



The Effect of Educational Comics on Teaching Environmental Issues and Environmental Organizations Topics in 7th Grade Social Studies Course: A Mixed Research

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Abstract

This research aims to reveal the effects of educational comics on teaching environmental issues and environmental organizations subjects in the 7th grade Social Studies course. The research was carried out according to mixed research method. The research included 83 students at 7th grade in a public secondary school in the Mediterranean region of Turkey. The experimental group consisted of 41 students and the control group consisted of 42. At the end of the study, statistical significance was found in favour of post-test scores between the mean scores of the students in the experimental group who were instructed by educational comics and those of the students in the control group in terms of academic achievement and attitude towards the environment. When the effect of the academic achievement pre-test scores was taken under control, the results of the academic achievement post-test scores of the students in the experimental and control groups were found to be significantly different from each other, which was in favour of the experimental group. Likewise, when the effect of pre-test scores on the environmental attitude was taken under control, it was found that the post-test scores of the students in the experimental and control groups differed significantly and this difference was in favour of the experimental group. And also it was concluded that students have a positive perspective on educational comics both in cognitive and affective aspects.

Keywords

Educational comics
Environmental issues
Environmental organizations
Environmental attitudes
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Introduction

As far as the historical development of humankind is concerned, the population and needs of human beings appears to have been limited in the early periods, and that there was a harmonious and balanced interaction with the environment. However, there has been a significant improvement in agricultural and industrial activities as well as an increase in human population over time. Over this developmental period, human beings have not only met their needs for better living standards but have also made rapid progress in the fields of science and technology. Yet, the improvements in technology and industry over this process have started to show negative effects especially on the environment. With the advances and developments in all areas, the human desire to have relatively better living conditions have adversely affected the human attitude towards the environment, and caused the environmental issues to grow constantly and reach a global dimension (Kaushik & Kaushik, 2010). Especially for the last two centuries, environmental pollution and deterioration has come to an extent incomparable with the past, causing the natural balance to deteriorate.

Among the main reasons of environmental issues are people's current life styles, their value judgments and their attitudes towards the environment. It is, therefore, of utmost importance to conduct an effective environmental education which will change people's perspective towards nature and influence their values and attitudes positively with the purpose of preventing the environmental issues (Gökçe, Kaya, Aktay, & Özden, 2007). Today, environmental issues are not only local but global. They have a deep impact on everyone in society as well as all other living beings and non-living things in nature. Thus, providing environmental education and protecting the environment are not only the duty of environmentalists or environmental educators, but also for every individual (Erten, 2004). A high level of environmental knowledge and environmental education is necessary to understand today's global environmental issues (Kalantari, Fami, Asadi, & Mohammadi, 2007).

At the International Environmental Education Programme organized by UNESCO in 1975, the general objective of environmental education was stated as creating a world population that is sensitive to and interested in environment and environmental issue, that can create solutions to existing problems, and that possesses knowledge, skills, attitudes, motivation and responsibility to prevent the emergence of new problems (as cited in Yaşaroğlu, 2012). Therefore, the aim of environmental education can be expressed as raising individuals who are environmentally friendly. According to Erten (2004), environmental education should be directed towards students' cognitive, affective and psycho-motor learning domains. The aims of environmental education in the cognitive domain lead people towards environmental literacy while its aims in the affective domain lead people to develop values and attitudes towards the environment and environmental issues (Doğan, 1997). Hence, environmental education is the process of developing the attitudes, value judgments, knowledge and skills required for the protection of the environment and acquiring positive behaviours towards the environment (Erten, 2004).

In general, environmental education in schools, teaches students fundamental principles of the interaction between nature and society with the acquisition of some practical skills. To this end, schools focus on two main objectives: strengthening the sense of responsibility in all observable social and individual behaviours of the student, and teaching functional skills such as observing nature, protecting, developing and duplicating natural beauties. Thus, the attitudes of the students towards the environment are shaped gradually with the environmental education given at primary and secondary level (Chapman & Sharma, 2001).

According to Benett (1989), since the knowledge level is dominant in the content of environmental education, the prevention or resolution of environmental issues requires possessing a broad knowledge base. Naturally, some phenomena and facts need to be taken into account within the content of environmental education. These phenomena and facts can be listed as nature and environmental-related systems, natural resources, artificial environment, environmental issues and social systems etc. (as cited in Yaşaroğlu, 2012). Through similar topics to be included in the content,

students could be provided with environmental awareness and sufficient skills to produce solutions to problems (Yaşaroğlu, 2012). The content related to environment and environmental issues should be taught by selecting appropriate strategies, methods and techniques in the learning-teaching process in which learning takes place. At this stage, it is of great importance to determine the content according to the targets, to ensure the active participation of the students, to use appropriate learning methods and techniques, and to organize the class appropriately (Sönmez, 2001). When the elementary and secondary school programs are examined, it is clearly seen that the acquisitions and contents related to environmental subjects are generally included in the Life Science, Social Studies and Science courses. The general aims of the teaching programs in these courses seem to be related with the issues such as raising the individuals who are aware of their rights about the environment and use them, who know the characteristics of the environment they live in, who communicate effectively with the environment they live in, who know that technological developments must be carried out in an environmentally friendly manner and who are sensitive to nature (Karatekin, 2011). Today, many methods, techniques and materials are used to teach students the subjects that have a great importance in raising environmentally friendly and sensitive individuals in classroom environments. One of these materials is the educational comics that are especially influential on cognitive and affective learning.

Educational comics are highly influential materials that contain the art of writing and painting, which triggers a sense of happiness and curiosity in people when they are read. Although educational comics are often confused with cartoon strips, they are actually a different kind of art with their own drawing rules. These products were initially printed by publishers for commercial purposes as comics on horror, crime and fantasy. The professional use of comics in the field of education started in America in the early twentieth century and then in other countries in Europe (Symeon, 2008). While individuals read the comic book, they try to establish a relationship between the text and the pictures, and participate fully and actively in the learning-teaching process (Rota & Izquierdo, 2003). In this respect, it can be asserted that educational comics are a means that is suitable for the constructivist approach since they have a structure in which the individual participates directly in the process (Topkaya, 2016a). In addition, Haugaard (1973) and Koenke (1981) stated that educational comics have the benefits of maximizing academic achievement, creating behavioural patterns, increasing motivation towards the course, triggering a sense of curiosity, and making the reading habit more popular. In addition, Haugaard (1973) stated that students showed a high level of interest in educational comics and that it was an effective material to maximize attitudes and motivation towards the course. Similarly, Sones (1944) stated that teaching through educational comics, which were more interesting than plain writing, was more successful.

Relevant studies on the effects of educational comics on different courses and subjects have been found in the literature. The effects of educational comics have been observed on language teaching and reading activities (Akkaya, 2013; Cary, 2004; Cihan, 2014; Freeman & Freeman, 2000; Khoii & Forouzes, 2010; Megawati & Anugerahwati, 2012; Meriç, 2013; Sones, 1944; Williams, 1995), on academic achievement and attitudes (Özdemir, 2010; Purnell & Solman, 1991; Topkaya, 2014, 2016a, 2016b; Topkaya & Şimşek, 2016) and on motivation towards the course (Haugaard, 1973; Hutchinson, 1949; Olson, 2008; Özdemir, 2017a; Topkaya & Yılar, 2015; Wright & Sherman, 1994).

