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The Effect of the 5E Instructional Model Enriched With Cooperative Learning and Animations on Seventh-Grade Students' Academic Achievement and Scientific Attitudes*

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Abstract

The aim of this research is to determine the effect of the different teaching methods, on seventh-grade students' academic achievement and scientific attitudes. The research was carried out using quasi-experimental methods. The research sample consisted of 84 seventh grade students studying in three different classes. One of these classes an animation group, the second class was a cooperative group, the third was a control group. The data collection tools used were the Science Achievement Test (SAT) and the Scientific Attitude Scale (SAS).When each group's SAT and SAS pre-test ANOVA scores were compared, no significant differences were found between them. SAT post-test results showed a significant difference in favour of the animation group. In addition, the findings of the study revealed that the cooperative group's mean post-test were not statistically significant. When SAS post-test scores of the animation and control groups were compared, there was a significant difference in favour of the animation group. When the SAS post-test scores of the cooperative and control groups were compared, there was a significant difference in favour of the cooperative group. When the SAS post-test scores of the cooperative and animation group were compared, there were no statistically significant differences in students' attitudes.

Keywords: 5E model, cooperative learning, animation, scientific attitude, academic achievement.

Introduction

Knowledge is constantly expanding in the information age and as a consequence modern societies are constantly changing. Intensive scientific studies have focused on finding new methods and techniques in education to improve learning and instruction (Çavaş & Huyugüzel-Çavaş, 2014). Turkey has in the past obtained relatively poor results in comparative international exams such as PISA, TIMMS and PIRLS in the field of mathematics and science. New approaches were introduced as a result of perceived

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failures in the curriculum and teaching approaches (Cengiz, 2014; Küçükyılmaz, 2014). Particular attention was given to changes in curricula and teaching methods for science courses. With this aim, views on science curricula were evaluated and international literature on science education was reviewed. Science curricula successfully implemented in developed countries were closely examined and incorporated into the new design, taking account of the conditions in different regions of Turkey (MEB, 2004). Taking into account educational research into how students learn science and the conditions which best promote science learning, it is evident that new understandings of the teaching-learning process and the learning environment must be embraced, and new teaching strategies developed (Cengiz, 2014). Science education research studies carried out in recent years emphasize that constructivist learning theory provides a useful and functional framework from which to attain the goals of science education and brings new practices to instruction (MEB, 2006). Constructivism is a learning theory which states essentially that a learner constructs knowledge and applies it (Karadağ & Korkmaz, 2007). The most effective model of constructivist learning theory is the 5E instructional model, which consists of five phases: Engage, explore, explain, elaborate, and evaluate. The 'engage' phase of the 5E model provides students with the opportunity to be aware of their own thoughts in relation to ideas on any concept. To achieve this, the teacher begins the lesson with an introduction which raises curiosity. In this phase, he or she raises questions about the phenomenon. What is important for students is to assert new ideas, but not to know the correct answers. In the 'explore' phase, students work individually or with a group. They carry out experiments, explore scientific knowledge via computer, video or in a library environment with the guidance of the teachers, or they generate solutions to problems. In the 'explain' phase of the model, students try to describe and explain the situation, phenomenon, or concept chosen under the guidance of the teacher. In this phase, the teacher encourages students to replace their incomplete or incorrect knowledge with correct scientific knowledge. In the 'elaborate' phase, students apply new learning to a new or similar situation and problem. Thanks to this phase, they learn new concepts which have not existed before. In the 'evaluate' phase of the model, the teacher observes students' behaviour and asks them questions as they solve problems. Moreover, the teacher encourages students to assess their own learning as they explore and apply new concepts and skills (Cengiz, 2014; Çepni, Akdeniz & Keser, 2000; Korkmaz & Karadağ, 2007; Turgut et al., 1997). Different studies revealed that the 5E instructional model had positive effects on students' academic achievement and also promoted students' meaningful learning (Ağgül-Yalçın & Bayrakçeken, 2010; Chen, 2008; Ceylan & Geban, 2009; Kanlı et al., 2007; Klavuz, 2005; Seyhan & Morgil, 2007).

