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The Impact of Instructional Comics on the Cognitive and Affective Learning about Environmental Problems

Yavuz Topkaya [1]

Abstract

The present study aimed to explore the impact of comics on teaching subjects related to environmental problems in "Our Country and the World" unit of 6th grade Social Science course. The study employed the pre-test post-test control quasi experimental research design. The sample consisted of 160 6th graders studying at four different governmental secondary schools in the district of central Dörtyol of the province Hatay, Turkey in the fall semester of the academic year 2014-2015. Data were gathered through "Scale of the Attitude Towards Environment For Students" and "Performance Test for Environmental Problems". The training program including comics prepared by the researcher was conducted in the treatment group while the control group was instructed in the way their teacher had planned without manipulation. The program lasted for four weeks. At the end of the experimental process, post-test was applied to experimental and control groups. Data were analyzed through using Multivariate Analysis of Covariance (MANCOVA) by SPSS 17.00. Findings revealed that instructional comics have positive impact on academic achievement and attitudes about environment in favour of experiential group.

Keywords

Environmental problem

Educational comics

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Introduction

Developments in positive science fields such as physics, chemistry, biology, maths, communication, meteorology and medicine have improved humans' life standards throughout the past century. However, the mankind, discontented with the developments, has continued to employ recklessly the natural environment as much as possible in the name of creating better life conditions (Bozyiğit & Karaaslan, 1998; Kahyaoğlu, Daban, & Yangın, 2008). As a natural result of this, various environmental problems have been rapidly increasing. Especially since the late 19th Century, regional wars, rapid urbanization, population increase, pesticides, chemical and radioactive substance, and excessive exploitation of the nature have led to environmental pollution, which is regarded as one of the biggest problems in the world (Atalay, 2000; Houghton, 2005).

[1] Kilis 7 Aralık University, Muallim Rıfat Faculty of Education, Department of Primary Education, Turkey, topkayay@gmail.com

Climatologists have been claiming that current environmental pollution in our day will negatively affect the climate zones and in the case of not cracking down necessary measures, course of events will grow and accelerate the global warming (Öztürk, 2002). As a matter of fact, several research studies conducted concluded that the earth has been getting warmer by 10°C per decade since the 1960s (Brass, 2002; Kerr, 2002). Along with global warming, icebergs melting in a quick fashion, the rise in the sea level, and frequent changes in weather conditions are predicted to negatively affect agricultural production (IPCC, 2007). In addition to that, it is predicted that ice cap melting will continue to increase the level of sea, frequent and unusual variance in the weather conditions will have a negative impact on the agricultural production, and that air pollution will threaten human beings' health status by causing bronchitis, asthma, and various skin disorders (Kovats, Campbell-Lendrum, & Matthies, 2005). Taking notice of the upcoming danger, many countries have finally begun to discuss and deal with those problems and their underlying causes under the United Nations Organisation in 1970s and 1980s (Ehrlich, 2008). Scholars, the (United Nations Educational, Scientific and Cultural Organization) UNESCO, the (The United Nations Environment Programme) UNEP, universities, local authorities, and nongovernmental organizations have taken remarkable amount of responsibilities in order to prevent the possible environmental problems, and suggested strongly international treaties about protecting the ozone layer, air pollution and climate change to be signed so as to preclude those problems (Baykal & Baykal, 2008). However, it is key to determine the environmental problems and take necessary measures before the problems occur (Şimşekli, 2004). Radio, internet web pages, and various media and mass communication associations have been broadcasting in order to develop awareness on people about the environmental problems that are described as big threat to the mankind in the future. However, environmental problems have grown too many technological elements and or laws, enacted by the states (Erten, 2012). In preventing the environmental problems the most important condition is to develop positive attitudes among individuals towards the environmental problems. Instruction in teaching positive attitudes need to be conducted in accordance with certain plan (Erten, 2000; Şahin, Cerrah, Saka, & Şahin, 2004).

Environmental education is one of the ways in which it is essential to bring up people as the individuals who are aware of the problems, capable of resolving those problems (DPT, 1997), sensitive towards environment and environmental problems (Ayvas, 1998), and respectful to the environment (Çev-Kor, 1999). Environmental education primarily aims to protect the nature by developing environmental awareness among people (Başal, 2003). However it is not only about shaping human behavior. It also aims to develop a challenging spirit in people (Yücel & Morgil, 1999). Environmental education, which is an important and critical issue for the Earth's future, is a process which begins within family and continues with preschool education. Effective application of environmental education, especially in pre-school period, can be said to play a key role in bringing up people who are sensitive to and conscious about the environmental problems and issues (Bradley, Waliczek & Zajicek, 1999; İlhan & Tosun, 2016; Seçgin, Yalvaç, & Çetin, 2010). However, it should not be forgotten that environmental education during the primary school education period underlies the most important and effective part of environmental education (Seçgin et al., 2010). Environmental education which is an inter-disciplinary field, enables students to become cognitively literate, develop affectively positive attitudes on them and convert those attitudes into behavior in terms of psycho-motor behavior (DPT, 1997; Seçkin, Yalvaç & Çetin, 2010) by impacting their cognitive, affective, and psycho-motor developmental areas (Unterbruner, 1991).

While environmental education, which is so pivotal for human beings' future, has been differently put into practice in different countries, it is emphasized that in primary and secondary education in Turkey. Environmental education used to be taught in Life Science, Science, Geography, Environmental Knowledge and Social Studies courses before the year 2005; while with the latest changes in educational programs, currently it has been taught to students mainly in Science, Life Science and Social Studies courses through latest changes in the instructional curriculums since 2013. It can be said that among those courses environmental knowledge is taught in the best way especially in social