Current environmental issues show that environmental education is not at the desired level. It is, therefore, necessary to transform the environmental education given in educational institutions into a more effective way. In order to achieve this, teachers should use materials with a high impact capacity during the course (Topkaya, 2016a). Wolschke Bulmahn and Gröning (1994) and Topkaya (2016a) stated that the use of educational comics had a great influence on consciousness- and awareness-raising among students about environmental issues. In the literature search, no study has been found about the analyses of the effects of the use of educational comics on teaching environmental issues and student views on educational comics by using mixed methods. This research conducted with mixed methods is believed to contribute to the related literature.

Purpose and Sub-Problems of Research

The main aim of this research is to identify the effects of the use of educational comics on academic achievement and attitude of the students at the 7th grade in teaching environmental issues and environmental organizations in Social Studies course, and to describe students' experiences during the teaching process through educational comics. To this end, answers were sought to the following questions:

1. Is there a statistical significance between the pre-test and post-test scores of the students in the experimental and control groups that took the Academic Achievement Test for environmental issues (AAT) and the Environmental Attitude Scale (EAS)?
2. Is there a statistical significance in the post-test scores of the students in the experimental and control groups that took the Academic Achievement Test for Environmental Issues?
3. Is there a statistical significance in the post-test scores of the students in the experimental and control groups that took the Environmental Attitude Scale?
4. What are the students' views about educational comics used in the teaching of environmental issues?

Method

Research Design

Involving qualitative and quantitative research techniques, mixed methods research design was used in this study. The mixed design is a technique that collects qualitative data as well as quantitative data related to the problem of a study (Leech & Onwuegbuzie, 2007), in which such data are merged and commented on by the researcher so that the problem can be revealed more clearly (Creswell & Plano Clark, 2011; Johnson & Christensen, 2004). This study is designed as a nested, mixed model, in which the quantitative dimension is more dominant. On the other hand, the qualitative dimension is embedded in the model (Creswell & Plano Clark, 2011).

Quantitative Scope of Research: In quantitative scope this research a quasi-experimental design was used. The quasi-experimental design is a research methodology used in many studies in the field of education, especially when all variables cannot be controlled (Cohen, Manion, & Marrison, 2000). In this design, there is an experimental and a control group, but random selection is not made in the selection of the groups and the equality of the groups is considered essential (Fraenkel & Wallen, 2006). Pre-tests were applied primarily to the experimental and control groups. The course was taught with the use of educational comics in the experimental group while there was no extra practice in the control group. After the application the research was then finalized when both groups were given the post-tests (Lodico, Spaulding, & Voegtler, 2006).

Qualitative Scope of Research: Students' opinions about educational comics were examined by using the case study. A case study is a technique that allows researchers to examine in depth any event or phenomenon that is difficult to control (Yıldırım & Şimşek, 2011).

Study Group

The study group was formed according to convenience sampling technique. The study group consisted of 83 secondary school students attending a public secondary school in the fall term of 2017-2018 academic year. In creating the study group, Academic Achievement Tests for Environmental Issues prepared by the researchers were applied to the students in four of the 7th grades (7A, 7B, 7C, 7D) at the secondary school where the application was carried out. One-way analysis of variance (ANOVA) test was used to find out whether or not the students' level of knowledge of the environment to which academic achievement test was applied were similar to each other. The analysis results are detailed below.

Table 1. One-way ANOVA Results for AAT Pre-test Results

Score	Groups	N	\bar{x}	SD	Comparing Variances	Sum of Squares	df	Mean Square	F	p
AAT Pre-test	7/A	41	10.80	2.20	Between Groups	623.02	3	207.67	40.815	.000
	7/B	42	10.73	2.52	Within Groups	803.92	158	5.088		
	7/C	40	7.82	1.85	Total	1426.94	161			
	7/D	39	13.43	2.37						
	Total	162	10.68	2.97						

AAT: Academic Achievement Test

As seen in Table 1, the mean AAT pre-test scores of the groups differ ($\bar{x}_{7A}=10.80$, $\bar{x}_{7B}=10.73$, $\bar{x}_{7C}=7.82$ and $\bar{x}_{7D}=13.43$). This difference was statistically significant ($F=40.815$, $df=161$, $p=.00<0.05$) according to ANOVA test results. The variances of AAT pre-test scores of the groups are distributed homogeneously [*Levene* (1.767 , $df=3$, 158)= $.156>0.05$]. Therefore, Tukey was used from among post-hoc tests in order to determine between which classrooms a statistical significance was observed with respect to the mean scores of the groups in AAT pre-test. According to the results of the test, mean scores from the AAT pre-test did not differ significantly between the classes 7A and 7B ($p=.999>0.05$). All other paired comparisons showed statistical significance. Therefore, it was decided that classes 7A and 7B would be chosen as experimental and control groups that had similar academic achievement levels.

Preparing the Teaching Materials

In order to prepare the teaching materials, the four acquisitions were examined in the unit titled 'Bridges Across Countries', included in the 7th grade Social Studies course. There were two acquisitions identified which focused on both the goals of international organizations in the face of global challenges and the recognition of individual responsibilities in undertaking personal responsibilities in resolving global problems. The scenarios and drawings of the educational comics to be used in the study were selected in line with these acquisitions. In the preparation of the educational comics, the following seven steps were taken into consideration.

Stage 1: In the preparation of educational comics, first of all, 2 instructors and 2 Social Studies teachers, who are experts on these issues (environmental issues, environmentally friendly international organizations), were consulted.

Stage 2: A total of six scenarios were prepared by researchers, three of which focused on the goals of international organizations in the face of global environmental issues and the other three focused on personal responsibilities for solving global problems.

Stage 3: A faculty member in the field of Turkish Language Education was consulted in order to determine whether the scenarios created by the researchers were suitable both for language-wise and students' education levels.

Stage 4: After the scenarios were prepared, the characters in the comics were started to be drawn by using the interface called Pixton (<http://www.pixton.com>).

Stage 5: Dialogues in the scenarios were carefully placed in the speech bubbles in the comic strips.

Stage 6: A pilot scheme was carried out with the participation of 14 students studying at the 7th grade, who were not included in the study group in order to arrange the comics in terms of colour, figure-ground relationship, physical appearance of the characters and clarity of the dialogues in speech bubbles. Within the scope of the pilot scheme, the students were asked for their opinions about the educational comics, after which the educational comics were revised and edited accordingly.

Stage 7: Two experts were consulted in order to determine whether the comics were prepared according to the acquisitions stated in the program. After the expert opinions were collected, the finalized educational comics were confirmed that they were prepared in accordance with the acquisitions. Thus, in the study, 6 educational comics, each consisting of 12 squares, were used during the application. Only a small portion of the educational comics used in the application are given below.