Raghavan, Sartoris & Glaser (1998) state that some students need more time and greater variety of experience in the environment to learn meaningfully and to provide reasonable responses at higher levels (as cited in Şahin & Çepni, 2012). Different teaching techniques can be used to realize this. One of these is the enriched 5E model, which research studies revealed was a suitable teaching method as it can be used in conjunction with other teaching methods and techniques (Orgill & Thomas, 2007; Sahin, Calik & Cepni, 2009; Sahin & Çepni; 2012; Türk & Çalık, 2008; Ürey & Çalık, 2008).

When the literature was reviewed, it could be seen that the 5E model has been enriched in different ways in science education. There is the 5E instructional model enriched with conceptual change texts (Sahin et al., 2009 ; Şahin & Çepni, 2012; Türk & Çalık, 2008; Ürey & Çalık, 2008), the 5E instructional model enriched with concept cartoons (İnel et al., 2009; Kabapınar, 2005; Sahin & Çepni, 2012), the 5E instructional model enriched with Predict-Observe and Explain Technique (Lee, 2007; Monaghan & Clement, 1999; Şahin & Çepni, 2009; Tao, 1997; Tao & Gunstone, 1997; Tao & Gunstone, 1999; Taylor & Coll, 2002; Yin, Tomita & Shavelson, 2008; as cited in Şahin & Çepni, 2012) the 5E instructional model enriched with worksheets (Şahin et al., 2009; Şahin & Çepni, 2009; Şahin & Çepni, 2012; Türk & Çalık, 2008; Ürey & Çalık, 2008; Yin et al., 2008,). These enriched 5E models demonstrated that students' academic achievement was increased, misconceptions in understanding were identified and eliminated, and also the students displayed positive attitudes towards the science course (Şahin & Çepni, 2012). However, when the literature was reviewed, no studies were found which featured the 5E model enriched with cooperative learning and animations. Our intention with this study was to eliminate these weaknesses.

Moreover, the research studies demonstrated that each student had different learning styles and they learned differently (Çalik, Okur & Taylor, 2010; Lamanauskas et al., 2010; Raghavan et al., 1998; She, 2005a; Tytler, 1998b; Uğur, Akkoyunlu & Kurbanoğlu, 2009; as cited in Şahin & Çepni, 2012). In this study, the 5E instructional model enriched with different teaching methods and techniques was used. Visuals must be considered important when designing an enriched 5E model because the studies revealed that concepts were more successfully retained in learning environments where real life visuals were provided (Şahin & Çepni; 2012). In addition, using information and communication technologies in student- centred education promotes students' comprehension skills (Mayer, 2003; Pekdağ, 2010). Animations can be used to actualize them. Because animations are dynamic and have the facility to create the illusion of abstract phenomena, they have a positive effect on learning (Lewarter, 2003; Lowe, 2003). Using animations enhances student learning (Dasdemir & Doymuş, 2012). It has been found that visual materials in a learning environment are important and e beneficial for teaching and learning and that visual materials provide opportunities for students to talk about the subject, increasing their self-confidence (Efe et al., 2011). In addition to using visuals, students are actively engaged in the lesson when using the cooperative learning method. The student takes responsibility, performs his duties, learns, teaches, discusses and asks questions. In this way, the student revises the information more than once (Efe et al., 2011). Through cooperative learning, students' level of remembering science subjects increases (Efe et al., 2011; Hevedanlı et al., 2005,). Moreover, the cooperative learning method enables students to become active in the learning environment and helps to raise achievement level in the class (Güngör & Özkan; 2012)

This study involved the implemention of the 5E instructional model enriched with different teaching methods and techniques. The reason why different teaching methods and techniques were used together was to address the issue of individual diversity (Şahin & Çepni; 2012), because every student has a different learning style and they learned differently (Çalik et al., 2010; Lamanauskas et al., 2010; Raghavan et al., 1998; She, 2005a; Tytler, 1998b; Uğur et al., 2009; as cited in Şahin & Çepni, 2012). The aim of this study is to determine the effect of the 5E model, enriched with other different teaching methods and techniques, on seventh grade secondary school students' academic achievement and scientific attitudes in a chosen course unit. For that purpose, answers will be sought to the following questions.