studies course. Because it is pointed in the Social Studies teaching program that it is necessary to teach environmental knowledge, ecology, and environmental awareness in social studies curriculum by getting students internalize (Karatekin & Aksoy, 2012). 2nd, 6th, 11th, 14th and 17th purposes in the social studies curriculum aim to teach the skills about knowing environmental rights and all characteristics of the nature, establishing healthy interaction with the environment, employing science and technology according to sustainable development, awareness of the problems affecting negatively humans and the nature, educating the generations that produce solutions against the environmental problems (Karatekin, 2011). Environmental knowledge is taught in Our Place Where We Live Unit, Know Our Region Unit, Resources of Our Country Unit the Bridges Between the Countries Unit in 4th, 5th, 6th and 7th grades in the context of the Social Studies Curriculum, with one acquisition for each grade level and four acquisitions in total. Knowledge about the environment is taught four times in an instructional year. The fact that instructional activities of the Social Studies course which are so critical in terms of teaching environmental education is conducted within previously determined frame by determining aims, will make contribution to general education, specifically environmental education (Işıldar & Yıldırım, 2008; Ercengiz, Keçeci Kurt & Polat, 2014). In this context, environmental instruction must be supported by different materials and appropriate activities for students' cognitive development in order to increase permanency of knowledge, (Özdemir, 2007; Venkataraman, 2008), skills (Aksoy, 2003), and attitudes (Bilen, 1996; Özdemir & Yapıcı, 2010; Seçgin et al., 2010; Şimşekli, 2004). The course materials to be used particularly during the lesson must initially possess a high-impact power. In contrast to the idea that building an attitude towards an object, situation and phenomenon, or converting an existing negative attitude into a positive one will take a long time (Baron & Byrne, 1977; Rokeach, 1968), there are various studies in the related literature stating that attitudes may change in a very short time, even as a result of instantaneous phenomena which may make a lasting impact on human psychology through the use of convincing materials with a high-impact power (Hovland, Janis, & Kelley, 1953; Petty & Caccioppo, 1986). Thus, it is known that teachers use cartoons, comics, photo, simulation, and especially concept cartoons to conduct effective environmental education. In addition to those visual materials, instructional comics have been employed in instructional activities about environmental education.

Since educational comics host literature and pictorial arts which are very rich two forms of cultural expression, students can actively be involved in the process by filling blanks between these two panels that require active thinking while reading (Rota & Izquierdo, 2003). Indeed, it can be said that this characteristic of educational comics is quite suitable for constructivist approach model which is applied today. In the studies by Haugaard (1973) and Koenke (1981), it was stated that educational comics have a very positive effect on achieving some desired changes in behaviors, promoting the academic achievement positively, maximizing the motivation towards the course, creating a sense of curiosity and bringing reading habits for children who have difficulties in reading and who do not like reading. Haugaard (1973) stated that children have a natural interest towards educational comics which bring such positive results and he further remarked that teachers who use educational comics in their courses can benefit greatly from attractive and motivating feature of comics.

It was detected in the related literature that there is a limited number of researchers and studies about the impact of instructional comics. In their study regarding the effectiveness of text and comics, Sones (1944) concluded that instructional comics and their visuals are superior to plain texts. Teachers who took part in Hutchinson's (1949) study revealed the opinion that instructional comics have a remarkable contribution in increasing student motivation and individual participation to courses. Haugaard (1973) stated in their study that students' attention to instruction can be easily increased through the use of the comics due to its alluring characteristics. Trent and Kinlaw (1979) found that instructional comics are appropriate instructional materials for economically and socially disadvantaged students in terms of education. Brocka (1979) concluded from their study that

instructional comics have more advantages than other literature activities. Purnell and Solman (1991) found in their study that texts and visual drawings in harmony with each other enable students to understand the subjects more clearly. Gambrell and Jawitz (1993) concluded in their study that comics have a crucial advantage in terms of enabling readers to focus on texts. In their study, Wright and Sherman (1994) found that instructional comics play an important role as teaching materials in developing students' attention and efficacy. In their study, Williams (1995) concluded that commercial comics are effective materials in language teaching and that English course books can be successfully prepared through the use of these materials. The study conducted by Freeman and Freeman (2000) proposed that instructional comics must frequently be used in schools due to their rich vocabulary source fullness and grammar constructs. As result of their research, Cary (2004) found out that the plain and clear statements in instructional comics are effective in gaining regular book reading habits for children. On the other hand, Liu (2004) studied the effect of comics on ELS students' reading and comprehension skills. They discovered that instructional comics employ more reading and increase understanding skills of ELS students whose level is low than ELS students with high level skills. Olson's (2008) study found that instructional comics are effective materials in increasing attention to instruction through science literacy. In the study conducted by Khoii and Forouzesh (2010), the conclusion reached was that instructional comics have positive impacts on reading and understanding text. In their study, Özdemir (2010) concluded that instructional comics are effective in teaching concepts about warmth and temperature in 6th grade science curriculum. Megawati and Anugerahwati (2012) pointed out that instructional comics must not solely be used in teaching writing skills, that at the same time they can be employed in event chain, content and grammar of texts due to their interesting characteristics. Akkaya (2013) found in their research that instructional comics have positive impacts on constructional knowledge such as 6th grade grammar, listening, speaking, reading, and writing topics. The study conducted by Meriç (2013) concluded that reading texts which are presented with visuals are more easily understood by students. Cihan (2014) suggested in their study that instructional activities for 8th grade Turkish course must be prepared with instructional comics. In his study, Topkaya (2014) reached the conclusion that using instructional comics in citizenship and democracy education courses increased academic attainment as well as attitudes towards the course. In their study conducted with 50 6th grade students, Topkaya and Yılar (2015) found that students have positive attitudes towards the instructions which are conducted with instructional comics. When the relevant literature is examined, it can be seen that most of the studies about instructional comics were conducted by foreign scholars and the trend to conduct research about instructional comics in Turkey is not enough.

Awareness of environment needs to be established on humans in order to prevent environmental problems, which is important both for the world and future of the mankind. Environmental education plays important roles in establishing this awareness. It can be said that when dimension of the environmental problems and their effect size are regarded, this awareness is not at the desired level for individuals yet. Therefore, environmental education in schools must be made interesting through developing authentic instructional activities. Busman vet Groaning (1994) found out that instructional comics are effective materials in attention to the environmental problems. Therefore, impact of instructional comics on cognitive and affective learning was aimed to determine within this context. When the relevant literature is examined, it can be observed that there is no experimental study investigating the impact of instructional comics on cognitive and affective learning about environmental problems. It is expected that the present study will help remove the lack of experimental research about the impact of instructional comics.

Purpose of the Study

The purpose of this study is to reveal the effect of instructional comics on attitudes towards environmental problems and academic success.

Sub-Problems

First sub-problem: Is there a significant difference between pre-test and post-test scores of "Performance Test for Environmental Problems" of control group students and experimental group students?

Second sub-problem: Is there a significant difference between pre-test and post-test scores of "Scale of the Attitude towards Environment for Students" of control group students and experimental group students

Limitations of the Study

- The research is limited to students who took part in experimental and control groups.
- The research is limited to the learning area of 6th grade Social Studies Curriculum "Our Country and the World" unit.
- The research is limited to the characteristics measured by Scale of the Attitude towards Environment for Students and Performance Test for Environmental Problems.

