollution as well as the measures that can be taken.	
			Explaining the causes of air pollution.	
			Explaining the relationship between air pollution and acid rain, the greenhouse effect, and ozone-layer depletion.	
			Discussing the effects of air pollution, acid rain, and ozone-layer depletion on our world and its species.	
Making inferences about the way an environmental problem in the world may affect Turkey.			Explaining noise and noise sources.	
			Discussing the effects of noise on human health.	
			Making suggestions about the ways noise pollution can be reduced.	
			Discussing the sources of light pollution and its results.	
			Discussing the sources of radioactive pollution and its results.	
Offering cooperative solutions for environmental issues in Turkey and worldwide and participating in relevant activities.	Organizations dealing with environmental issues in Turkey and worldwide		Offering cooperative solutions for environmental issues in Turkey and worldwide and participating in relevant activities. **	Let's inform authorized people, let's solve the environmental issue (Writing a petition to authorized people)*
Exemplifying the practices of Atatürk about environmental love.	From Atatürk to us, From us to the future		Exemplifying the practices of Atatürk about environmental love.	The walking mansion of Atatürk (Reading Text)

*Activity added after implementation.
**Objective added after implementation.

the city center, one located in an industrial area, and one located in a rural area). One experimental group and one control group were chosen from each school (Table 4). While the instructional design as developed by the researcher and the students' guide as prepared based on the instructional design were used in the experimental groups, the current curriculum and the student textbook as specified by the Ministry of National Education for Republic of Turkey was used in the control groups.

In assessing the development of the instructional design, student opinions were obtained in regard to their cognitive development, its influence on their environmental attitudes, and the conduct of lessons, while teacher opinions were received in regard to how they found the design. The RT, AT, and EAS were administered to both the experimental and control groups as pretests while the AT and EAS were administered as a post-test. In addition, after the instructional design was implemented, the LEF and MEF were administered to the experimental group students and teachers respectively.

Table 4
The Schools Included in the Study and the Number of Experimental Group and Control Group Students from These Schools

School Name	Experimental Group	Control Group
School A (industrial area)	7B (N = 18)	7A (N = 19)
School B (city center)	7A (N = 17)	7C (N = 17)
School C (rural area)	7A (N = 17)	7B (N = 22)
School D (city center)	7A (N = 30)	7B (N = 25)
	$N_{experimental} = 82$	$N_{control} = 83$

Findings

Need Assessment

Ten was the lowest score and 85 was the highest score achieved in the RT that was carried out for determining the cognitive knowledge levels of the students about ecosystem, biodiversity, and environmental issues which they had learned in previous years. Of the student scores, 7% ranged between 0 and 20, 33% were between 25 and 45, 36% were between 45 and 60, 23% between 65 and 80, and 1% between 85 and 100. The average score was 48.15. That meant that the students had low readiness levels. Table 5 given below indicates that the correct percentages of answers from the students were very low in the answers about "soil formation, soil types, and intended uses by soil type" and "the possible results of losing a ring in the food chain". Imperfection of conceptual understanding is evident in the answers about "the characteristics and classification of living beings," "change undergone by water on earth and the water cycle," and "the food chain in a living space." The highest correct-answer percentages were about "species in the surrounding living spaces" and "adaptation of species to their habitats" (Table 5).

Table 5
Average Percentage of Correct Answers for the RT by Subject (N = 176)

Subject	Average correct answer percentage (%)
Species in the surrounding living spaces	73%
Adaptation of species to their habitats	72.7%
Environmental issues in the surroundings and the causes of these issues	55.7%
The food chain in a living space	47.5%
Change undergone by water on earth and the water cycle	46%
The characteristics and classification of species	45%
The possible results of losing a ring in the food chain	37%
Soil formation, soil types, and intended uses by soil type	18%
General Average	49%

The Cognitive Achievement Levels and Environmental Attitudes of Students before and after the Implementation of Instructional Design

Improvement in the cognitive achievement levels and environmental attitudes of the experimental group and control group students through the coverage of subjects examined in the present study was evaluated through comparison of the pretest and post-test scores of the groups via the paired samples *t*-test. Through coverage of the subjects, a statistically significant improvement occurred in the cognitive achievement levels of both the experimental

Table 6
t-Test Results for the Pretest and the Post-test Results of the Experimental Group and Control Group Students