1. Does the 5E instructional model enriched with animations have an effect on students' academic achievement?
2. Does the 5E instructional model enriched with animations have an effect on students' scientific attitudes?
3. Does the 5E instructional model enriched with cooperative learning have an effect on students' academic achievement?
4. Does the 5E instructional model enriched with cooperative learning have an effect on students' scientific attitudes?

5. Which one is more effective in teaching the seventh grade course unit on light? Is it the 5E instructional model enriched with animations or the 5E instructional model enriched with cooperative learning?
6. Which one is more effective in teaching the seventh grade students scientific attitudes?

Is it the 5E instructional model enriched with animations or the 5E instructional model enriched with cooperative learning?

Method

In examining the effect of teaching materials and methods in schools and classrooms, a quasi-experimental research design is preferred, which involves selecting students rather than random allocation (Cohen & Manion, 1994; Çepni, 2007). This design is advantageous and useful in circumstances where it is not possible to randomize individuals or groups (Karasar, 2005; McMillan & Schumacher, 2006). For this reason, the study was carried out using a quasi-experimental method and according to the pre-test post-test design with randomly chosen groups.

Sampling

The research sample consisted of 84 seventh grade students studying in three different classes of a secondary school in Erzurum. One of these classes was chosen as an animation group, which was taught with the 5E model enriched with animations (n= 29). The second group was a cooperative group taught with the 5E instructional method enriched with cooperative learning (n= 27). The third was a control group (n= 28), where the 5E instructional method was implemented. All three groups were taught with the same science teacher. The teacher had 12 years of teaching experience. The science teacher was a graduate of the science teaching department of the Education Faculty. The teacher had experience of teaching with the 5E instructional model. Moreover, he had completed his Ph.D. and conducted studies which involved animations and cooperative learning techniques.

Data Collection Tools

The data collection tools used were the Science Achievement Test (SAT) and Scientific Attitude Scale (SAS). The SAT was composed of questions designed to take into consideration the learning outcomes of the units included in the teacher's books, which were produced by different publishing houses. The opinions and suggestions of an assistant professor from the science education field and two science teachers were sought to verify the reliability and validity of the questions. The resulting SAT consisted of 25 questions. The reliability coefficient of these questions was administered to 64 sixth grade students who were familiar with the background information required for this unit. Using Cronbach Alpha, the reliability coefficient was determined to be 0, 78. The Scientific Attitude Scale developed by Moore and Foy (1997), and adapted to Turkish by Demirbaş (2005), was used in the study. The scale consisted of 40 items. The Cronbach Alpha reliability coefficient was found to be 0.76 and the Spearman-Brown split-half test correlation was 0.84 (Afacan, 2008). A typical 5-level Likert Scale was used and the following quantitative values were given: Strongly disagree (1)", "Disagree (2)", "Neither agree nor disagree (3)", "Agree (4)" and "Strongly agree (5)".

The scoring for the negative items was reversed. Both the Science Achievement Test (SAT) and the Scientific Attitude Scale (SAS) were administered to three groups as pre-test and post- test. As a result of the Scientific Attitude Scale, the minimum score a student can get is 40 and the maximum is 200.