Method

Design of the Study

The present study aiming to discover the effectiveness of instructional comics on cognitive learning (academic achievement) and affective learning (attitudes towards environmental problems) was designed in quasi-experimental research pre-test and post-test with control group along with the quantitative tradition. In this design of quasi-experimental research pre-test and post-test with control group, treatment group is exposed to manipulation by independent variable, and there is a control group which is not manipulated by the independent variable. This design includes a treatment group and a control group; however, participants are not randomly assigned to the groups, and the assumption that the groups are equal, is emphasized (Fraenkel & Wallen, 2006). In testing the hypotheses, the variations between pre-test and post-test scores of the groups are compared to see whether there is a significant difference (Bulduk, 2003; Christensen, 2004; Karasar, 2005). If there is no significant difference between the pre-test scores of the groups, the groups can be said to be comparatively equal. Therefore, academic achievement, one of the dependent variables of the study, is controlled for both of the groups. For this reason, quasi-experimental research was employed by regarding similar researches in the literature (Linn & Gronlund, 2000). Courses supported by activities with instructional comics are independent variable of the research; attitudes towards environmental problems and academic achievement are dependent variables of the research.

Participant Groups

Convenience sampling method, which is one of the non-probability sampling methods has been adopted when creating sample of study. Appropriate sampling method preferred for the nature of this study is used by researchers in cases in which random or systematic sampling using is difficult. Those who were selected by convenience sampling are individuals whom researchers can easily reach (Franked & Walled, 2006). The sample of this research is consisted of 160 6th grade students of secondary schools in four publicly owned different secondary schools in 2014-2015 academic years in the fall semester in Hatay Döryol district centre. Academic achievement test for environmental issues is applied as pre-test in determining the equivalence of academic achievement level of students. Pre-tests are applied in schools where the study will be conducted and the results of measurement are shown to be equivalent to each other and experimental and control groups are formed in similar levels in each school site. With reference to this; 160 students consist of the sample of the study including 41 in school A (20 controls, 21 experimental), 41 in school B (21 controls, 20 experimental), 40 in school C (20 controls, 20 experimental) and 38 in school D (19 controls, 19 experimental).

Preparation Process of the Instructional Materials

Five acquisitions to be obtained from Unit 5, 'Our Country and the World' within the 6th grade Social Studies Curriculum were examined in detail. Of all the five acquisitions, the one involving environmental problems and operations of environmentally-friendly organizations which states: 'The student realizes the importance of our country's being in mutual cooperation with other countries in the cases of natural disasters and environmental problems' was regarded as the central issue, and the instructional comics were prepared by the researcher. The following stages were followed successively in the preparation process of the instructional comics:

Stage One: A faculty member, who is an expert on environmental problems, two Science teachers and two Social Studies teachers were asked for their opinions in drawing the scenarios.

Stage Two: The researcher prepared eight scenarios in which each environmental problem was mentioned.

Stage Three: A faculty member, who is an expert in Turkish language teaching, was asked for an opinion to determine the suitability of the scenarios with respect to the language and the students' level.

Stage Four: After preparing the scenarios, the characters in the comics were drawn considering students' ages and interests by using the Pixton (http://www.pixton.com) program.

Stage Five: The dialogues in the scenarios were placed into the speech bubbles in the comics.

Stage Six: Necessary expressions were placed into the narration boxes in order to clarify the transitions between the frames within the comics with respect to time.

Stage Seven: The pilot study was conducted with 10 students at the 6th grade, who were excluded from the study, to test the visual quality and clearness of the instructional comics. After the instructional comics were handed out, students were asked for their opinions about the comics. Some of the dialogues and drawings in the comics were reviewed according to the students' opinions.

Stage Eight: Finally, two faculty members, one of whom is an expert on environmental problems and the other one on instructional comics, were asked for their opinions to determine whether the instructional comics were suitable to the acquisitions specified in the programme. Based on the positive opinions obtained from the experts, the preparation process of the comics was completed. The eight comics involving nine frames each were made use of during the application. A sample of the instructional comics used in the study was given as follows:

Experimental Process

Experimental process was indicated in the Table 1.

Table 1. Experiment Design

School	Group	Pre-Test	Application	Post-Test
(School A)	TG	T_1 T_2	ICFEP	T_1 T_2
	CG	T_1 T_2	CB	T_1 T_2
(School B)	TG	T_1 T_2	ICFEP	T_1 T_2
	CG	T_1 T_2	CB	T_1 T_2
(School C)	TG	T_1 T_2	ICFEP	T_1 T_2
	CG	T_1 T_2	CB	T_1 T_2
(School D)	TG	T_1 T_2	ICFEP	T_1 T_2
	CG	T_1 T_2	CB	T_1 T_2

In Table 1, TG indicates the treatment group in which Instructional Comics for Environmental Problems (ICFEP) was implemented. CG is the control group in which ordinary course books developed by the Ministry of National Education (CB) was carried out. T_1 displays Environmental Attitude Scale for Primary School Students (EASPSS), and T_2 indicates the Academic Success Test For Environmental Problems (ASTEP). Before starting the implementation, a meeting was held with the 4 social studies teachers to carry out the activity, and necessary issues were identified for them to pay more attention during the implementation. These teachers were conducted a training regarding instructional comics two hours per week for three weeks. In the first week, the teachers were given some technical information about comics such as frames, strips, characters, speech bubbles and narration boxes by the use of a sample instructional comic. It was aimed to increase the teachers' level of knowledge about instructional comics. In the second week, the teachers were shown a lesson flow directive in order for them to carry out the activities in a planned manner during the lesson. Each stage in the lesson flow directive was explained to the teachers in detail, and the teachers were asked to carry out their lessons by complying with the lesson flow directive. It was aimed to ensure that the teachers carry out the lessons systematically. In the third week, the teachers were given eight instructional comics to use

during the implementation process, and the dialogues in the materials were discussed. The training ended after the discussion conducted with the aim of increasing the teachers' level of knowledge about the fictions in the scenarios. Before starting the study, a pilot study was conducted in order to determine whether the teachers used the instructional comics in line with the lesson flow directive. The pilot study involved an instructional comic composed of 18 frames prepared to teach the topics mentioned in the unit called 'Resources of Our Country'. Accompanied with the researcher, the practice teachers taught 2 lessons by using these materials. In the pilot study, it was observed that the teachers taught the activities during the lesson in compliance with the lesson flow directive, and benefited from the instructional comics efficiently. Accordingly, the pilot study ended after the necessary observations. The presented study was launched by applying the EASPSS and the ASTEP to both of the groups as pre-test. The ICFEP was conducted for two course hours in a week and lasted for four weeks. Same teachers instructed in both the treatment groups and the control groups so as to minimize the difference emerging from teacher variable. Instructions, given to the treatment groups, were implemented in five steps in accordance with the lesson flow directed by the social studies teachers. Those steps were explained in details in the Table 2.