Group	Test	Measure	*N*	$\overline{X}$	*ss*	*sd*	*t*
Experimental Group	AT	Pretest Post-test	82 82	40.700 64.254	17.4613 19.4705	81	-12.942*
	EAS	Pretest Post-test	79 79	3.6768 3.8625	0.55791 0.58882	78	-4.603*
	EAS – Behavior	Pretest Post-test	79 79	3.5273 3.7850	0.69815 0.70962	78	-4.002*
	EAS – Feeling, Thought, and Willingness to Act	Pretest Post-test	79 79	3.7772 3.9138	0.61633 0.65594	78	-3.029*
Control Group	AT	Pretest Post-test	83 83	36.465 46.317	13.8578 18.4400	82	-5.865*
	EAS	Pretest Post-test	82 82	3.6955 3.7321	0.50312 0.61663	81	-.711
	EAS – Behavior	Pretest Post-test	82 82	3.5373 3.6398	0.63350 0.75344	81	-1.600
	EAS – Feeling, Thought, and Willingness to Act	Pretest Post-test	79 79	3.8131 3.7836	0.56583 0.64470	78	0.495

*$p < .01$.

group students and the control group students. While a significant increase occurred in the scores achieved by the experimental group students in the dimensions of *Behavior* and *Feeling, Thought, and Willingness to Act,* as well as the scores achieved in the entire scale measuring environmental attitudes, no significant difference occurred in the case of the control group students (Table 6).

Comparing the Cognitive Achievement Levels and Environmental Attitudes of Students After Implementation

Comparison of the AT and EAS Post-test Scores of the Experimental Group and Control Group Students: The results of the independent samples *t*-test indicated that there was no significant difference between the cognitive achievement levels ($t_{163} = 1.73$; $p = .86 > .05$) and the environmental attitudes ($t_{163} = -.42$; $p = .678 > .05$) of the experimental group and control group students before the experiment. However, there was a significant difference between the two groups in terms of readiness ($t_{163} = 2.77$; $p = .006 < .05$). Since the level of readiness could affect achievement and attitude scores after implementation, the RT scores of the students were determined to be covariate and hence the ANCOVA test was carried out. Analyses were made after it was ensured that the prerequisites of ANCOVA (normality of the data, independence of the groups, and homogeneity of regressions, for example) were fulfilled.

ANCOVA results (Table 7) showed that there was a significant difference between the average scores achieved by the experimental group and the control group students in the post-test AT ($F_{(1\text{-}162)} = 27.78$; $p = .00 < .05$). Based on the results of the post-test AT, the Bonferroni test results demonstrated that the experimental group students ($\bar{x} = 62.47$) exposed to the instructional design developed by the researcher had a higher cognitive achievement level in comparison to the control group students taught by use of the already existing instructional design ($\bar{x} = 48.08$). No significant difference was found between the scores achieved by the experimental group students and the control group students for the post-test EAS ($F_{(1\text{-}158)} = .12$; $p = .73 > .05$).

Comparison of the Score Differences for the Experimental Group and Control Group on the EAS: As shown in Table 8, the differences between the improvement in the environmental attitudes of the experimental group students and the control group students was examined via an independent samples *t*-test through the calculation of the differences between the scores they achieved on the post-test EAS the scores they achieved on the pretest EAS (X_2-X_1). The analysis results indicated that there was a significant difference in the EAS scores of the experimental group and control group ($t_{159} = 2.28$; $p = .024 < .05$). It was seen that the positive increase in the environmental attitudes score of the experimental group students was bigger than the environmental attitudes scores of the control group students. However, no significant difference was found between the two groups in the dimension of behavior ($t_{159} = 1.709$; $p = .089 > .05$).

The Questions which were Answered Correctly at a Low Percentage in the AT: Though the experimental group students had higher levels of cognitive achievement in comparison to the control group students, some questions in the AT were answered correctly at a low percentage. The questions which were answered correctly at a low percentage were about the living and non-living elements of the ecosystem (38%), the effects of the non-living elements of the ecosystem on living beings (35%), and the results of an increase in the number of living beings in a particular area (27%).