Implementation

This study was carried out within the context of the course unit on light, which is part of the secondary school seventh grade curriculum. The unit included the following sub-topics: absorption of light, 'is white light really white?' refraction of light, and lenses. Before starting the unit, the science achievement test and the scientific attitude scale were administered to all students as pre-test. Then, the light unit lectures were delivered over a period of 4 weeks (16 hours in total), in line with the science curriculum. The secondary school science curriculum is based on the 5E instructional model. In conjunction with the teaching model adopted for the curriculum, a student's book, work book and teacher's book were designed and developed. While the 5E instructional model on its own was administered to the control group, the animation group was taught with the 5E instructional model enriched with animations and the cooperative group received the 5E instructional model enriched with the cooperative learning model. The 5E instructional model applied to the control group was implemented according to the teacher's book. In the engage phase of this model, questions were asked to generate students' interest and to access their prior knowledge. In the explore phase, activities were conducted to help students discover key concepts. In the explain phase, the teacher provided scientific explanations of the subject. In the extend/elaborate phase, students applied new learning to new situations. In the evaluate phase of the model, students were asked questions about their learning and the subject was evaluated. In addition to the 5E instructional model administered to the control group, the animation group watched animations related to the subject. The teacher made necessary explanations and asked questions during the animation screening. In the case of wrong responses to the questions, the animations were repeated until the students came up with the correct answer. In addition to the 5E instructional model administered to the control group, the cooperative group was divided into groups of four and they were required to ask each other questions about the subject. In this way the subject matter was reinforced. As soon as the implementation was completed, a science achievement test and a scientific attitude scale were administered to all students as post-test. Some examples of the animations shown to the animation group are given below:

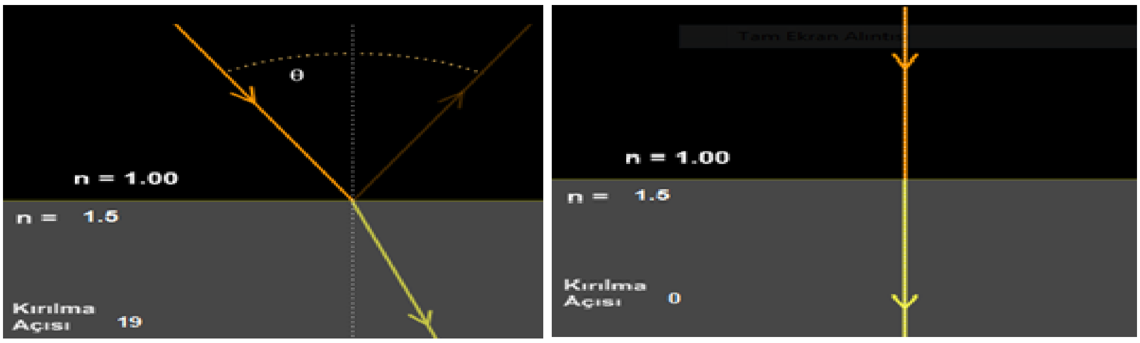

Figure 1. *The light gets through from less dense to denser environment*

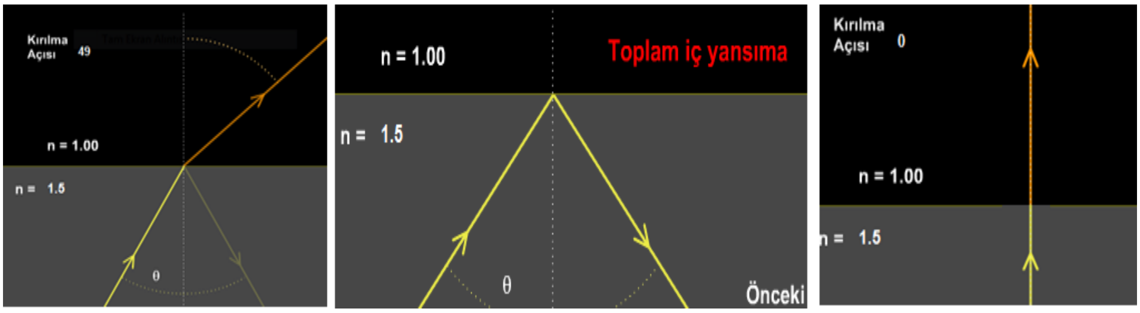

Figure 2. *The light gets through from denser to less dense environment*

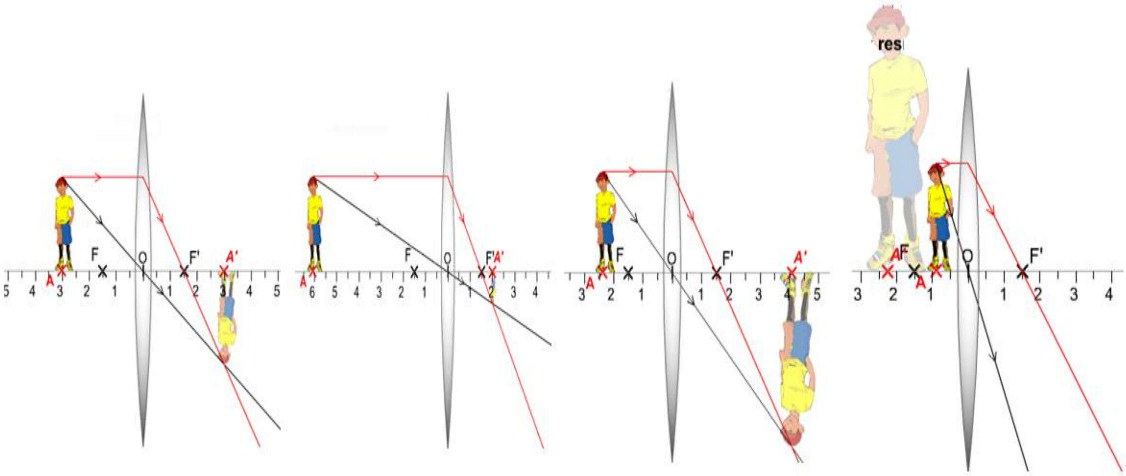

Figure 3. *The thin edge of the lens image*

Data Analysis

The data obtained from the Science Achievement Test (SAT) and Scientific Attitude Scale (SAS) were analysed using the SPSS 16.0 package program. A one-way analysis of variance (ANOVA), one of the parametric tests, was used for the scores obtained from the SAT and SAS pre-test post-test of the students participating in the research study. The reasons why a parametric test was used for the analysis of the data are that the data was normally distributed. It was derived from an equal-interval scale and the variances were equal. The reason for the application of the one-way analysis of variance (ANOVA) was to compare the means of more than two independent groups.

Findings

The findings obtained from the responses of the students in the experimental and control groups in the Science Achievement Test (SAT) and Scientific Attitude Scale (SAS) pre-test and post-test are presented in the following tables:

Table 1. *Descriptive statistical results of the students' (SAT) pre-test post-test total scores*

Groups	Measurement	*N*	*M*	*sd*	*se*
Animation	Pre-test	29	38.00	11.827	2.028
	Post-test		72.67	11.171	2.039
Cooperative	Pre-test	27	44.12	14.455	2.479
	Post-test		59.19	12.579	2.421
Control	Pre-test	28	42.67	12.794	2.336
	Post-test		54.80	12.872	2.350

Maximum score= 100

When the descriptive statistics in Table 1 were examined, the mean pre-test scores for the Animation, Cooperative, and Control groups were ($M_{(\text{Animation})}$= 38.00, $M_{(\text{Cooperative})}$= 44.12 and $M_{(\text{Control})}$= 42.67), respectively. It was determined that the mean post-test scores were ($M_{(\text{Animation})}$= 72.67, $M_{(\text{cooperative})}$= 59.19 and $M_{(\text{Control})}$= 54.80, respectively. A difference was revealed between the groups' pre-test and pot-test scores. A one-way analysis of variance (ANOVA) was applied to determine whether this difference was significant or not (see Table2).