Table 2. Activities, Conducted on Experimental Groups

Week	Instructional Flow
Week 1	i) Teacher tries to develop on awareness on students by explaining environmental problems (earthquake, flood, landslide, and climate change). ii) Teacher gives away 2 instructional comics on earthquake, flood, landslide, and climate change and asks them to read carefully. iii) Teacher gets students discuss statements of the characters in the instructional comics. iv) Teacher tries to identify learning dimension and misconceptions about earthquake, flood, landslide, and climate change by asking questions about environmental problems in the instructional comics. v) Teacher summarizes activities and finishes the lesson.
Week 2	i) Teacher summarizes the activities carried about in previous week, and begins the lesson. ii) Teacher tries to develop an awareness on students about environmental problems that has been encountered in the World, by explaining briefly. iii) Teacher gives away 2 instructional comics on water pollution, soil pollution, air pollution, and chemical wastes to students and asks them to read carefully. iv) Teacher gets students discuss statements of the characters about water pollution, soil pollution, air pollution, and chemical wastes in the instructional comics. v) Teacher tries to identify learning dimension and misconceptions about water pollution, soil pollution, air pollution, and chemical wastes by asking questions. vi) Teacher summarizes activities and finishes the lesson.
Week 3	i) Teacher summarizes the activities (water pollution, soil pollution, air pollution, and chemical wastes) carried about in previous week, and begins the lesson. ii) Teacher tries to develop an awareness on students about environmental problems (fluid wastes, solid wastes, and global warming) that has been encountered in the World, by explaining briefly. iii) Teacher gives away 2 instructional comics on fluid wastes, solid wastes and global warming to students and asks them to read carefully. iv) Teacher gets students discuss statements of the characters about fluid wastes, solid wastes, and global warming in the instructional comics. v) Teacher tries to identify learning dimension and misconceptions about solid wastes, fluid wastes, and global warming by asking questions. vi) Teacher summarizes activities and finishes the lesson.

Table 2. Continue

Week	Instructional Flow
Week 4	i) Teacher summarizes the activities (fluid wastes, solid wastes, and global warming) carried about in previous week, and begins the lesson. ii) Teacher stresses importance of pro-environmental associations aiming to prevent environmental problems, and cooperation with other countries, thereby develop an awareness among students about this issue. iii) Teacher gives away 2 instructional comics about cooperation with other countries, and asks them to read those instructional comics carefully. iv) Teacher gets students discuss statements of the characters about natural disasters, pro-environmental associations, cooperation with other countries against environmental problems in the instructional comics. v) Teacher tries to identify learning dimension and misconceptions about importance of natural disasters, pro-environmental organizations, cooperation with other countries by asking questions. vi) Teacher summarizes activities and finishes the lesson.

However, the teachers were not interfered in the control groups at all. The teachers acted in line with the 6th grade Social Studies Curriculum, and taught the lessons according to the constructivist learning approach and multiple intelligence theory. The teachers were advised to use argumentation, question-answer and case techniques in order to enrich the content of the lesson while teaching. At the end of a four-week implementation, the study ended after both the experimental group and the control group were given 'Environmental Attitude Scale for Primary School Students' and 'The Academic Success Test for Environmental Problems'.

Instrumentation

Environmental Attitude Scale for Primary School Students

In the present study, Environmental Attitude Scale for Primary School Students (EASPSS) developed by Gökçe, Kaya, Aktay, and Özden (2007) was employed. Cronbach's Alpha coefficient, which is the most appropriate one for Likert type scales, was calculated and found to be .87. In order to determine the scale's validity, criterion validity, construct validity, and content validity were calculated. Content validity was found through expert investigation. Criterion validity was calculated through sparing the 27 % top of the distribution and 27 % of bottom of the distribution counting on the scale scores and testing whether the difference between the means of these two groups were statistically significant. Accordingly, t-test was applied to the scores of these groups and the difference between 27% of top and bottom of distribution was found to be significant for all the items ($p<.001$). In terms of the internal reliability of the scale, Cronbach's Alpha was calculated through students' replies to the items in the scales and found as .83. In order to test the construct validity of the scale, factor analysis was conducted. As a result of the factor analysis Scale with 34 items, , varying .34-.77 intervals, was found out that there is construct with 6 factors based on 36 items and those six factors explains 44 % of the total variance. Thus, the scale was made up of 36 items with factor loadings of between .34 and .77. These 36 items, including both positive and negative statements, were inserted into three rating grades as Disagree 1, Neutral 2 and Agree 3. The maximum point that can be scored in the scale is 102 and the minimum point is 34. In the light of aforementioned statistical characteristics of the scale, it was decided to be reliable and convenient instrument to use in the present research.

The Academic Success Test For Environmental Problems

An instrument that assesses and measures academic attainment level for learning task is called academic success test (Yıldırım, 1999). Academic success test primarily needs to have adequate content validity. Therefore, it is necessary that all the behaviors related to learning tasks in a field must be placed proportionally (Büyüköztürk, 2004). Initially, five acquisitions obtained from Unit 5, 'Our Country and the World' within the 6th grade Social Studies Curriculum were examined in detail for the academic

success test, and it was observed that only one acquisition (The student realizes the importance of our country's being in mutual cooperation with other countries in the cases of natural disasters and environmental problems) regarded environmental problems as a central issue. Great attention was paid to the questions in that they represent all subject matters (natural disasters, air, soil, solid waste, noise, chemicals) regarding environmental problems to be taught, to a certain extent. Within this context, 35 questions were prepared by the researcher for the identified acquisition. A field expert in linguistics and two faculty members, who are experts in environmental issues, were presented the academic success test to ask for their opinions about the test for the purpose of achieving the validity of the questions in the test. As a result of the review made by the experts, 35 questions were discussed, and it was agreed that 20 questions be used in the academic success test. In order to conduct item analysis, these 20 items were given away to 155 students from two schools in the district center of Dörtyol of the province Hatay who had already been instructed the unit and who were outside the sample group selected for this study. Because items in the academic success test are multi-optional, true responses were coded as 1 and wrong and missing responses were coded as 0. In the general sense, items with a total correlation score of .30 and higher are accepted to differentiate among individuals relatively well, items between .20 and .30 can be included in the test when necessary, and items with scores lower than .20 should not be included in the tests (Tekin, 2004; Büyüköztürk, 2004). It was found that the items of the academic success test had difficulty index ranging between .29 and .61 and distinctiveness index ranging between .34 and .71. Kuder-Richardson-20 coefficient was used to calculate reliability analysis. As a result of the analysis the coefficient was found as .76 and it was concluded that the academic success test is reliable instrument.