Only 37% of students were aware of the fact that the number of species in an area does not necessarily mean

Table 7
ANCOVA Results for the AT and EAS as Post-tests by Group

Test	Source of Variance	Sum of Squares	*sd*	Sum of Squares	*F*
Post-test AT	RT	10963.254	1	10963.254	37.291
	Group	8166.587	1	8166.587	27.778
	Error	47626.487	162	293.991	
	Total	575185.350	165		
Post-test EAS	RT	7.250	1	7.250	22.641
	Group	.039	1	.039	.123
	Error	50.592	158	.320	
	Total	2378.596	161		

Table 8
t-Test Results Concerning the EAS Score Differences of the Experimental Group and Control Group (X_2-X_1)

Test	Measure	*N*	$\overline{X}$	*ss*	*sd*	*t*
EAS Score Difference	Experimental	79	0.186	0.3586	159	2.281*
	Control	82	0.037	0.4660		
EAS – Behavior	Experimental	79	0.258	0.5723	159	1.709
	Control	82	0.103	0.5797		
EAS – Feeling, Thought, and Willingness to Act	Experimental	79	0.137	0.4010	156	2.223*
	Control	79	-0.030	0.5295		

* $p < .05$.

high biodiversity. The students in the experimental group did not achieve a high level of understanding about biodiversity in a country being part of biodiversity in the entire world, that conservation of biodiversity is necessary for the treatment of future diseases, or that a diversity of ecosystems that exists in a country increases biodiversity.

The answers about environmental issues showed that 54% of the students failed to realize that factories cause soil pollution and plastic waste causes water pollution. Moreover, 50% of the students had the misconception that acid rain leads to depletion of the ozone layer.

The Ability to Implement Instructional Design by Different Teachers

The instructional design was implemented by the researcher in three of the four experimental groups. In one of the experimental groups, the instructional design was implemented by the science teacher of the students. The scores achieved by the experimental group going through the instructional design implementation by the science teacher in the post-test AT and post-test EAS were compared with those achieved by the other three experimental groups going through the instructional design implementation by the researcher through one factor analysis of variance (ANOVA) in order to determine whether or not the developed instructional design was influenced by the factor of teacher. The experimental groups were equivalent in terms of the pretest AT ($F_{3\text{-}78} = .551$; $p = .65 > 0.05$), RT ($F_{3\text{-}78} = 2.230$; $p = .09 > .05$), and EAS as pretest ($F_{3\text{-}78} = 1.201$; $p = .32 > .05$). ANOVA results concerning the scores achieved in the post-test AT and post-test EAS indicated that there was no statistically significant difference between the average scores achieved by the experimental group going through the instructional design implementation by the science teacher and that achieved by the other three experimental groups going through instructional design implementation by the researcher in the AT ($F_{3\text{-}78} = 1.271$; $p = .29 > .05$) and EAS ($F_{3\text{-}78} = .805$; $p = .50 > .05$). In other words, the factor of teacher did not influence student achievement or attitudes, and there was no difference between the instructional design implementations of the two teachers.

Student and the Teacher Opinions about Instructional Design

Both of the teachers who were asked to express their opinions via the MEF stated that the prepared guides were clear, understandable, and appropriate to the levels of the students in terms of language and expression. The teachers thought that the activities were consistent with the objectives and supported the teaching of the subjects. In addition, the teachers said that the pictures, slides, videos, and so forth used in the activities had been selected from daily life, were interesting and attention-grabbing, and made learning easy and permanent. According to the teachers, the students' guide was entertaining and functioned as a good source for the students. The teachers' statements on this subject are as follows:

> "The texts prepared for the students were very appropriate to the students' level and clearly written. The activities were consistent with the objectives. Both the students and I enjoyed it a lot. The videos watched by the students attracted their attention and they remembered the videos easily because they were examples from daily life. The students cooperated during the activities. We had an enjoyable and productive 'Humanity and the Environment' unit." (T1)

> "The guide you prepared was simple, plain, clear, and understandable. The observations and activities supported the teaching of the subjects and were adequate in terms of content. … The pictures, news, and slide-shows were very beautiful and attention-grabbing, and they facilitated understanding. (Those which I liked

most) … The subjects were covered in detail. There was nothing requiring the students to turn to a different source for doing research." (T2)

The negative opinions of the teachers were about the problem of time and lack of revision in the activity sheets. The opinions of the teachers on this subject are as follows:

"There was a problem of time because several activities were carried out on some subjects. There was no other adversity." (T1)

"Activity sheets separate from the observation and experiment sheets were not adequate. Repetition through activity sheets would be more effective." (T2)

