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The Effects of Animation Technique on Teaching of Acids and Bases Topics

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ABSTRACT

This study has been carried out in order to determine the effect of computer animations in teaching acid and base topics in science and technology courses on the academic success of the primary school students and the opinions of students related to teaching with the animations. This research was conducted by the participation of 55 students from two different classes of 8th grade at a primary school in the city centre of Erzurum during the first semester of the 2006-2007 academic years. One of the classes, in which animation technique was used, was determined as the "animation group" and, the other class, in which the traditional teacher-centered instruction was dominant, as the "control group". Data in this research were collected by Science and Technology Achievement Test (STAT) and Student Opinion Scale (SOS). The data gathered through by STAT were compared by independent sample t test. The results of SOS were presented in table as percentages and arithmetic means. The finding indicates that students taught by computer supported animations were better than those in traditional teaching group. In addition, data gathered through student's opinion scale suggest that students liked computer animations.

Keywords: Science and Technology, Animation Technique, Acids and Bases

INTRODUCTION

Science helps us to know better the world and the universe we live in, to from a stronger and healthy social atmosphere, and to understand and evaluate the circumstances taking place around us. Both learning and teaching those skills which are related to science are of utmost importance. Teaching of science course is fulfilled within the courses of social science, science and technology. These courses help the children development the interest of searching the environment (Kaptan, 1999). Science course, that is taught at the fourth grade of the primary school include the subjects of physics, chemistry and biology. However, sciences as physics, chemistry and biology are taught as separate courses in high schools and in the schools which are equivalent to high schools. The most important common feature of these courses is those depends on concrete objects and are experimental (Akgün, 1996). Chemistry course, as in other science courses, contains some hardships

related to abstract situation and the process of turning those abstract situations into concrete. Three levels are preferred to understand the subject better in chemistry. These are macroscopic, microscopic and symbolic levels (Johnstone, 1993; Gabel, 1998). Chemical events in the macroscopic level are known as observable process (for instance; the burning of a candle). Chemical events in the microscopic level may be explained by the movements of molecules and atoms. In the symbolic level they are explained by numbers, formulae, equations and structures. Experimental studies have shown that students have difficulty in understanding chemistry in microscopic level when compared to macroscopic and symbolic levels but they could better understand in micro level with the use of audio-visual materials (Ben-Zvi, Eylon & Silberstein, 1986). Due to this specific reason, various teaching materials and methods should be utilized in order to learn the subjects effectively and put those into practice. High technology increases the alternatives in the material used for the education processes in educational institutes. Effective teaching technologies will, of course, make better the teaching process by increasing the activities that address more sense organs of the students. The assist of computer is necessary for the students to learn complicated chemistry subjects and to revive the solutions in their minds easily and correctly (Tezcan & Yılmaz, 2003).

Animation is a Latin word that means to revive. Animation is an alive, stripped and detailed form of computer. Because of their dynamic characteristics, animations indicate the change in figures or colors, emergence and extinction of some situations in realization process of the events. These changes may be either graphic, picture or caricature (Foley, Van-Dam & Feiner,1990; Laybourne,1998). Computer animations work as the rapid change of the picture on the computer screen. Three features of the animations may be mentioned. These may be listed as picture, indication of certain movements and simulation. Decoration, taking attention, providing motivation, having over knowledge and providing the classification of complex information and events all are listed as some of the probable roles of animations. Besides, taking the attention of the students on the subject is an important function of the animations. Animations related to the subject to be taught should be suitable for the content of the subject. Otherwise animations may spoil attention (Vermaat, Kramers-Pals & Schank, 2004). Movement is the one of the most important features of the animations. Since the chemical events are dynamic, invisible and hard to revive in the mind molecular level, animations can be powerful tools in the education of science-technology and chemistry (Burke, Greenbowe & Windschitl, 1998).

Animations are widely used in physics (dynamics, mechanics), engineering (working principle of the all-wheel drive vehicles, photon and absorbance) astronomy (planets, motions of the stars), molecular biology (genetic structure of human-being), various branches of computer sciences (types of algorithm) and especially in natural sciences (botanic, zoology) (Najjar, 1995). Animations serve different roles in education. Some of these roles are taking attention, increasing motivation, giving extra information, understanding some complex information and incidents (Weiss, Knowlton & Morrison, 2002). Animations should overlap with the content of the text to be explained in order to reach the goal of the education (Large, 1996). Scientist produces various course materials and models with the collaboration of their colleagues in order to explain scientific events. But limitation in the production of materials and models may have negative effect on the formation of necessary spiritual processes of the students (Kozma & Russel, 1997; Seel, 2003). They use various projects to understand it better. If the students can form a deep relationship between the molecular world and realities of daily life, they can solve science problems (physics, chemistry and biology) easily (Hill & Petrucci, 1999). Animations should be put into action at this point (Williamson & Abraham, 1995). Models that are used in chemistry are teaching materials used to visualize abstract concepts. Those models