Table 2. *A One-Way Analysis of variance (ANOVA) Results for the SAT Question Scores Obtained from the Pre-Test and Post –Test*

		Sum of Squares	*SD*	Mean squares	*F*	*p*
Pre-test	Between groups	799.886	2	399.943	2.353	0.101
	Within groups	13768.623	81	169.983		
	Total	14568.509	83			
Post-test	Between groups	5945.114	2	2972.557	18.962	0.00
	Within groups	12697.641	81	156.761		
	Total	18642.755	83			

When the One-way Analysis of variance (ANOVA) Results for the SAT Scores from the pre-test were viewed, it was revealed that there was no significant difference between the animation, control and cooperative groups ($F_{(2, 81)=}$ 2.353, p> 0.05). In this context, it can be stated that the groups had similar prior knowledge. However, when the one-way Analysis of variance (ANOVA) Results for the post-test results were viewed, it was found that there was a statistically significant difference between the groups ($F_{(2, 81)}$= 18.962, p<0.05, r= 0.56). A Games-Howell post hoc test was administered to determine which specific groups differed. When this test was examined, it was viewed that there was a statistically significant difference between the animation group and the cooperative group p=.0000; Differences between the means =13.481; se= 3.165; p<0.05) and animation group and control group (p= .0000; Differences between the means= 18.838; se= 3.064; p<0.05), but there was no statistically significant difference between the cooperative group and the control group (p=.250; Differences between the means= 5.357; se= 3.330; p>0.05). Considering these results, it can be stated that, with regard to the teaching of the seventh grade course unit on light, the 5E instructional model enriched with animations was more effective than the cooperative learning model and the 5E instructional model. Moreover, it is viewed that it has a medium-sized effect (r=0.56).

Table 3. *Descriptive statistical results of the students' (SAS) pre-test-post-test total scores*

Groups	Measurement	*N*	*M*	*sd*	*se*
Animation	Pre-test	29	140.00	13.625	2.530
	Post-test		142.03	13.291	2.314
Cooperative	Pre-test	27	139.81	12.510	2.247
	Post-test		140.56	12.804	2.263
Control	Pre-test	28	133.52	9.553	1.838
	Post-test		132.75	9.348	1.767

Maximum score =200

When the descriptive SAS statistics in Table 3 were examined, the mean pre-test scores for Animation, Cooperative, and Control groups were ($M_{(Animation)}$= 140.00, $M_{(Cooperative)}$= 139.81, $M_{(Control)}$= 133.52), respectively. It was determined that their mean post-test scores were ($M_{(Animation)}$= 142.03, $M_{(cooperative)}$= 140,59, $M_{(Control)}$= 132.75), respectively.

A difference was identified between the groups' mean scores. A one-way Analysis of variance (ANOVA) was applied in order to determine whether this difference was statistically significant or not (see Table 4)

Table 4. *One-Way ANOVA Results for the SAS Question Scores Obtained from the Pre-Test and Post –Test*

		Sum of Squares	*df*	Mean squares	*F*	*p*
Pre-test	Between groups	758.858	2	379.429	2.598	0.08
	Within groups	11827.539	81	146.019		
	Total	12586.397	83			
Post-test	Between groups	1468.184	2	734.092	5.046	0.008
	Within groups	11784.690	81	145.490		
	Total	13252.874	83			

Maximum score =200

Considering the SAS pre-test results given in Table 2, it was found that there was no statistically significant difference between the animation, cooperative, and control groups. ($F_{(2, 81)}$= 2.598, p= 0.08, p>0.05). In this context, it can be stated that the groups' scientific attitude skills are similar. However, it was found that there was a statistically significant difference between the groups with regard to their SAS post-test scores ($F_{(2, 81)}$= 5.046; *p*= 0.008; *p*<0.05, *r*= 0.35) A Games-Howell post- hoc test was administered to determine which specific groups differed. When this test was examined, it was observed that there was a statistically significant difference between the animation group and the control group and in favour of the former (*p*= 0.006; *p*<0.05). Also there was a statistically significant difference between the cooperative group and control group, in favour of the cooperative group (*p*=0.023; *p*<0.05). However, there was no statistically significant difference between the cooperative group and the animation group (*p*= 0.893; *p*>0.05). According to these results, it can be stated that the 5E instructional model enriched with animations and cooperative learning made a contribution to students' scientific attitudes at medium level.