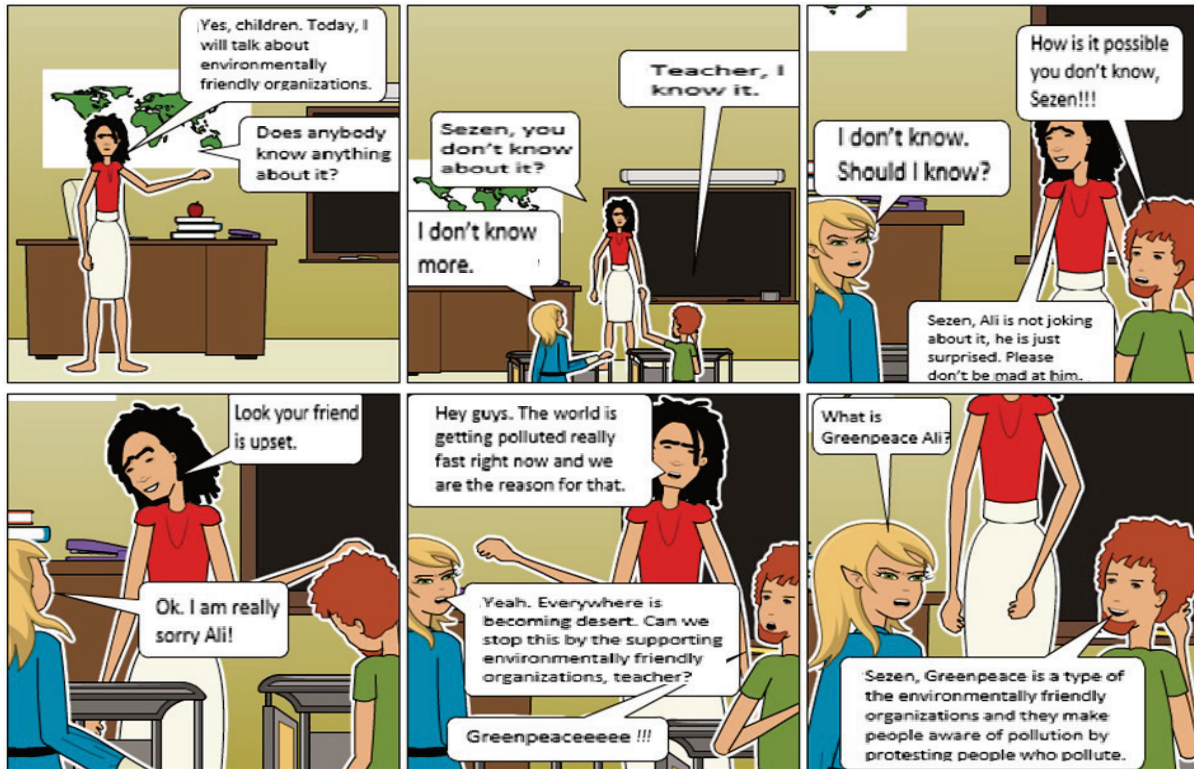


Figure 1. A Small Portion of the Educational Comics Used in the Research

Teacher Training and Pilot Study

Week 1: The Social Studies teacher was informed about the components of educational comics (speech balloons, comic strips). In order to carry out this information flow in a sound manner, three different educational comics previously used by the one of the researchers were used. The researchers showed the teacher a detailed description of what the speech balloons and comic strips on educational comics were. With the first weekly education given, it was aimed to enable the teacher to recognize the educational comics and be informed about the subject.

Week 2: The Social Studies teacher was given a course flow plan about how and in which order the practices should be carried out. Each stage in this course flow plan was explained in detail by the researchers. With this training, it was aimed to enable the teacher to conduct the lessons in an effective way.

Week 3: The statements in the dialogues between the characters in the 6 educational comics, which the Social Studies teacher would use during the application, were carefully analysed and discussed over. It was aimed to provide the teacher with a clear understanding of the scripts and dialogues between the characters in the comics.

Before the research, it was decided to conduct a pilot scheme in order to determine the extent of success achieved during the training given to the Social Studies teacher about the educational comic books and to determine whether the teacher was teaching the courses in line with the course flow plan. In this context, the pilot study was conducted while teaching the unit, 'Living Democracy', which was followed by the unit related to the research subject. In line with the acquisitions in the unit titled 'Living Democracy', the researchers prepared three different educational comics and a course flow plan, each

consisting of nine squares, and delivered it to the teacher upon reviewing these materials. Then, under the supervision of the researchers, the Social Studies teacher used the materials during the two course hours. During the pilot scheme, it was observed that the teacher taught the lesson according to the lesson flow plan and benefited well from the materials.

The study started with the application of the 'Academic Achievement Test for Environmental Issues (AAT)' and 'Environmental Attitude Scale (EAS)' in the experimental and control groups. The application lasted for two hours a week for a period of three weeks in total. The applications were carried out in the experimental group according to the course flow plan while a constructivist approach model was applied in the control group. After three weeks of application, the experimental and control groups were given the 'Academic Achievement Test for Environmental Issues' and 'Environmental Attitude Scale', and the research was finalized. The activities performed in the experimental and control groups are given in detail in Table 2.

Table 2. Activities Performed in the Experimental and Control Groups

Week	Activities in the Experimental Group	Activities in the Control Group
Week 1 (2 hours)	<ul style="list-style-type: none"> i) At the beginning of the course, students are informed about the global environmental issues that are currently taking place in the world in order to raise awareness. ii) Two educational comics, which deal with different types of environmental issues (land, air, water, etc.), are distributed to the students and the students are asked to read the educational comics very carefully. iii) The students are asked about their favourite characters in the given educational comics. iv) The statements of the characters in educational comics about global environmental issues are discussed in class. v) The students are asked questions about the global environmental issues mentioned in educational comics and the learning dimension and misconceptions of the subject are identified. vi) The teacher summarizes the topic briefly and finishes the lesson. 	<ul style="list-style-type: none"> i) The teacher briefly informs the students about environmental issues. ii) Case studies taken from newspapers related to environmental issues are discussed in the classroom. iii) The students are shown two cartoons about environmental issues. iv) An activity is conducted: What comes to your mind when you hear about global issues? v) Wrong or incomplete learning is identified using the question-answer technique. vi) The subject is summarized by the teacher and the class is over.
Week 2 (2 hours)	<ul style="list-style-type: none"> i) The global environmental issues (land, air, water, etc.) of the previous week are briefly summarized and the lecture starts. ii) The global environmental issues that have been taking place in the world in recent years and the activities of international organizations in the face of these problems are explained and an awareness is raised about the subject. iii) Two educational comics on global environmental issues and activities of international environmental organizations are distributed to students and they are asked to read them carefully. 	<ul style="list-style-type: none"> i) The teacher briefly informs the students about the non-governmental organizations trying to prevent environmental issues. ii) Promotional films are shown to the students about the way non-governmental organizations function in order to deal with environmental issues. iii) One billion people starving! : The internet news about the project is discussed in class. iv) An activity is carried out: What can you do to avoid wasting food, i.e. bread?

Table 2. Continued

Week	Activities in the Experimental Group	Activities in the Control Group
Week 2 (2 hours)	<p>iv) The statements of the characters in educational comics about global environmental issues and the aims of international organizations are discussed in class.</p> <p>v) The students are asked a variety of questions about the global environmental issues in educational comics and the kinds of activities that international organizations encounter in the face of these problems in order to determine the learning dimension and any misconceptions related to the subject.</p> <p>vi) The teacher summarizes the topic briefly and finishes the lesson.</p>	<p>v) Wrong or incomplete learning is identified using the question-answer technique.</p> <p>vi) The subject is summarized by the teacher and the class is over.</p>
Week 3 (2 hours)	<p>i) The teacher briefly summarizes the topic covered in the previous week (global environmental issues and the activities of international organizations on environmental issues), and makes an introduction to the lecture.</p> <p>ii) The teacher tries to raise awareness about the responsibilities of an individual in the face of global environmental issues and the ways in which these solutions will be put into practice.</p> <p>iii) The teacher distributes two educational comics to the students about the responsibilities of an individual in the face of the global environmental issues and the ways in which the solutions to be produced in the face of these problems will be put into practice and asks them to read these educational comics carefully.</p> <p>iv) The teacher discusses the views of the characters in educational comics on the global environmental issues in class.</p> <p>v) The teacher tries to identify the learning dimension and misconceptions of the subject by asking questions to the students about the responsibilities of an individual in the face of global environmental issues and the solutions to be produced in the face of these problems.</p> <p>vi) The teacher summarizes the subject and finishes the lesson.</p>	<p>i) The teacher briefly informs the students about the responsibilities for environmental issues.</p> <p>ii) Banners on environmental responsibilities are evaluated by students.</p> <p>iii) The students are asked to read the text, 'What could be the contribution of the waste management in environmental protection and reduction of environmental pollution?' and asked about their ideas on the subject.</p> <p>iv) The teacher reads a story to the students about solutions to environmental issues.</p> <p>v) Wrong or incomplete learning is identified using the question-answer technique.</p> <p>vi) The subject is summarized by the teacher and the class is over.</p> <p>vi) The teacher summarizes the subject and finishes the lesson.</p>