Data Analysis

Before statistical analyses of data obtained in the study can be conducted, the data set needs to be prepared for analysis by being arranged. For this purpose, first missing values and extreme values (outliers) were investigated. In order to determine general characteristics of the groups, descriptive statistics values such as standard deviation, means were calculated. In the study, Multivariate Analysis of Covariance (MANCOVA) was employed to discover impact of the experimental manipulation on academic success and attitudes towards environmental problems (Çokluk, Şekercioğlu, & Büyüköztürk, 2010). MANCOVA is strong statistical method to reveal experimental manipulation's effect on post-test independently pre-test measurement. In other words, Experimental manipulation's effect on post-test was assessed by disregarding pre-test impact on post-test in MANCOVA. There are certain pre-conditions which need to be met. In the current study, it was identified that the groups were independent from each other, there was a variance homogeneity (F_{AA} = .98, p > .05; F_{ATE} = 2.11, p > .05), and within-group regression coefficients (F_{AA} = 1.91, p > .05; F_{ATE} = 4.08, p > .05) were equal. To determine the effect of experimental design, eta square effect size was used. In current paper, results were quantitatively compared by assessing eta square. As effect size is not related to means and relationships, this provides more adequate and confidential information than p value from the study (Thompson, 2003). The values of .01, .06 and .14 refer small, medium and large effect since, respectively. Besides because of the fact that experimental process was conducted with different teachers under different schools, effectiveness of the experimental process was calculated for each school. Data were analyzed through the SPSS 17.00 (Statistical package for the social sciences).

Findings

This section involves the analyses made and results obtained with regards to the effects of instructional comics on the academic success and attitude towards environmental problems, as well as the descriptive analysis of the data obtained via success test and attitude scale.

Table 3. The Descriptive Analysis of the Answers Given to the Questions in Academic Success Test

Questions in the Academic Success Test	Experimental Group Pre Test				Experimental Group Post Test				Control Group Pre Test				Control Group Post Test			
	True		False		True		False		True		False		True		False	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
1-Which of the following is the most important factor leading to global warming?	39	48.8	41	51.3	68	85.0	12	15.0	38	47.5	42	52.5	46	57.5	34	42.5
2-Which of the following is not counted as one of the factors leading to water pollution?	35	43.8	45	56.3	68	85.0	12	15.0	30	37.5	50	62.5	46	57.5	34	42.5
3-Which of the following is not a global environmental problem threatening all living creatures?	37	46.3	43	53.8	67	83.8	13	16.3	40	50.0	40	50.0	51	63.8	29	36.3
4-Which of the following is not one of the factors leading to soil pollution?	34	42.5	46	57.5	63	78.8	17	21.3	38	47.5	42	52.5	48	60.0	32	40.0
5-Which of the following items does not have a negative effect on ecological balance?	36	45.0	44	55.0	63	78.8	17	21.3	39	48.8	41	51.3	51	63.8	29	36.3
6-Which of the following is the most important precaution to prevent environmental problems?	34	42.5	46	57.5	65	81.3	15	18.8	35	43.8	45	56.3	47	58.8	33	41.3
7-Which of the following is not one of the factors leading to air pollution?	38	47.5	42	52.5	68	85.0	12	15.0	32	40.0	48	60.0	43	53.8	37	46.3
8-Which of the following is the environmental problem caused by solid waste not dissolving in the nature for a long time?	35	43.8	45	56.3	58	72.5	22	27.5	34	42.5	46	57.5	47	58.8	33	41.3
9-Which of the following energy resources is a nature-friendly fuel type?	39	48.8	41	51.3	66	82.5	14	17.5	36	45.0	44	55.0	49	61.3	31	38.8
10-Which of the following is not one of the environmental problems?	37	46.3	43	53.8	69	86.3	11	13.8	33	41.3	47	58.8	45	56.3	35	43.8
11-Which of the following is the most important technological precaution that can be taken in order to protect the environment?	39	48.8	41	51.3	62	77.5	18	22.5	40	50.0	40	50.0	51	63.8	29	36.3
12-Which of the following type of waste is impossible to recycle?	30	37.5	50	62.5	64	80.0	16	20.0	34	42.5	46	57.5	43	53.8	37	46.3
13-Which of the following is the most effective factor among precautions that can be taken against global warming?	46	57.5	34	42.5	67	83.8	13	16.3	41	51.3	39	48.8	48	60.0	32	40.0
14-Pollution in which of the following can be eliminated harder than the others?	34	42.5	46	57.5	61	76.3	19	23.8	40	50.0	40	50.0	53	66.3	27	33.8
15-Which of the following is not one of the international foundations determining environmental policies?	36	45.0	44	55.0	67	83.8	13	16.3	41	51.3	39	48.8	50	62.5	30	37.5
16-Which of the following is the first institution founded to determine environmental policies in Turkey?	37	46.3	43	53.8	65	81.3	15	18.8	38	47.5	42	52.5	48	60.0	32	40.0
17-Which of the following is not one of the precautions that can be taken to reduce air pollution?	36	45.0	44	55.0	66	82.5	14	17.5	38	47.5	42	52.5	46	57.5	34	42.5
18-Which of the following is an example of biological pollution caused by liquid waste in water?	37	46.3	43	53.8	67	83.8	13	16.3	41	51.3	39	48.8	55	68.8	25	31.3
19-Which of the following is the environmental problem caused by harmful gases?	35	43.8	45	56.3	64	80.0	16	20.0	38	47.5	42	52.5	49	61.3	31	38.8
20-Which of the following is pro-environmental behavior?	39	48.8	41	51.3	61	76.3	19	23.8	39	48.8	41	51.3	52	65.0	28	35.0

Table 3 shows the estimation of the frequency and percentages regarding the answers that the participants gave to each question in the academic success test. In the pre-test, the highest correct response rates were to the questions 13, 1, 9, 11 and 20, respectively in the experimental group whereas the lowest correct response rates of the same group in the post test were to the questions 10, 1, 2, 7 and 3, respectively. In the pre-tests, the highest correct response rates were to the questions 13, 15, 18, 11 and 14, respectively in the control group whereas the lowest correct response rates of the same group in the post tests were to the questions 18, 14, 20, 11 and 5, respectively.