are either two dimensional, three dimensional or still pictures and are used to transfer information. Computer animations are quite useful in order to teach chemical concepts or develop the understanding of conceptual meanings. Two dimensional computer animation models indicate the motion features of the chemical events. Three dimensional animation models are used for teaching extension relationship. Animations are known to be effective means to teach concept containing motion at molecular levels (Theall, 2003). One of the subjects that the students of chemistry education have difficulty is that of acid and bases. Researches carried out on this issue indicate that students have various misunderstanding on the concept of acid and base and they have these misunderstanding even after the learning process (Özmen & Demircioğlu, 2003). It has been put forward that students have difficultly in conceptual understanding in the process of teaching acid and base in primary school (Cros, Amouroux, Chastrette, Fayol, Leber, & Maurin, 1986; Ross & Munby, 1991; Ebenezer, 2001; Chiu, 2005; Drechsler & Schmidt, 2005). There arises the problem of how effective the animation technique will be in eliminating the inadequacies in conceptual understanding of the students.

This study has been carried out in order to determine the effect with computer animations in teaching acid and base in science and technology course on the academic success of the primary school students and the opinions of students related to teaching with the animations. The followings are the questions of which the answers are sought:

1) Does education with computer animations indicate a meaningful increase in academic successes of primary school students compared to traditional teaching method?

2) What are the opinions of the primary school students on the teaching with computer animations in studying science and technology courses?

METHODOLOGY

In analyzing the effects of teaching materials or teaching methods in different schools and classrooms, it is more convenient to use the quasi-experimental research design. In this type of research design, classrooms are not organized for a certain goal but taken into the area of research as they are in their own conditions. This method is useful and practical when the sample cannot be chosen equally (McMillan & Schumacher, 2006). Therefore, the research was conducted in a quasi-experimental structure and non-equal groups according to pre-test and post-test design.

a-Sample: This research was conducted by the participation of 55 students from two different classes of 8^{th} grade at a primary school in the city centre of Erzurum during the first semester of the 2006-2007 academic year.

One of the classes, in which animation technique was used, was determined as the "animation group" (n=26); and, the other class, in which the traditional teacher-centered instruction was dominant, was accepted as the "control group" (n=29). In the animation and control groups, the instruction was performed following the course materials prepared by the researcher from the source books, and with the same content in the classrooms having similar physical facilities and environmental conditions in two different teaching methods. By this way, it was aimed to leave the teaching method as the mere independent variable.

b-Data Collection Instruments : In this study, the dependent variables "academic achievement" and "students' opinions of instruction (animation technique)" were measured. Teaching methods (teaching through the use of computer animations techniques and traditional instruction) were the independent variables of the research.

Science and Technology Achievement Test (STAT) was designed by the researcher to determine the academic achievement levels of the students attending the Science and Technology courses in the topics of acids and bases. This test consisted of 16 multiple-

choice questions at the knowledge and comprehension levels aiming to measure all attainments from the given topics. In the same test, different questions measuring the same attainment were also included. STAT was conducted to the students who had seen the relevant unit before to determine its reliability; and, the reliability co-efficiency (Cronbach Alpha) was found to be 0.77. For the validity analysis, an evaluation form including positive and negative opinions in relation to the capacity of the test to measure the attainments from acids and bases unit was given to an expert group of three staff from the Chemistry department of the Education Faculty and two Science and Technology teachers. Considering the evaluation forms of the experts, the decision related to the test validity was made by the consensus percentage. The experts agreed upon, by a 90 percentage, that all test items could measure the attainments related to the unit.

Student Opinion Scale (SOS) used by Doymuş et al., (2004), aiming to identify the opinions of the students in relation to cooperative learning method was adapted to teaching through animation technique to determine students' opinions of the instruction performed utilizing computer animations.