Table 9
The Activities the Students Liked Most and Least

Activity Name	The Activities the Students Liked		The Activities the Students did not Like	
	*f**	%	*f**	%
Biodiversity observation in the garden	34	25.19	-	-
Watching documentaries and animations	27	20.00	-	-
Water and soil pollution experiment	23	17.04	-	-
Games played on the computer and in the classroom	18	13.33	1	
Examining the protozoa culture via microscope	11	8.15	-	-
Biodiversity slide	5	3.70	-	-
Making the poster of the species in danger of extinction	3	2.22	-	-
Let's create our own ecosystem	2	1.48	1	0.74
Talking about animals	1	0.74	-	-
Question and answer	1	0.74	-	-
Reading texts	1	0.74	-	-
Lecturing		0.74	1	
Examples	1	0.74	-	-
Posing a question	1	0.74	1	
Written activities about the book	-	-	3	2.22
All	7	12.5	-	-
None	-	-	48	92.31
Void	16		17	

* One student stated more than one activity.

Of the 72 experimental group students who were asked to express their opinions via the LEF, 92.3% said that there was no activity they did not like. The activity students liked most was biodiversity observation in the garden (25.2%). It was followed by watching documentaries or animations on various ecosystems, environmental issues and their effects (20%), and the water and soil pollution experiment (17%) respectively (Table 9).

All 72 experimental group students mentioned some positive sides of the student guide. On the other hand, six experimental group students expressed some negative opinions about the guide (see Table 10). The positive opinions (44.6%) suggested that the student guide was liked and well-prepared (S31, S48, S56, S67). Of the opinions, 13.4% suggested that the guide was informative and explanatory (S5, S10, S56), and 9.8% suggested that it was visually rich (S31, S48, S62, S67). In addition, the students said that the guide was necessary, beneficial, useful (S3), enjoyable (S7, S48, S62, S69), it had nice content and was better than the textbook (S5), the texts and activities were understandable (S61), and attention-grabbing (S7). Some student opinions are given below:

"It was a source which we could make perfect use of. Its visual richness made me happy." (S3)

"It was nicer than the textbook." (S5)

"The manual contained a lot of enjoyable and attention-grabbing things." (S7)

"It contained more information than the textbook…" (S10)

"It was a very well-prepared manual. The pictures helped us understand more." (S31)

"It was a very nice, easy-to-understand and enjoyable manual, and its pictures were quite clear." (S48)

"It was so nice. I loved it. The manual helped us obtain whatever we wanted and learn whatever we had difficulty in." (S56)

"… This manual helped me understand better." (S61)

"… The activities in it were enjoyable. It allowed covering the subjects in an amusing way." (S62)

"I think it was a very nice manual. It contained colorful pages (pictures) and a lot of activities. It made the people more interested in the lessons." (S67)

"I think the lessons were more enjoyable with this manual." (S69).

Table 10
Student Opinions about the Students' Guide

Positive Opinion			Negative Opinion		
Codes	*f**	%	Codes	*f**	%
I liked it – Nice – Well-prepared	50	44.64	Too many blanks	2	1.78
Instructive – informative – explanatory	15	13.39	Difficult activities	1	0.89
Visually rich	11	9.82	Experiments should be increased	1	0.89
Necessary – beneficial – useful	10	8.93	Complicated	1	0.89
Enjoyable	8	7.14	It must be more colorful	1	0.89
Nice content	4	3.57			
Clear	3	2.68			
Better than the textbook	3	2.68			
Attention-grabbing	2	1.78			
Total	106	94.64		6	5.36

* Student answers were evaluated in more than one theme.

Of the student opinions about the guide, as can be seen in Table 10, 5.% were negative. A third of these negative opinions suggested that the guide contained too many blanks. Apart from that, one student said that the activities were difficult (S32); one student said that experiments should be increased (S51); one student argued that it was complicated (S68); and one student suggested that it should be more colorful (S50). Some of the students' opinions are as follows:

"…, some activities were just difficult, I think." (32)

"… In short, it had a nice content, but the blanks on the back page were redundant." (S47)

"… To be honest, I did not detect any serious deficiency. However, it could have been more colorful." (S50)

"It was good, but it would have been better if there had been some more experiments…" (S51)

"It was somewhat complicated, but good." (S68)