Table 4. The Descriptive Analysis for the Items of the Environmental Attitude Scale

Items of the Environmental Attitude Scale	Experimental Group Pre Test		Experimental Group Post Test		Control Group Pre Test		Control Group Post Test	
	$\bar{x}$	ss	$\bar{x}$	ss	$\bar{x}$	ss	$\bar{x}$	ss
1- I believe that environmental problems can be solved through intelligence and information.	1.70	.683	1.74	.742	1.96	.665	1.28	.503
2- I like learning about various plants and animals.	1.78	.656	1.77	.729	1.98	.693	1.21	.441
3- I do not believe that shopping too much harms the environment.*	1.58	.708	2.24	.767	2.57	.612	2.71	.532
4- I enjoy taking part in activities aimed at beautifying the environment.	1.84	.754	1.74	.807	2.04	.683	1.25	.490
5- It does not disturb me when people throw litter on the ground.*	1.71	.750	2.43	.725	2.34	.728	2.72	.503
6- I believe that natural and historical beauties should be protected.	1.68	.671	1.84	.787	1.86	.707	1.29	.508
7- I hate people who spit on the ground.	1.55	.692	1.60	.739	1.79	.706	1.29	.532
8- I am willing to do my part on solving environmental problems.	1.51	.656	1.51	.656	1.71	.750	1.19	.393
9- I do not like joining planting works.*	1.70	.736	2.35	.813	2.37	.736	2.74	.470
10- I appreciate people working voluntarily for the environment.	1.49	.595	1.41	.630	1.58	.652	1.16	.371
11- It upsets me when people polluting the environment are not reacted to.	1.46	.615	1.35	.576	1.59	.688	1.16	.371
12- I do not believe that there are recyclable items in the trash.*	1.60	.587	2.18	.792	2.51	.693	2.81	.424
13- I want everyone to be sensitive towards environment.	1.46	.594	1.33	.497	1.61	.684	1.19	.424
14- I am bored by environmental excursions.*	1.65	.695	2.46	.711	2.56	.691	2.81	.393
15- I appreciate people growing plants.	1.50	.636	1.39	.515	1.66	.674	1.15	.359
16- I do not believe that environmental problems negatively impact national economy.*	1.74	.631	2.36	.698	2.41	.706	2.75	.490
17- I am aware that individuals have parts in resolving environmental problems.	1.61	.684	1.74	.742	1.69	.686	1.18	.382
18- I think practices about environment will prevent economic development.*	1.70	.683	2.51	.711	2.40	.704	2.80	.488
19- I enjoy taking part in activities in nature.	1.53	.656	1.50	.675	1.71	.697	1.15	.359
20- I am very angry with people who harm historical remains.	1.48	.595	1.43	.569	1.61	.684	1.28	.449
21- I find having a pet disgusting.*	1.61	.665	2.51	.711	2.48	.656	2.74	.497
22- I really like having a picnic in nature.	1.59	.650	1.35	.576	1.61	.665	1.20	.403
23- I am aware that cleanliness is important for the environment.	1.51	.574	1.34	.526	1.53	.675	1.29	.508
24- I like animals.	1.58	.612	1.51	.551	1.54	.635	1.46	.550
25- I believe that everyone should notice the beauties in nature.	1.54	.572	1.36	.534	1.56	.672	1.19	.393
26- I am really disturbed when people having a picnic throw litter around.	1.55	.654	1.38	.513	1.58	.689	1.26	.497
27- I do not believe that countries should work together for the environment.*	1.65	.658	2.30	.736	2.55	.654	2.74	.443
28- Continuous energy resources such as the sun should be used for the environment.	1.51	.551	1.33	.497	1.63	.736	1.21	.412
29- I believe that people should be thrifty for the environment.	1.53	.573	1.53	.573	1.59	.724	1.19	.393
30- I do not believe that humans are a part of the environment.*	1.60	.648	2.20	.753	2.59	.650	2.72	.449
31- I do believe that humans are a part of the environment.	1.51	.636	1.26	.443	1.56	.691	1.19	.393
32- I believe that the real reason of environmental problems is humankind's senseless behaviors.	1.61	.626	1.31	.466	1.63	.700	1.16	.371
33- I do not want to buy items harmful for the environment while shopping.	1.57	.632	1.31	.466	1.58	.689	1.21	.412
34- I care about using recyclable products.	1.60	.686	1.33	.471	1.61	.684	1.13	.333

* Negative items

In Table 4, the pre-test and post-test scores of the experimental and control groups, which were gathered via Environmental Attitude Scale for Primary School Students, were analyzed according to each item in each scale. On analyzing the answers given by the students in the experimental group, the post-test scores of the items number 2, 5, 9, 12 and 17 were observed to increase when compared to the scores obtained from the pre-tests, whereas the post-test scores of the items number 4, 10, 23, 32 and 34 decreased when compared to the pre-test scores. On the other hand, on analyzing the answers given by the students in the control group, the post-test scores of the items number 5, 9, 12, 14 and 16 increased when compared to the pre-test scores, whereas the post-test scores of the items number 1, 2, 3, 17 and 28 decreased when compared to the pre-test scores.

Findings Concerning Sub-Problems

MANCOVA was used to analyze the data. Findings about first and second sub-problems were displayed on the Table 5, the Table 6, the Table 7 and the Graphic 1.

Table 5. MANCOVA Results About the Variables

Factor	Variance Source	Wilks' Lambda	F	$Sd_{hypothesis}$	Sd_{error}	p	η^2
	AA pre-test	.72	7.08	2	36	.003	.28
A School	ATE pre-test	.93	1.28	2	36	.293	.07
	Group	.18	76.65	2	36	.000	.82
	AA pre-test	.93	1.30	2	36	.284	.06
B School	ATE pre-test	.97	.55	2	36	.579	.03
	Group	.19	76.15	2	36	.000	.80
	AA pre-test	.39	11.59	2	35	.000	.40
C School	ATE pre-test	.98	.38	2	35	.681	.02
	Group	.21	63.56	2	35	.000	.78
	AA pre-test	.51	15.99	2	33	.000	.49
D School	ATE pre-test	.99	.09	2	33	.914	.00
	Group	.16	88.51	2	33	.000	.84

AA: Academic Achievement**, ATE:** Attitudes Towards the Environment

As a result of the MANCOVA, impact of pre-test point on post-test points was not found as significant at the level of .05 (λ= .93, F(2, 36)= 1.28, p> .05, η^2= .07), impact of the instructional comics on the academic achievement and attitudes towards the environment in post-test (λ= .18, F(2, 36)= 76.65, p< .001, η^2= .82). In addition to that it was concluded that pre-test scores have impact on the post-test scores (λ= .72, F(2, 36)= 7.08, p< .01, η^2= .28). Based on this finding it can also be said that observed variation in academic achievement stems from the pre-test in the A School.