Data Collection Tools

Environmental Attitude Scale (EAS)

A 25-item, 5-point Likert-type attitude scale was developed by Atasoy and Ertürk (2008) in order to determine the attitudes of secondary school students towards the environment, and the Cronbach alpha reliability coefficient of the scale was calculated as .85 and KMO value was .91. Five of the items in the scale were related to animals and plants, 5 to ecological issues and environmental pollution, 5 to consumption and thriftiness, 5 to human and environmental relations, and 5 to energy resources.

Academic Achievement Test for Environmental Issues (AAT)

The acquisitions in the unit, 'Cross-Country Bridges' in the 7th Grade Social Studies Course Curriculum was firstly examined for the academic achievement test prepared by the researchers so that the questions could be prepared in such a way that they covered all subjects to be taught (air pollution, land pollution, natural phenomena, solid waste, environmentally-friendly organizations, etc.). In this context, the acquisitions in the program were focused on and 36 questions were prepared by the researchers. The questions included in the academic achievement test were presented to two field experts working in the field of language in order to determine the language validity of the questions and to the two faculty members who are experts in environmental issues to identify the content validity, and the experts were asked about their opinions of the test. Sixteen questions were excluded from the test according to expert opinions. After the expert opinions, it was decided to keep 20 questions in the academic achievement test. Multiple choice questions were used in the academic achievement test, and 1 point was given for each correct answer given in the evaluation of the test and 0 for the wrong or blank answers. The academic achievement test was applied to 148 students outside the sample in the study in three secondary schools located in the centre of Hatay province in order to carry out the item analysis of the test. As a result of the analysis performed for the academic achievement test, it was identified that the difficulty indexes of the items included in the achievement test varied between .33 and .58 while the discrimination indexes ranged from .25 to .66. To calculate the reliability of the items included in the academic achievement test, the KR20 reliability coefficient was calculated as .81.

Semi-Structured Interview Form

The questions prepared for use in the semi-structured interview form were determined primarily by using the related studies which focused on the educational comics. The 11 questions prepared by the researchers were presented to three experts (experts on Social Studies education, Science education, and on educational comics). Upon the expert opinions, four questions were excluded from the interview form to finalize. The semi-structured interview form was applied to 41 students in the experimental group after the end of the experimental procedure.

Data Analysis

Analysis of Quantitative Data

In the study, Academic Achievement Test (AAT) was used to interpret the cognitive outcomes of the students, and the Environmental Attitude Scale (EAS) data was used to interpret affective outcomes of the learners. In order to increase the effectiveness of the analysis results of the quantitative data before the analyses, it is necessary to control the extreme values with the lost data (Pallant, 2016) because the lost data and extreme values have the effect of increasing the variance of error and statistically reduce the power of the analysis (Osborne & Amy, 2004). Therefore, in the first stage, the average was assigned for each item to eliminate the missing data. Average assignment is a method that is frequently used instead of lost data (Little & Rubin, 2002). Then, one-way and two-way extreme values were identified. In determining the one-way extreme values, standard Z scores were calculated out of the total scores obtained from the measurement tools for each measurement. For each measurement, the scores were within ± 3 range. Therefore, it was concluded that there were no one-way extreme values, for all the points in the distribution of the one-way extreme values should be located at ± 3 standard deviation distance from the average (Mertler & Vannatta, 2005). In addition, the versatile extreme values were controlled by the Mahalanobis distance ($p < .001$). As a result of the control, it was determined that there was no versatile extreme value.

Two paired sample t-tests and one-way covariance analysis (ANCOVA) were used in the study to search for answers to quantitative research questions. The paired sample t-tests were used to test the difference of the preliminary and final scores for repeated measurements (Bayram, 2015). In this context, t-test was used to examine the experimental and control groups in terms of some variables after the applications. From another perspective, ANCOVA provides a statistical analysis of the variable or variables associated with the dependent variable, except for a factor or factors whose effect is investigated in the study (Büyüköztürk, 2009). ANCOVA was used to compare post-test scores of experimental and control groups more effectively, independent of pre-test scores. The suitability of the analysis techniques used was examined primarily for various assumptions and is given below.

Table 3. AAT and EAS Pre-test and Post-test Descriptive Statistical Results

Groups		N	Min.	Max.	\bar{x}	SD	Skewness	Kurtosis
Experimental	EAS Pre-test	41	56.00	108.00	80.92	14.48	.264	-1.167
	EAS Post-test	41	92.00	117.00	107.70	6.84	-.978	-.110
	AAT Pre-test	41	6.00	16.00	10.80	2.20	.290	.218
	AAT Post-test	41	14.00	20.00	16.68	1.29	.339	-.063
Control	EAS Pre-test	42	44.00	108.00	83.88	18.35	-.622	-.869
	EAS Post-test	42	80.00	114.00	99.09	9.75	-.367	-1.114
	AAT Pre-test	42	7.00	16.00	10.73	2.52	.263	-.907
	AAT Post-test	42	8.00	18.00	13.76	2.47	-.158	-.708

AAT: Academic Achievement Test, EAS: Environmental Attitude Scale

Normality: With the aim of testing the assumption of normality, the total scores of each measurement made with AAT and EAS were examined on the basis of the skewness and kurtosis coefficients. When Table 3 is examined, the distribution range of the variables varies between -1.167 and +.339. According to Tabachnick and Fidell (2013), if the Skewness and Kurtosis coefficients of the variables are within ± 2 range, they show normal distribution. In this context, it can be said that the data have shown normal distribution. In this case, the normality, which is the basic assumption of the paired two sample t-tests used in the analysis of the data is maintained. In addition, one of the assumptions that are valid for ANCOVA analysis was observed.

Linearity: At this stage, the relationship between AAT and the pre-test and post-test scores of the EAS was examined. Especially in terms of ANCOVA analysis, there should be a strong linear relationship between covariance variable and dependent variable. For this purpose, the correlation value significantly greater than 30 can be used as an indicator of strong linear relationship (Bayram, 2015). There was a significant and linear relationship between AAT pre-test and post-test scores ($r=.672$, $p<0.01$) and between EAS pre-test and post-test scores ($r=.696$, $p<0.01$). According to these results, it is observed that the hypothesis of a linear relation between the covariable and dependent variables is maintained for the ANCOVA analysis.