Comparing the experiment they went through with their previous science lessons, 36.67% of the students said that the experiment was better or nicer than previous science lessons (S10, S45), and 36.67% said that they enjoyed it more (S10, S18, S31, S47). 8.89% of the students stated that they understood and learned better in comparison to previous science lessons (S10, S31, S47) while 5.55% stated that the experiment increased their interest in and fondness of the science course (S18, S45, S67). Table 11 shows these findings. Some student opinions on this subject are as follows:

Table 11
Student Opinions in Comparing the Experiment with Previous Science Lessons

Positive Opinion			Negative Opinion		
Codes	*f**	%	Codes	*f**	%
Perfect – nice – good	33	36.67	Boring – sometimes enjoyable and sometimes boring	6	6.67
Enjoyable – pleasurable	33	36.67	The same – both are the good	5	5.55
I learned better/ I understood – beneficial	8	8.89			
My interest in the science course increased – I liked it more	5	5.55			
Total	79	87.78	Total	11	12.2

* Student answers were evaluated in more than one theme.

"It was nicer and much more enjoyable. I learned better." (S 10)

"I was not bored at all. I did more experiments and was engaged in the lessons more." (S18)

"Our lessons used to be very boring. We didn't use to understand anything, but we understood better and enjoyed more in these 3 weeks." (S31)

"I think this three-week period was nice. I did not use to like the science course at all. However, I started to like it in this three-week period." (S45)

"We did not have any slides or similar things in previous science lessons. These kinds of things make me enjoy lessons and understand better…" (S47)

"I already liked the science lessons, but I started to like it more. I think it was beneficial." (S67)

6.7% of the students said that the lessons were sometimes boring and sometimes enjoyable (S4, S34, S69) while 5.5% said that both the previous lessons and the lessons involving the implementation of the new instructional design were equally good (S16, S53), as shown in Table 11. Some student opinions are as follows:

"It was nice. It was sometimes enjoyable and sometimes boring." (S4)

"It was very good, but our previous lessons were very good, too." (S16)

"It was only boring today." (S34)

"There was not a big difference. We just watched more slides, went out, and did experiments." (S53)

"It was more boring than the previous lessons." (S69)

Discussion

This study aimed to develop an instructional design allowing students to learn ecosystem, biodiversity, and environmental issues effectively and permanently. Firstly, the RT and need-assessment on the basis of literature were carried out. The scores achieved from the RT indicated that students had more permanent knowledge of the subjects which they could observe and notice concretely in their surroundings, but did not have permanent knowledge of the more abstract and theoretically 'covered' subjects such as the possible result of losing a rung in the food chain, the change undergone by water on earth and the water cycle, as well as the characteristics and classifications of species. Literature review also shows that students have imperfect conceptual understanding on these subjects (e.g. Adeniyi, 1985; Aguirre-Bielschowsky et al., 2012; Atasoy & Ertürk, 2008; Bell, 1985; Erduran Avcı & Darçın, 2009; Griffiths & Grant, 1985; Gökdere, 2005; Kuhlemeier et al., 1999; Munson, 1994; Özata Yücel & Özkan, 2015; Özkan et al., 2004; Uluçınar Sağır et al., 2008). In addition, there are some criticisms in which it can be argued that the current curricula fail to teach environmental concepts effectively or provide students with environmental awareness (Atasoy & Ertürk, 2008; Gökdere, 2005; Özata Yücel & Özkan, 2014a; Özsevgeç & Artun, 2012; Tanrıverdi, 2009). The results of both RT and the need assessment based on the research in the literature demonstrated that to achieve an effective environmental education, there was a need for an instructional design in which the goals and objectives are clear, understandable, and accessible; necessary information is presented completely and accurately; effective teaching methods, techniques, and various materials are used; and students are interested and engaged.

The findings of the present study indicated that the instructional design developed for the teaching of ecosystem, biodiversity, and environmental issues, some of the basic concepts of ecology and as based on the results of the need assessment, made more contribution to the cognitive development of students on these subjects in comparison to the current curriculum. On the other hand, some supportive activities were added to the instructional design and some arrangements were made because the percentage of correct answers by the experimental group students were not satisfactory for some questions even though they were higher than those of the control group students. In this way, both teachers were provided with alternative activities and the instructional design was made to serve the purpose better (Tables 1, 2, and 3). Although whether or not any difference occurred between the experimental and control groups was often investigated in studies in the literature, no rearrangement was made on the activities or instructional designs that were created, especially when experimental group students were more successful. In this sense, the present study is different from other studies.