According to data from B School, pre-test scores of attitudes towards the environmental problems (λ= .97, F (2, 36)= .55, p> .05, η^2= .03), and academic achievement test (λ= .93, F(2, 36)= 1.30, p> .05, η^2= .06) do not any significant effect on those of the post-test at the level of .05. Groups have significant impact on post-test scores of the attitudes towards the environmental problems and the academic achievement test (λ= .19, F(2, 36)= 76.15, p< .001, η^2= .80).

Findings from the C School indicated that while pre-test scores of attitudes towards the environmental problems doesn't have any significant impact on the post-test scores (λ= .39, F(2, 35)= .38, p> .05, η^2= .40), groups do have significant impact on post-test scores of the attitudes towards environmental problems and academic achievement test (λ= .21, F(2, 35)= 63.56, p< .001, η^2= .78). Moreover pre-test scores of the academic achievement test have significant impact on the post-test scores (λ= .39, F (2, 35) = 11.59, p< .01, η^2= .40). Observed variation in the post test scores of the academic achievement test also stems from the pre-test.

Finally data from the D School revealed that pre-test scores of attitudes towards the environmental problems don't have any significant impact on the post scores (λ= .99, F (2, 33) = .09, p> .05, η^2= .00), groups have significant impact on the post test scores of the attitudes toward environmental problems and the academic achievement test (λ= .16, F (2, 33) = 88.51, p< .001, η^2= .84). Besides pre-test scores of the academic achievement test have significant effect on the post-test scores (λ= .51, F (2, 33) = 15.99, p< .01, η^2= .49). Based on these results of the MANCOVA, observed variation in the academic achievement stems from the pre-test scores.

To determine the effects of experimental design carried in four schools, effect size (eta square) was applied. Accordingly, when examining the effect sizes, it was observed that effect size values are in large level (A school, η^2 = .82, B school, η^2 = .80, C school, η^2 = .78, D school, η^2 = .84). Those findings increase the reliability of the results.

Table 6. Interaction between the Variables

Factor	Variance Source	Dependent Variables	KT	Sd	KO	F	p	η^2
A School	Group	AA post-test	195.02	1	195.02	75.80	.000	.67
		ATE post-test	809.72	1	809.72	93.10	.000	.72
B School	Group	AA post-test	91.14	1	91.14	29.10	.000	.44
		ATE post-test	1004.74	1	1004.74	145.65	.000	.80
C School	Group	AA post-test	110.33	1	110.33	106.70	.000	.75
		ATE post-test	478.29	1	478.29	42.52	.000	.54
D School	Group	AA post-test	124.93	1	124.93	102.40	.000	.75
		ATE post-test	882.60	1	882.60	109.46	.000	.76

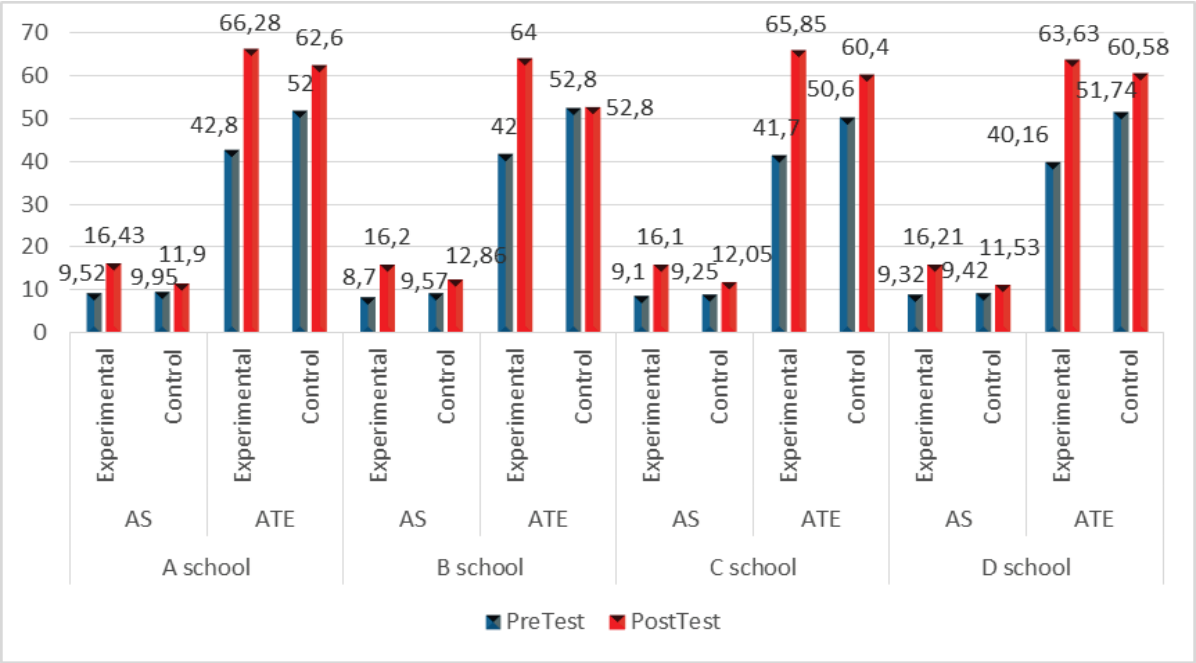
AA: *Academic Achievement*, **ATE:** *Attitudes Towards the Environment*

In Table 6, it can be observed that there is significant difference between both of the groups' scores of the attitudes towards the environmental problems and academic achievement test in all of the schools. As result, it was found that there is significant difference between treatment group students' scores of attitudes towards the environmental problems and the academic achievement test and those of the control group. Therefore, instructional comics, experimental manipulation of the present study, do have significant impact in increasing academic achievement about the environmental problems and developing attitudes towards the environmental problems. pre-test and post-test of the attitudes towards environmental problems and academic achievement test from both of the groups was displayed in detail on the Table 7 and Graphic 1.