Homogeneity: One of the basic assumptions for ANCOVA analysis is the homogeneity of variances and regression slopes (Bayram, 2015). Levene and regression slopes of dependent variables were examined separately for this purpose. Based on Levene test results, AAT ($F=2.984$, $df=81$, $p=.091>0.05$) and EAS ($F=2.480$, $df=81$, $p=.119>0.05$) post-test scores can be presumed to meet the assumption of homogeneity of variance for dependent variables. Then, the dependent variables (AAT and EAS post-test scores) and covariance variables (AAT and EAS pre-test scores) were tested for the assumption of homogeneity. The regression slopes could be regarded to meet the assumption of homogeneity according to the values obtained from the linear regression models factorized by the experimental-control groups in which AAT pre-test was the covariance variable, AAT post-test was the dependent variable ($F(1.83)=4.445$, $p=.061$), EAS pre-test was the covariance variable, and EAS post-test was the dependent variable ($F(1.83)=2.620$, $p=.110$).

Analysis of Qualitative Data

The qualitative data were analysed by content analysis. Firstly, the data obtained by the videos during the focus group interview were transcribed and then the relevant codes were made by using the NVivo program. In the analysis process, students' opinions about educational comics were coded and then these codes were divided according to certain categories. The result of the analyses revealed that the students' statements were mostly the answers referring to the cognitive and affective domains. Thus, the findings were divided into two parts: Cognitive Domain and Affective Domain. In addition, this study analysed the qualitative data by the use of such criteria as credibility instead of internal validity, transferability instead of external validity, consistency instead of internal reliability and confirmability instead of external reliability (Lincoln & Guba, 1985).

In the criterion of *credibility*, Creswell (2013) pointed out that diversity and external supervisory strategies should be utilized in order to ensure credibility. The data were analysed independently by three different researchers and the results of the analysis were checked by an expert researcher and controlled by an external controller with the aim of ensuring the diversity.

In the criterion of *transferability*, it was suggested that, in order to ensure that the data obtained within the scope of the study could be adequately described (Erlandson, Harris, Skipper, & Allen, 1993), they should be transferred directly without making any comment on the concepts and themes based on the raw data obtained. In this context, a detailed description was made without making any comments on the themes created in the research and by adding direct quotations.

In the criterion of *consistency*, events and phenomena were regarded as a variable each and the variability in question was put forth in a consistent way (Yıldırım & Şimşek, 2011). In this context, consistency was ensured first during the independent coding, and then at the consensus stage, where the reliability was ensured, by the use of statements related to the codes.

In the criterion of *confirmability*, an independent expert evaluated the data obtained, data collection tools and analyses, and presented his/her opinions (Erlandson et al., 1993). The results of the analysis with the raw data obtained in this context were presented to the expert opinion.

Results

Results Related to the First Sub-Problem of Research

The change in students' attitudes towards the environment (affective outcomes) and academic achievement (cognitive outcomes) before and after the teaching activities were analysed by paired two sample t-test. The results are given in Table 4.

Table 4. T-test Results of AAT and EAS Pre-test and Post-test of Experimental and Control Groups

Groups	Variables	\bar{x}	SD	SE	t	df	p
Experimental	AAT Pre-test	10.80	2.20	0.25	-23.07	40	0.00
	AAT Post-test	16.68	1.29				
	EAS Pre-test	80.92	14.48	1.77	-15.05	40	0.00
	EAS Post-test	107.70	6.84				
Control	AAT Pre-test	10.73	2.52	0.14	-20.63	41	0.00
	AAT Post-test	13.76	2.47				
	EAS Pre-test	83.88	18.35	1.50	-10.08	41	0.00
	EAS Post-test	99.09	9.75				

Table 4 shows the differences between the mean scores of Experimental and Control Groups in AAT and EAS pre-test and post-test. The difference between the AAT and EAS pre-test and post-test mean scores of the students in the experimental groups that were taught about the environment through the educational comics were statistically significant in favour of the post-tests [AAT($t=-23.07$, $df= 40$,

$p < 0.05$), $EAS(t = -15.05, df = 40, p < 0.05)$]. The difference between the AAT and EAS pre-test and post-test mean scores of the students in the control group showed statistically significant differences in favour of the post-tests [$AAT(t = -20.63, df = 41, p < 0.05)$, $EAS(t = -10.08, df = 41, p < 0.05)$]. According to these findings, the relevant teaching activities can be said to have a positive effect on the academic achievement of the groups and their attitudes towards the environment.

Results Related to the Second Sub-Problem of Research

The covariance analysis (ANCOVA) was used to examine whether there were any differences between the post-test scores of the Experimental and Control Groups where different teaching techniques were applied. AAT pre-test scores, which were effective on AAT post-tests in ANCOVA, were defined as a covariance (common) variable. In this context, the effect of AAT pre-test scores was taken under control, and the adjusted averages of AAT post-test scores are given in Table 5.

Table 5. Corrected Mean Scores of the Experimental and Control Groups' AAT Post-test

Groups	n	\bar{x}	Corrected Mean	Corrected Score Change %
Experimental	41	16.68	17.07	+2.33
Control	42	13.76	13.78	+0.14

Table 5 shows that the AAT post-test mean scores and corrected mean scores are higher in the experimental group in which environmental education was conducted with educational comic books. Considering the direction and ratio of the corrected scores, it is seen that the experimental group achieved more effective results regardless of pre-tests. In this case, it can be said that educational comic book practices in environmental education provide more positive contributions to academic achievement (cognitive outcomes). The results of the covariance analysis of the final test scores are given in Table 6.

Table 6. AAT Post-test Scores of Experimental and Control Groups' ANCOVA Results

Source of Variance	Sum of Squares	df	Mean Square	F	p	Partial Eta-Square
AAT Pre-test	218.499	1	218.499	174.80	.000	.686
Group	171.431	1	171.431	137.14	.000	.632
Error	99.998	80	1.250			
Total	19684.000	83				

When the effect of the AAT pre-test scores were checked in Table 6, it was found that the AAT post-test scores of the students in the experimental and control groups in which different teaching was applied in environmental education were significantly differentiated [$F(1, 83) = 137.14, p = .00 < 0.05$]. There was a statistical significance in favour of the experimental group in comparing the academic achievement post-test mean scores of the students in the experimental and control groups. When the AAT pre-test scores were taken under control, it was determined that the AAT post-test scores accounted for approximately 63% of the presence of different teaching practices ($\eta^2 = .63$) in the groups that were taught with different teaching practices. As a result, it can be asserted that the teaching practices realized with the educational comics differed effectively from the teaching methods applied to the control group with respect to academic achievement.

Results Related to the Third Sub-Problem of Research

A covariance analysis (ANCOVA) was used while analysing whether there were any differences between the EAS post-test scores of the Experimental and Control Groups to which different teaching methods were applied. EAS pre-test scores, which are effective on the EAS post-tests in ANCOVA, were set as covariance (common) variables. In this context, the effects of EAS pre-test scores were taken under control and the corrected mean of EAS post-test scores are given in Table 7.