The results of the present study, which were obtained through the implementation of the instructional design and contained examples from daily life as well as many activities for addressing the senses of the students, are consistent with those of the studies in literature. Tarng, Tsai, Lin, and Shiu (2009) attempted to teach biodiversity, environmental pollution, and erosion by creating a web-based virtual lake for students to discover an ecological lake; Farmer, Knap, and Benton (2007) gave one-day environmental education at a national park; Şimşekli (2010) provided some unique activities such as group discussion, films, microscopic examination, and observation in the school garden; Güngör (2011) taught the "Humanity and the Environment" unit to 7th grade students via cooperative learning; and Öznacar (2005) collectively used different methods such as meaningful learning, project-based learning, and cooperative learning. As all these studies do, the present study indicates that teaching processes that involve activities addressing more than one of the students' senses drive them to think, allow them to learn by doing and experiencing, and allow them to associate subjects with real life, thus having a positive effect on their cognitive development. In addition, there are some studies whose results support the result of the present study that activities based on context-based learning are effective. Hırça (2012) reports that physics materials built upon context-based learning contribute to the permanence of student knowledge. To Acar and Yaman (2011), microorganisms are learned effectively and permanently through context-based learning. Kutu and Sözbilir (2011) argue the same thing for chemistry subjects. According to Connel, Fien, Lee, Sykes, and Yencken (1999), students regard their personal experiences as the most reliable source of environmental information.

The findings obtained in the present study through comparison of the pretest and post-test scores achieved by the students in the EAS show that the developed instructional design was influential on the improvement of environmental attitudes as well as cognitive achievement. However, while a significant difference in scores was found between the experimental and control groups in the dimension of feeling, thought, and willingness to act, no difference was found between the groups in the dimension of behavior (Table 8). These results show that though the increase in the EAS scores of the experimental group students was higher than that in the EAS scores of the control group students, the increase was not statistically significant for the dimension of behavior. Contrary to this, Erdoğan (2011) found that ecology-based nature-education curriculum created a significant difference in the environmentally responsible behaviors of middle-school students, but no statistically significant increase occurred in their environmental knowledge, attitudes, consciousness, or willingness to act. In parallel with the present study, Özdemir (2010) determined that environmental education curriculum based on out-of-school observation and examination activities increased the tendency of students to exhibit environmentally responsible behaviors while Oluk and Özalp (2007) found that teaching global warming, ozone layer depletion, and acid rain through the problem-based learning approach raised the environmental consciousness of students.

The present study showed that it was more difficult to improve student attitudes and behaviors than to improve their cognitive achievement. Thus, various activities whereby the instructional design could promote the environmental attitudes and behaviors of the students were added (Tables 1, 2, and 3).

Another important finding of this study is that the developed instructional design can be implemented by different teachers, too. No difference was found between the achievement levels or attitudes of the experimental group students who were taught via implementation by the researcher and those of the experimental group students who were taught via implementation by the science teacher. Thus, it can be said that explanations, practices, and activities in the teachers' guide can be implemented by different teachers.

Besides the statistical results obtained in the study, the qualitative data that was acquired based on teacher and student opinions also implies that the developed instructional design is suitable for environmental education. Teacher and student opinions about the prepared guides indicate that the texts were clear, understandable, and appropriate to the levels of the students; the activities supported the teaching of the subjects and there were interesting and attention-grabbing activities associated with daily life, which facilitated learning. These opinions of the students and teachers demonstrate that criticisms about the conduct of lessons set forth in the currently implemented curriculum (Atasoy & Ertürk, 2008; Erdoğan & Uşak, 2009; Gökdere, 2005; Özata Yücel & Özkan, 2014a; Özsevgeç & Artun, 2012; Tanrıverdi, 2009) were taken into consideration, and deficiencies were corrected while the students' guides and teachers' guides were being prepared.

The criticism of the teacher who implemented the developed instructional design in his own class was that the vast size of the number of activities caused a time problem. However, the researcher was able to complete the implementation of the design in three classes as planned. The time problem experienced in the above-mentioned class may have resulted from personal characteristics of the students, the physical structure of the learning environment, or the approach of the teacher to the instructional design.

The criticism of the teacher observing the implementation of the instructional design was that some activities should have been added for revision. However, in the developed instructional design, assessment was intended to be made via activities. In other words, students would not be graded, but their deficiencies would be determined and corrected instantly. These activities mean revision, too. Still, this criticism was taken into account and some new activities were added to the instructional design. These newly added activities not only allowed the students to revisit subjects but also provided teachers with flexibility in selecting activities.