Table 7. Pre-Test and Post-Test Scores of the Groups

School	Measurement	Group	Pre-Test		Post-Test	
			Mean	SD	Mean	SD
A	AA	Treatment	9.52	1.29	16.43	2.18
		Control	9.95	1.23	11.90	1.37
	ETA	Treatment	42.80	2.36	66.28	4.55
		Control	52	3.47	62.60	5.12
B	AA	Treatment	8.70	.21	16.20	2.37
		Control	9.57	1.50	12.86	1.11
	ETA	Treatment	42.00	2.27	64.00	3.90
		Control	52.80	2.84	60.95	4.00
C	AA	Treatment	9.10	1.88	16.10	.79
		Control	9.25	1.44	12.05	1.63
	ETA	Treatment	41.70	2.40	65.85	3.55
		Control	50.60	4.00	60.40	2.98
D	AA	Treatment	9.32	2.60	16.21	1.55
		Control	8.42	1.39	11.53	1.47
	ETA	Treatment	40.16	2.75	63.63	3.25
		Control	51.74	3.11	60.58	2.48

AA: *Academic Achievement*, **ATE:** *Attitudes Towards the Environment*



Graphic 1. Pre-test Scores and Post-test Scores of the Attitudes Towards the Environmental Problems and Academic Achievement Test from the Treatment Group and Control Group

Discussion, Conclusion and Suggestions

It is known that the environmental problems, one of the biggest threats to the World, have been increasing. An awareness and conscience for the environment must be developed on citizens in order to prevent those environmental problems this awareness and conscience is especially taught in the first years of the instructional process. Because it is known that the education, especially given to in the first years of the education process, are vital and influential. Consequently Erten (2004) emphasized that education in earlier school life about the environmental problems are more effective to reflect this awareness and conscience to behaviors in the next years of education. However results of several research studies indicated that most of the primary school students have conceptual misunderstanding (Arsal, 2007; Bahar & Aydın, 2002; Bal, 2004; Boyes & Staneisstreet, 1993; Darçın, Bozkurt, Hamalosmanoğlu, & Köse, 2006; Driver, Guesne, & Tiberghien, 1985; Groves & Pugh, 1999; Kılınç, Stanisstreet, & Boyes, 2008; Şahin et al., 2004; Treagust, 1988; Tüzün & Yanış, 2010) and possess negative attitudes towards the environment (Atasoy & Ertürk, 2008). The problem is how to remove conceptual misunderstanding and the negative attitudes towards the environment constitute remarkable scope of studying for educators. Because concepts influence quality and permanency of learnings as a center of cognitive constructs (Novak, 1997; Ülgen, 2001; YÖK/Dünya Bankası, 1997). Nonetheless environmental education, conducted in the schools, still fails to remove those conceptual misunderstandings and negative attitudes.

The present study sought to discover how instructional comics had an impact on cognitive learnings (achievement test) and affective learnings (attitude towards the environment) on the environmental problems based on reasons above. In the first-sub-problem question of "Is there significant difference between academic achievement test scores of the treatment group students and academic achievement test scores of grade control group students" was sought to answer. As a result of the findings, it was concluded that instructional materials, supported by instructional comics, significantly increased academic achievement scores and attitudes test of the environmental problems in favor of the experimental group students. There are a great number of research studies indicating that instructional materials in which visual is taken to the foreground emphasizing visual materials significantly increased academic achievement in different subjects in the literature (Altınışık & Orhan, 2002; Ayva, 2010; Beard & Rhodes, 2002; Cary, 2004; Ersoy & Türkkan, 2010; Gambrell & Jawitz, 1993;

İlhan, Yıldırım, & Sadi Yılmaz, 2016; Kan, 2006; Karakuş, Palaz, Kılcan, & Çepni, 2012; Oruç, 2006; Özcan, 2008; Özdemir, 2010; Purnell & Solman, 1991; Topçubaşı & Polat, 2014; Topkaya, 2016; Topkaya & Şimşek, 2016; Uğurel & Moralı, 2006; Yaman, 2010). It was thought that instructional comics, main theme of the present study, increased academic achievement by making cognitive schemas more concrete through its visual elements and enabling students to compare the persons' ideas and dialogs made by the characters in the comics. It was observed that the instructional comics allow issues to be dealt with more plainly and ideas to be explained more clearly, students to revise knowledge's and their misunderstandings. Furthermore it can be said that the instructional comics positively influenced academic achievement by enabling permanent and meaningful learnings. For instance, Topkaya (2014) conducted a research study to investigate the impact of instructional comics on "Each Individual is Precious Unit" and found out that instructional comics significantly made significant difference in favor of the experimental group students, and increased academic achievement in "Each Individual is precious" unit in the course of citizenship and democracy. Özdemir (2010) conducted a research to reveal impact of instructional comics in "Warmth and Heat Unit", and according to the findings gained, instructional comics have positive impact on learnings in 6th grade the "Heat and Warmth Unit". Sones (1944) sought impact of plain text and visual of comics on academic achievement comparatively, and at the end of the research concluded that visual materials are more superior in teaching than plain texts. Brocka (1979) found that comics have more advantages than those of literature texts in increasing academic success.

In the second sub-problem of the present study, question of "Is there significant difference between attitudes towards the environmental problems scores of experimental group and the attitudes towards the environmental problems and scores of the grade control group students?" was sought to answer. As result of the findings, it was observed that instructional comics made significant difference in favor of the experimental group students. There are few research studies investigating how instructional materials, in which priority is given to visually, influence the attitudes for different courses (Çelik, 2007; Çetin, 2012; Freeman & Freeman, 2000; Göncü, 2006; Hutchinson, 1949; Olson, 2008; Sones, 1944; Topkaya, 2014; Topkaya & Şimşek, 2015; Topkaya & Şimşek, 2016). It was observed that instructional comics stimulated wonder among students through its engrossing way of explanation and their imagery world and their humorous characteristics relaxed the students. It was also thought that visual elements, drawing characteristics positively influenced scientific discussion atmosphere in the classroom, made contribution to increasing student attention to the activities. It can be interpreted that the instructional comics can develop positive attitudes on the students. About this issue Topkaya (2014) conducted a research study about the impact of instructional comics on attitudes towards citizenship and democracy education course and found out that usage of instructional comics achieved to develop positive attitudes on the students towards citizenship and democracy education course.

As a result of the study, it was concluded that the instructional comics created significant difference in favor of the experimental group students. Based on the results of the study, following suggestions can be made:

The present study was implemented within four weeks. Applications with longer durations should be conducted to determine the impact of instructional comics on attitudes and academic achievement more precisely.

This study lasted for four weeks, which is short. In order to understand the impact of instructional comics on attitudes towards the environmental problems and academic achievement in depth and detail the studies with longer duration must be conducted.

The present study did not cover demographic variables which may have effect on attitudes and academic achievement. In future research studies, the impact of the instructional comics can be disclosed by taking demographic variables impact into consideration in more detailed way.

The instructional comics were designed through the Pixton web site. The Web-site can be used for different courses and contents and examined its impact on different courses and contents.

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