Table 7. Corrected Mean Scores of the EAS Post-Tests of the Experimental and Control Groups

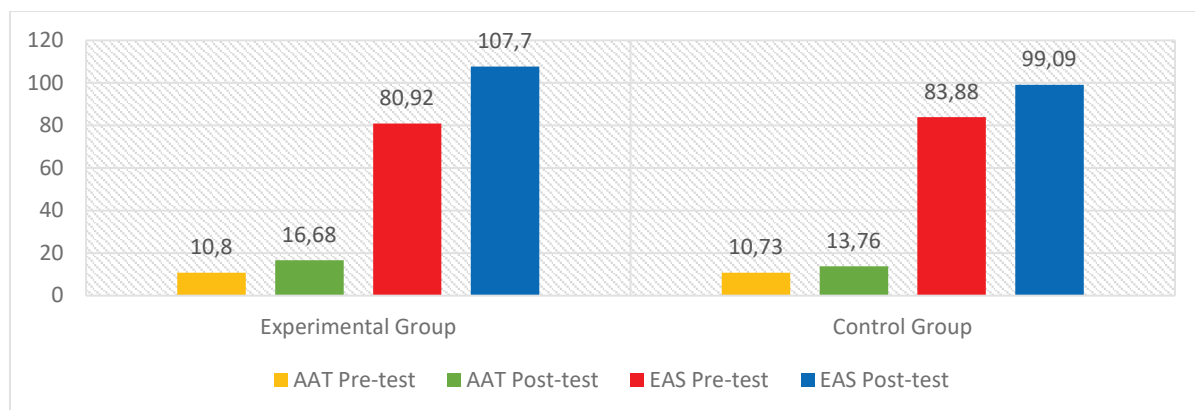
Group	n	Mean	Corrected Mean	Corrected Mean Score Change %
Experimental	41	107.70	108.34	+0.59
Control	42	99.09	98.45	+0.36

Table 7 shows that the EAS post-test mean scores and the corrected mean scores of the experimental group where the educational comics were used were higher. Considering the direction and ratio of the corrected scores, it was observed that the experimental group achieved more effective results regardless of the pre-test. In this case, it can be asserted that educational practices through educational comics provide more positive contributions to environmental attitudes (affective outcomes). The results of the covariance analysis of the post-test scores are given in Table 8.

Table 8. EAS Post-test Scores of the Experimental and Control Groups and Results from ANCOVA

Source of Variance	Sum of Squares	df	Mean Squares	F	p	Partial Eta-Square
EAS Pre-test	4007.85	1	4007.85	181.12	.000	.694
Group	2003.69	1	2003.69	90.55	.000	.531
Error	1770.25	80	22.12			
Total	893848.00	83				

Table 8 shows that when the effect of the EAS pre-test scores was checked, it was found that the EAS post-test scores of the experimental and control groups in which different teaching methods were applied in environmental education were significantly differentiated [$F(1, 83)=90.55, p=.00<0.05$]. In this context, the Bonferroni test performed to determine the source of the significance revealed that there was a statistical significance in favour of the experimental group in the comparison of the environmental attitudes between the experimental and control groups. When EAS pre-test scores were controlled, it was determined that the EAS post-test scores accounted for approximately 53% of the availability in different teaching practices ($\eta^2=.53$). As a result, it can be asserted that environmental teaching practices carried out with educational comics differed from the teaching methods applied to the control group in terms of attitude towards environment. Pre-test-and post-test mean scores for experimental and control groups are given in Graphic 1.

**Graphic 1.** Pre-test and Post-test Mean Scores of Experimental and Control Groups' AAT and EAS

Results Related to the Fourth Sub-Problem of Research

The themes and sub-themes obtained as a result of the content analysis performed for the student views on the fourth sub-problem of the research, 'What are the student views about educational comics used in teaching of environmental issues?' are given below in more detail.

Results Related to the Effect of Educational Comics on Cognitive Domain

The sub-themes obtained from the analysis of student views about the effects of educational comics on cognitive domain in teaching environmental issues are given in Figure 2.

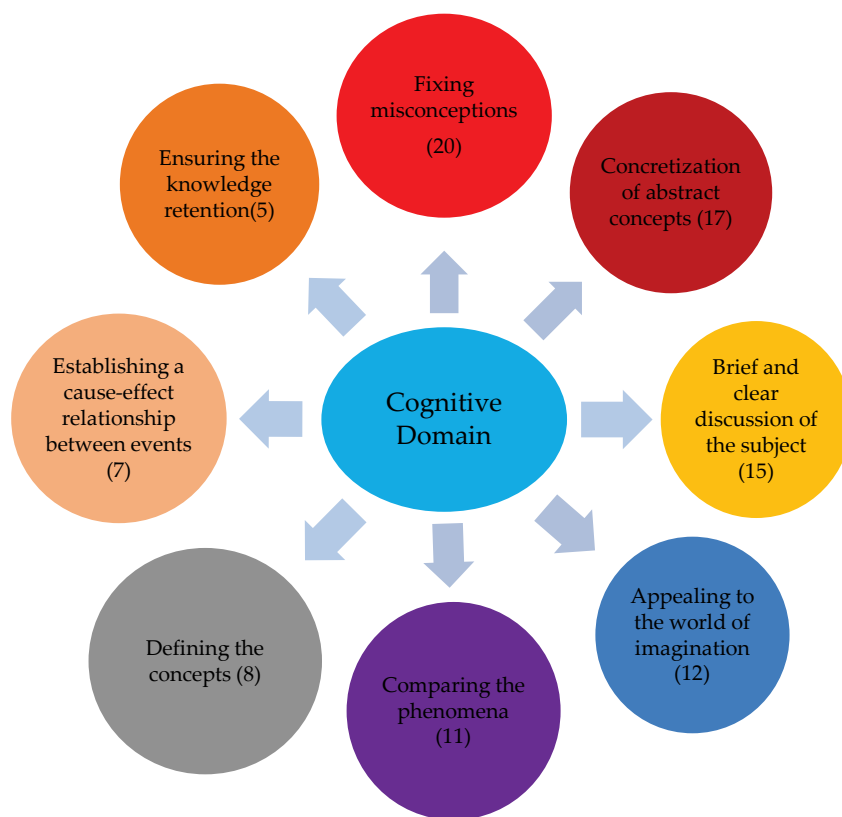


Figure 2. The Schema Related to the Effects of Educational Comics on Cognitive Domain

Fixing misconceptions: The content analysis of the answers given by the students participating in the research revealed that educational comics were an effective material for eliminating misconceptions. It is quite expected that some technical concepts related to environmental issues are not taken into consideration when the class level is considered. However, it is thought that dealing with the concepts related to environmental issue in a simple way just by supporting them with visuals in educational comics is effective in eliminating misconceptions. Some of the students' opinions on this theme are given below.

"In the documentaries that I have seen before, I thought I had learned about the environmental problems in the world. However, after reading the comics that my teacher gave us, I learned that I misunderstood some of the things in the documentaries." (Student 1)

"I thought I knew exactly what the global warming was, but thanks to comics I have now understood that I learned many concepts about global warming incorrectly." (Student 8)

Concretization of abstract concepts: The analysis of the students' responses in the research about the effects of the educational comics on the cognitive domain revealed that a large number of them stated the significant effect of educational comics in the concretization of abstract concepts. It is thought that the characters' frequent debates in the educational comics about abstract concepts related to environmental issues were influential on students' views. Some of the students' opinions on this theme are given below.

"I want to say that I have learned in the light of these comics some of the concepts that I have not understood. Especially the heroes in the comics have made the concepts simpler related to the subject by constantly talking to each other." (Student 11)

"I have learned more accurately many concepts I know wrong, thanks to the speeches in the comics about the environmental issues." (Student 21)

Brief and clear discussion of the subject: It is seen that some of the students who participated in the research expressed the opinion that the educational comics handled the subjects in a brief and clear manner. It is thought that the students' way of thinking was shaped by the comprehensible and simple processing of the topics discussed through educational comics. Some of the students' opinions on this theme are given below.