Results and Discussion

A one-way analysis of variance (ANOVA), one of the parametric tests, was administered as the data was normally distributed. It was derived from an equal-interval scale and the variances were equal. When each of the three groups' SAT pre-test ANOVA scores were compared, it was found that there were no significant differences in the groups' preparedness before the implementation (see Table1). Because the students in these three groups are so close in terms of their levels of prior knowledge, it provides an excellent opportunity to compare the methods implemented (Şahin & Çepni, 2012; Özsevgeç, 2007). Moreover, this result that it can be concluded that the students who study at the same school with the same curriculum have the same level of knowledge. Also, when the pre-test scores of the students in these three groups are examined, it is revealed that they have considerable knowledge of the subject matter in the light unit. It may be concluded that, because of the spiral structure of the science curriculum, the students have prior knowledge of the unit from their previous grades. They come in to the formal learning environment with this background knowledge and also with the right or wrong information they have learnt from their environment (Dekkers & Thijs, 1998; Erginer, 2006; Novak, 1988; Seiger-Ehrenberg, 1981; Şahin & Çepni, 2012).

When the three groups' science achievement test post-test results were evaluated (Table2), a significant difference in favour of the animation group was found iwhen compared with the cooperative group. It can be concluded that the 5E model enriched with animations was more effective in understanding the course unit than the cooperative learning model. This result is not compatible with the studies of Doymuş et al. (2010) and Karaçöp et al. (2009). Doymuş et al. (2010) examined the effect of computer animations and the cooperative learning model on students' learning of electrochemistry topics in their studies. The findings of the study revealed that computer animations and the cooperative learning model had similar effects on students' understanding of the subject matter. Karaçöp et al (2009), in their study, taught experimental groups with computer animations and the jigsaw technique, and control groups with the traditional teaching method, when teaching the electrochemistry unit. The findings revealed that a computer-assisted teaching method implemented with computer animations, combined with the jigsaw technique used for teaching the course, was more effective than the traditional lecture method. There were no significant differences between the animation technique and the jigsaw technique. This situation can be explained by the fact that the effectiveness of every teaching method can differ between classes and between subjects.

Moreover, it was concluded at the end of the study that the 5E model enriched with animations was more effective in understanding the seventh grade light unit than the 5E instructional model.

A possible explanation for this situation is that the computer animations may have created a richer learning environment for students through the use of visual, aural, and interactive support (Özmen & Kolomuç, 2004). This result was compatible with the results of Aksoy, (2013), Aslan-Efe (2015), Daşdemir and Doymuş (2012), Karaçöp and others (2009), Keleş and others (2010), Lowe (2003), Mayer and Moreno (2002), McClean and others (2005), Park and Gittelman (1992), Rieber (1991), Rotbain and others (2008), Schnotz and Rasch (2005), Sülün and İskender (2007) and Tezcan and Yılmaz (2003).