The activity which the students liked most was "Biodiversity in Our Garden." This may be because it could easily be carried out in the school garden, outside the ordinary classroom environment. It concretely presented biodiversity, an abstract concept for the students, and the students liked conducting activities outdoors. Research in the literature reports that outdoor activities are found to be interesting by students (Erdoğan & Uşak, 2009; Palmberg & Kuru, 2000; Şimşekli, 2010). Other activities that the students liked most were documentaries, animations, and the experiment entitled "The Effects of Waste on the Soil." Tarng et al. (2009) stated that students considered the web-based virtual lake activity, which they had prepared for the exploration of an ecological lake that was difficult for individual observation, quite interesting. The students could have found documentaries and animations interesting because they allow abstract subjects which are difficult to be observed through one-on-one observation in daily life (such as food relations among living beings, the elements of the ecosystem, different ecosystems such as deserts and forests, and the effects of environmental pollution) to be made concrete.

Research in the literature reports that one of the sources of environmental information for students is media tools such as television, radio, newspaper, and documentaries (Connel et al., 1999; Erdoğan & Uşak, 2009). Thus, it was logical that the useful and scientifically reliable tools which could easily be accessed by students to reach information about the subjects and concepts they were interested in were identified and made part of the lessons. Of the experimental group students, 93.3% said that the instructional design contained no activity they did not like. Lecturing, reading texts, and the Q & A practices which were used to support the activities based on a traditional method were the activities the students liked least. That shows that it was logical to give limited coverage to activities which address less of the students' senses, are more disconnected from real life, or are frequently faced by students in the instructional design. However, it does not seem possible to completely give up using these techniques which contribute to the construction of the scientific basis of knowledge acquired by students through activities and permanence of the awareness that has been created.

Implications

This study showed that activities that are based on real life and allow students to gain one-on-one experiences are more influential on students' environmental knowledge and attitudes. Thus, teaching subjects about the environment should be designed in such a way that out-of-school activities, visual materials such as documentaries and posters, and real life elements such as journals, newspapers, and news videos can enrich the learning environment; teachers should be provided with a wide variety of materials. This may contribute to improvement of students' environmental knowledge and attitudes. If news and short documentaries about the environment which are associated with daily life are used as materials, students may understand better how important environmental issues are and that putting what is learned into practice is important. By this means, problems in putting what is learned into practice through attitudes may be overcome. These materials may be conveyed to teachers as a CD accompanying textbooks or via websites.

Since students obtain the most reliable and effective environmental information through their own personal experiences, curricula and teaching activities should involve activities that allow students to know and be more engaged in nature. Students should be provided with an opportunity to visit zoos, living tree museums, botanical gardens, areas with high levels of pollution, and some special living spaces for making one-on-one observations there. The learning and teaching environment should be enriched with trips, observations, experiments, current news, and various visuals, thereby allowing students to establish a connection with daily life and interact with the environment. It should be remembered that the immediate surroundings of the school, the school garden, and even classroom windows can be used to examine and observe the environment. Projects are also one of the effective methods that can be used in environmental education. The most important thing to consider during the implementation of the activities is that students should take pleasure in doing these activities. Teachers should be capable of evaluating the entire process of teaching concepts, planning the process in such a way that students are driven to think, search, and question, while controlling the process effectively. In addition, curriculum, which is a tool to make students achieve relevant objectives, should be implemented effectively. In this regard, it is important that teachers know the curriculum very well and be capable of implementing it effectively.

Teachers should be aware that the improvement of environmental attitudes is more difficult than the improvement of cognitive knowledge and requires a long time. For that reason, the educational process should be moved beyond the classroom and placed in the daily life of students.

The last stage of work involving the preparation of instructional material on various subjects and concepts, the creation of the students' guide and teachers' guide, and the preparation of instructional designs is usually the implementation of these materials, guides, and designs as well as the evaluation of their results. However, adding a rearrangement stage to the research following the stage of evaluation may improve the effectiveness of prepared materials, guides, and designs by making research results functional and thus making the contributions of these researches to the literature stronger.

The model used in the present study for instructional design as developed for the effective teaching of ecosystem, biodiversity, and environmental issues proved to be effective. This instructional design model may be used in instructional design works on different subjects, too.

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