"The topics in the Social Studies course book are mostly elaborated in length. When I come to the end of the text, sometimes I ask myself what I read at the beginning. But in these educational comics what I read about global warming is very clearly described." (Student 9)

"I understood the issues related to environmental issues very well because the topics in the comics were clearly discussed." (Student 25)

Appealing to the world of imagination: It is seen that part of the students stated that educational comics were materials that appealed to the imaginary world. It is thought that the students' way of thinking was shaped by the way the subjects in the educational comics were elaborated and by the unusual expressions between the characters. Some of the students' opinions on this theme are given below.

"I like these comics I've read because the hairstyle of some characters and the way they speak looks like me. I felt like I was in that comics." (Student 5)

"When I started reading the comics that our teacher gave us, I felt like I was talking to heroes in the comics. I felt like I was with them." (Student 13)

Comparing the phenomena: Some of the students stated that educational comics had a positive effect on comparing phenomena. It can be said that the students' way of thinking was caused by the way the topics were taught through educational comics as they enabled to make comparisons clearly. Some of the students' opinions on this theme are given below.

"In the comics we read, I clearly understood how environmental issues occur, what we shouldn't do to protect the environment or what actions do harm on the environment." (Student 12)

"The statements of the heroes in the comics clearly show what kind of environmental changes will be experienced between the present and the future. From those conversations, I now know what dangers await people in the future." (Student 9)

Defining the concepts: It is seen that some of the students were of the opinion that educational comics had a significant effect on defining the concepts. It can be assumed that this way of thinking was caused by clear and understandable expression of the concepts related to the subject while the students discussed the issues in the educational comics. Some of the students' opinions on this theme are given below.

"I would like to say that I clearly learned some concepts that I had never heard of as they were mentioned in a nice and understandable way in the comics." (Student 5)

"I realized that I had misunderstood some of the concepts related to the environment. Besides, I have now learned such concepts through these comic books." (Student 17)

Establishing a cause-effect relationship between phenomena: Some of the students expressed that educational comics had an important effect in establishing cause-effect relationship between phenomena. It can be assumed that this way of thinking was caused by the fact that educational comics had a significant effect in linking the subjects discussed. Some of the students' opinions on this theme are given below.

“While reading these comics that our teacher brought to the class, I gained a good understanding of how environmental issues occur. In fact, I already knew how they occur, but now I can establish a cause-and-effect relationship in a very comfortable way about environmental issues. Therefore, I think that if our teachers make use of these comics in different courses, they will be helpful for us.” (Student 2)

“When we read the speeches of the heroes in the comics, we clearly see why environmental issues occur.” (Student 16)

Ensuring the knowledge retention: Some of the students expressed that educational comics had an important effect in ensuring the knowledge retention. It can be said that this way of thinking was caused by the discussion of the subjects in a striking and humorous manner through educational comics. Some of the students' opinions on this theme are given below.

“The characters in the comics, which I read about environmental problems, discussed the topics with each other in a very funny way. I guess I won't forget them again.” (Student 1)

“The heroes in the comics have strikingly mentioned the environmental issues. I can say that I've absorbed the information so well.” (Student 7)

Results Related to the Effect of Educational Comics on Affective Domain

The views of the students about the impact of educational comics on the affective domain are given in Figure 3.

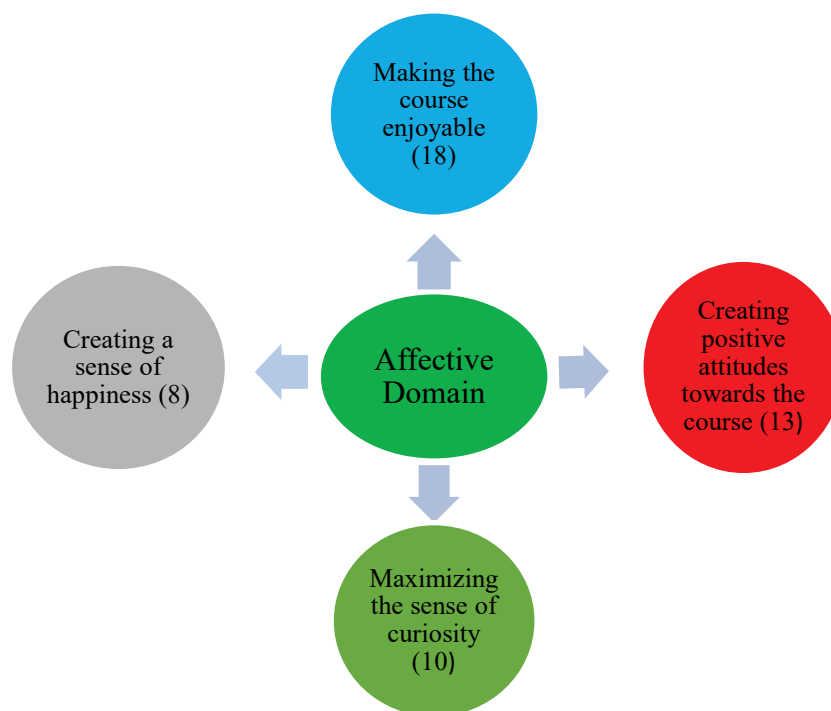


Figure 3. The Schema Related to the Effects of Educational Comics on Affective Domain

Making the course enjoyable: The analysis of the students' views about the impact of the educational comics on the affective domain revealed that some of the students stated that educational comics made the lessons fun. It can be assumed that this way of thinking was caused by the humorous language used in the speeches of the characters in the educational comics. Some of the students' opinions on this theme are given below.

“The heroes in the comics discussed environmental issues in a very funny way. I would like to say that I had a lot of fun reading the heroes' conversations with each other in the comics.” (Student 24)

“Some subjects in textbooks are never-endingly long. That’s why I’m so bored in class. But reading these comics that our teacher has brought is very nice and enjoyable.” (Student 20)

Creating positive attitudes towards the course: The analysis of the students’ attitudes revealed that some of the students were of the opinion that educational comics had a positive impact on the attitude towards the course. It is assumed that this way of thinking was caused by the humorous language of educational comics and the use of visuals to support the content. Some of the students' opinions on this theme are given below:

“I’m really bored with Social Studies because I don’t like reading. These comic books I read have explained the subject very briefly. I wish that our teachers always used these comics to teach the lessons.” (Student 21)

“These comics are incredibly good and I’ve never been bored of reading them. I will look forward to the next week’s Social Studies course.” (Student 8)

Maximizing the sense of curiosity: The analysis of the students’ views revealed that the students were of the opinion that educational comics maximized the level of curiosity. It is assumed that this way of thinking was caused by the way the topic was presented in the squares consecutively, awakening a sense of curiosity. Some of the students' opinions on this theme are given below.

“In the comics I read, the content was so flowingly presented that I was always curious about what was going to happen in the next phase.” (Student 4)

“I always wondered how it would end when I read the comics.” (Student 1)

Creating a sense of happiness: The analysis revealed that some of the students were of the opinion that educational comics created a sense of happiness in themselves. It can be assumed that this way of thinking was caused by the humorous language used in the educational comics making the students feel happy. Some of the students' opinions on this theme are given below.