Aslan-Efe (2015) determined that using animations in environmental education had positive effects on university students' academic achievement. Aksoy (2013) found that using animations with the sixth grade 'Solar System and Beyond' unit in primary school positively affected students' academic achievement. Moreover, Daşdemir (2013) revealed that using animations with the sixth grade 'Structure of Matter' unit in primary school made a contribution to students' academic achievement, retention of knowledge, and development of science process skills. Also, the findings revealed that the cooperative group's mean post-test scores were higher than those of the control group between the cooperative learning model and the control group (see Table 1) but they were not statistically significant. This demonstrates again that one method might not be equally effective with all subjects or all classes. The result obtained from this study is compatible with the studies of Atıcı and Gürol (2002), Bilgin and Akbayır (2002), Tatar and Oktay (2007), Topsakal-Umdu (2010), Varank and Kuzucuoğlu (2007). In their study; Topsakal-Umdu (2010) examined and compared the effect of teaching with cooperative learning and the traditional teaching method on 8th grade primary school students' achievements and attitudes in Science and Technology course. It was found that the cooperative learning method had positive effects on attitudes towards the Science and Technology course and although the post-test scores of the students in the experimental group were higher than the students' post-test scores in the control group, this difference was not statistically significant. Varank and Kuzucuoğlu (2007) revealed that the cooperative learning method did not increase student because the teacher did not provide good guidance for the students and this method selected students randomly when forming the student groups. Tatar and Oktay (2007) observed that students saw each other as rivals and this situation had a negative effect on achievement. Moreover, a one-way analysis of variance (ANOVA), a parametric test, was used as the data obtained from the scientific attitude scale (SAS) was normally distributed. It was derived from an equal-interval scale and the variances were equal. When the three groups' SAS pre-test ANOVA results were compared, it was found that there was no significant difference between the groups' scientific attitude pre-test scores before the implementation (see Table 4). It can be concluded that because the students in the three groups had the same scientific attitudes, their interest in science courses were similar. When the SAS post-test results were considered, it was revealed that there was a statistically significant difference between the groups (see Table 4). According to the results of the Games-Howell post- hoc test administered to determine which specific groups differed, a significant difference in favour of the animation group ($p= 0.006$; $p<0.05$) was determined when compared with the control group. From this result, it can be stated that because using the 5E instructional model supported with animations in education was effective in teaching students scientific facts, concepts, phenomenon, and principles (Schank & Kozma, 2002), it makes a positive contribution to students' success. The results obtained from this research study are compatible with the studies conducted by Genç (2013), Bülbül (2010) and Baram and others (2011). Genç (2013) examined the effect of using computer animations on students'attitudes to their course when they were incorporated into the "cells" and "tissues" topics of their biology course. The findings revealed that students' mean attitude scores towards the biology course increased significantly. Similarly, Bülbül (2010) stated that a teaching method based on a computer-assisted 7E learning cycle was effective in developing students' attitudes towards the biology course. Moreover, Bayram and others (2011) in their research studies concluded that animations used professionally, in the right place at the right time, had a positive effect on students' perspectives, interests, and attitudes towards chemistry and on achievement in the chemistry course.

In addition, when the SAS post-test scores of the cooperative group and control group were compared (p=0.023; p<0.05), it was determined that there was a significant difference in favour of the cooperative group. This situation can be explained as follows: Cooperative learning contributed to students' developing a positive attitude towards their science course (Bilgin & Karaduman, 2005). The finding from this study is consistent with those obtained from studies by many researchers (Aktaş, 2013; Altun, 2015; Ateş, 2004; Ayna et al., 2008; Azar, 2008; Bilgin & Geban, 2004; Çinici, 2010; Demiral, 2007; Doymuş et al., 2004; Ghaith & Bouzeineddine, 2003; Hevedanlı & Akbayın, 2006; Kaptan & Korkmaz, 2000; Koçakoğlu & Solak, 2006; Köseoğlu, 2010; Şimşek, 2007).

Bilgin & Geban (2004) investigated the effect of the cooperative learning model on pre-service teachers' attitudes towards science courses, through its application to the Teaching Science I course. The study found that the cooperative learning model had a positive effect on students' attitudes towards science. Köseoğlu (2010) revealed that the cooperative learning method had positive effects on students' academic achievements and they exhibited positive attitudes towards a biology course.

Also, when the SAS post-test scores of the cooperative group and animation group were compared, it was observed that there were no statistically significant differences in students' attitudes. This situation can be explained by the fact that a change may not have occurred between students' attitudes that were taught with two active teaching methods.

In future studies, the effectiveness of the enriched 5E model, the cooperative learning model and the 5E instructional model can be further examined in different classes and with different course units. Moreover, it would be beneficial if teachers and students' views on these teaching methods could be further explored.

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