“The heroes in the comics were talking to each other so humorously that I couldn’t stop laughing. Almost all of the class laughed during the lesson and I didn’t understand how time passed.” (Student 5)

“I wish our teachers would benefit from these comics in other courses. I was sad for the first time that the lesson ended.” (Student 9)

Discussion, Conclusion and Suggestions

In order to prevent the environmental issues encountered currently, an effective environmental education is required. Therefore, it can be said that environmental education to be given to children at early ages, is of great importance (Erten, 2004; Topkaya, 2016a). However, nowadays, it is seen that the environmental education given to individuals is not very sufficient considering the impact area and size of environmental issues. As a matter of fact, some research has shown that the majority of children, especially in the primary school period, have misconceptions against environmental issues (Boyes, Staneisstreet, & Papantoniou, 1999; Groves & Pugh, 1999; Treagust, 1988) and a negative attitude towards environmental issues (Atasoy & Ertürk, 2008). The main underlying reasons are that teachers do not have enough motivation when describing environmental issues, that education programs are very intensive and environmental education is not given due importance as well as shortage of educational materials (Barrett, 2007; Palmer, 1998).

Considered to be effective teaching materials on environmental education, educational comics were studied in this research in order to reveal their effects on cognitive and affective learning of students as well as the students’ opinions about educational comics with the purposes of raising consciousness and awareness about current environmental issues and preventing them. The results of

this study indicated that there was a significant difference in favour of the post-tests between the pre-test and post-test mean scores of the students in the experimental group taught by the use of educational comics and in the control group with regards to the academic achievement (cognitive), and the attitudes towards the environment (affective). In this respect, it can be assumed that educational comics applied to experimental group and the teaching methods applied to control group have positive contributions to cognitive and affective learning.

When the pre-test scores of the students were defined as covariance and the effect of pre-test scores were taken under control, the academic achievement post-test mean scores and corrected mean scores of the experimental group were higher than those of the control group. A statistical significance was found in favour of the experimental group in comparison of the academic achievement post-test scores of the students in the experimental and control groups. In this case, it can be asserted that the teaching practices realized with educational comics in teaching environmental issues differed from the teaching methods applied to the control group in terms of academic achievement.

It was concluded that educational comics created a statistically significant difference on the academic achievement (cognitive learning) of the experimental group in which the activities were carried out through educational comics. It was assumed that the reasons underlying this outcome were the short and clear expressions used in the educational comics that clarified the details, creation of the cognitive schemes in a more robust way by activating the visual intelligence, and the possibility to make comparisons among the mindscapes through the discussions by the comic book heroes. In the literature, there are relevant studies on the effects of educational comics on academic achievement (Wolschke Bulmahn & Gröning, 1994; İlhan, 2016; Özdemir, 2010, 2017b; Sones, 1944; Topkaya, 2014, 2016a, 2016b; Topkaya & Şimşek, 2016). Wolschke Bulmahn and Groning (1994) indicated that the educational comics were very effective teaching materials in teaching about environmental issues and raising awareness in individuals about them. İlhan (2016) stated in his study that the use of comics in Social Studies teaching has a positive effect on increasing students' academic achievement. Özdemir (2010) stated that the educational comics have an important effect on increasing the academic achievement in teaching the 6th grade students the concepts under the unit called 'Heat and Temperature'. In his study, Özdemir (2017b) showed that educational comics have a positive effect in eliminating misconceptions. In a study by Sones (1944), he investigated the effects of educational comics and plain texts on academic achievement. At the end of the study, it was found that educational comics brought more effective results in increasing academic achievement compared to plain texts. In the study presented by Topkaya (2014), it was revealed that educational comics significantly increase the academic achievement of students in the theme of 'Every Human is Valuable' included in the Citizenship and Democracy Course Curriculum. Topkaya (2016a) examined the effect of educational comics on academic achievement in the teaching of environmental issues in another work. At the end of the study, it was concluded that educational comics create a statistically significant difference in the academic achievement of the students in the experimental group. In the study presented by Topkaya (2016b), the effectiveness of educational comics and concept cartoons was compared in conveying the value of sensitivity to natural environment. As a result of the study, it was concluded that educational comics have more statistically significant effects on academic achievement than concept cartoons. A study by Topkaya and Şimşek (2016) investigated the effects of educational comics on teaching the earthquake phenomena. At the end of the research, it was determined that educational comics produced positive results on academic achievement related to earthquake issues.

When the pre-test scores of the environmental attitude test were defined as covariance and the effect of pre-test scores were taken under control, the environmental attitude post-test scores and corrected mean scores of the experimental group taught with educational comics were found to be

higher. It was found out that the environmental attitude post-test scores of the students in the experimental and control group showed a statistical significance in favour of the experimental group. According to this result, it can be stated that environmental education practices carried out with educational comics differ from teaching according to constructivist approach model with respect to environmental attitudes.

It was concluded that educational comics have a statistical significance on the attitudes of experimental group students towards the environment (affective learning). This result can be associated with the fluent language used in the educational comic books that makes an individual to feel curious about what will happen in the next frame, triggering the imagination by using different time frames simultaneously, enabling students to feel relaxed by dealing with the concepts in a humorous manner and increasing the interest in the course. In the literature, there are a few studies revealing the effect of educational comics with visual attractiveness on attitudes (İlhan, 2016; Olson, 2008; Topkaya, 2014, 2016a; Topkaya & Şimşek, 2016). Among the studies showing that educational comics have impact on affective learning, İlhan (2016) found that using comics in Social Studies teaching has a positive effect on students' attitudes towards the course.

Olson (2008) showed that educational comics are an effective material in maximizing attitudes towards science. In a study by Topkaya (2014), it was concluded that educational comics have a positive effect on the attitude towards Citizenship and Human Rights course. As a result of the study which examined the effect of educational comics on the attitude towards environmental issues by Topkaya (2016a), it was concluded that educational comics had a positive effect on the attitude towards environmental issues. Topkaya and Şimşek (2016) examined the effect of educational comics on the attitude towards earthquake phenomena, concluding that educational comics were effective on the attitude towards earthquake issues.

According to the results obtained from the qualitative dimension of the study, it was observed that the views of the students about the educational comics were concentrated in two dimensions as cognitive and affective domains. When students' views on cognitive domain were examined, they expressed their opinions under the sub-themes such as eliminating the misconceptions, concretization of the abstract concepts, discussing the subject briefly, addressing the world of imagination, comparing phenomena, defining concepts, establishing cause-effect relationship between phenomena and maintaining the knowledge retention. When the views of students about affective domain were examined, it was observed that the majority of the students expressed their opinions under the sub-themes such as *'making the lesson fun, affecting the attitude towards the lesson positively, creating a sense of happiness, maximizing the sense of curiosity'*. When the related literature is examined, few studies (İlhan, 2016; Özdemir, 2017a; Topkaya & Yılar, 2015) were found in which students' opinions about the educational comics were revealed.

İlhan (2016) stated that students have a positive perspective on comics used in Social Studies teaching. In the research conducted by Özdemir (2017a), it was observed that educational comics offered a more fun learning environment to teach scientific concepts. In the study conducted by Topkaya and Yılar (2015), the majority of the students having read the educational comics stated that they liked the educational comics, that the message was conveyed through educational comics more clearly and that they identified themselves with the characters in the comic book.

In this study, it can be suggested to carry out more research on the use of educational comics in teaching different courses based on the finding that the use of educational comics in teaching environmental subjects has positive results. Different from this study, it can also be suggested to investigate the effects of educational comics on students' self-efficacy, motivation and etc. in other courses. Moreover, it can be suggested to examine the opinions of the teachers who teach different classes at different levels about the educational comics to be used in the course process.

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