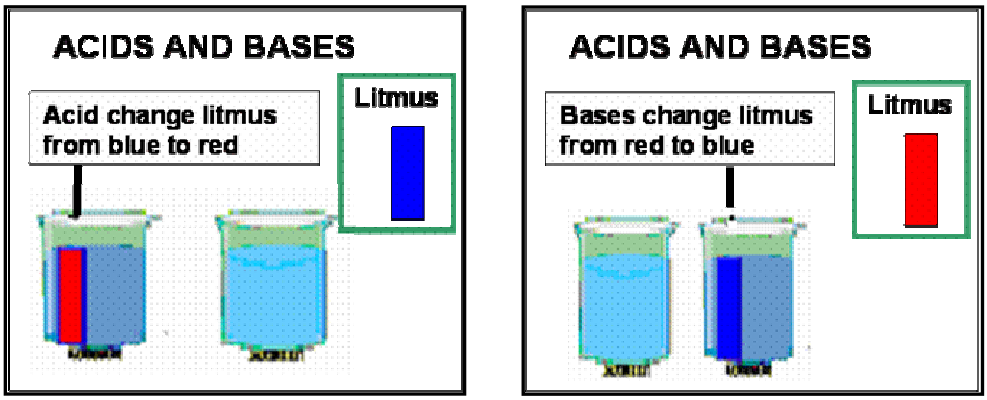
c-Procedure: Teaching of the acids and bases unit was realized by using computer animations, whose effects were researched in the study, and traditional teaching methods. In animation and control groups, the teaching materials prepared by the researcher from different sources were followed. In addition, the research was conducted in two different classrooms with the same physical facilities and environmental conditions in three-week period (three hours a week). By the aim to measure students' background knowledge related to acids and bases unit, STAT, as a pre-test, was given to the both groups.

In the control group, the traditional teaching method was used. Teaching of acids and bases in this method was performed by the researcher following the consideration that, with a good presentation, this method can be successful as well. Accordingly, the lessons were conducted having prepared an effective introduction, a presentation plan, related examples, the questions to be asked, and the materials to be used. As for the course materials, the sources given to the students before the lessons were used. The subject topics were written on the board and students' information about them were questioned; by this way, it was tried to attract their attention to the lesson. During the presentation, some questions were directed to the students; and, according to the answers taken the teacher continued to teach or make some repetitions. In addition, some questions were given to the students to be answered at home; and it was told to them to prepare for the next lesson.

In the animation group, topics of the unit were taught by using animation techniques. The animations used in the study were designed by the support of Ataturk University Kazım Karabekir Education Faculty Computer and Instructional Technologies Teaching Department. The animations used were divided into four groups: the use of litmus paper which is an indicator utilized in discovering whether a substance is an acid or a base (Figure 1a and 1b), the solutions of acids and bases in water (Figure 2a and 2b), the daily indicators of acids and bases (Figure 3a and 3b), and the conductivity of acids and bases in water (Figure 4a and 4b). In the animation group, the researcher spent the first five minutes of the lesson asking questions to the class, in order to determine the students' previous knowledge on the subject. Later, the subject was taught through the animation technique. Animations were presented by the help of a projection machine both visually and in motion in the teaching of related topics and their sub-topics, for two-minute periods (Williamson, 1992; Burke, Greenbowe & Windschitl, 1998; Tezcan & Yılmaz, 2003). The animations were shown by projecting them on a white board, using a projection device compatible with computers. After the presentation of the animations, questions related to the subject were asked for 15 minutes. Parts of the subjects not fully understood were determined according to the answers and these parts were covered again using the animation

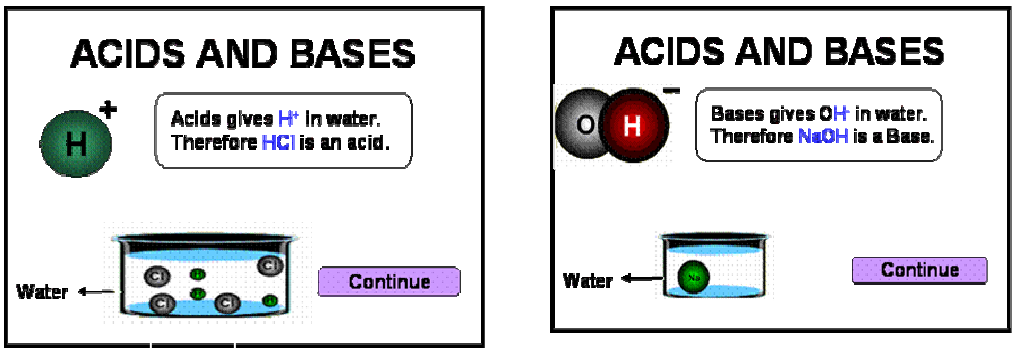
technique. For each step, students were engaged with class discussion and animation sequences.

After the instruction of the units, the STAT was given to both animation and control groups as a post-test. SOS was given to the animation group as the post-test apart from the control group. Furthermore, to determine the effect of this technique on the permanence of knowledge, six months after the application of the last test, STAT was conducted to students again as a permanence test.



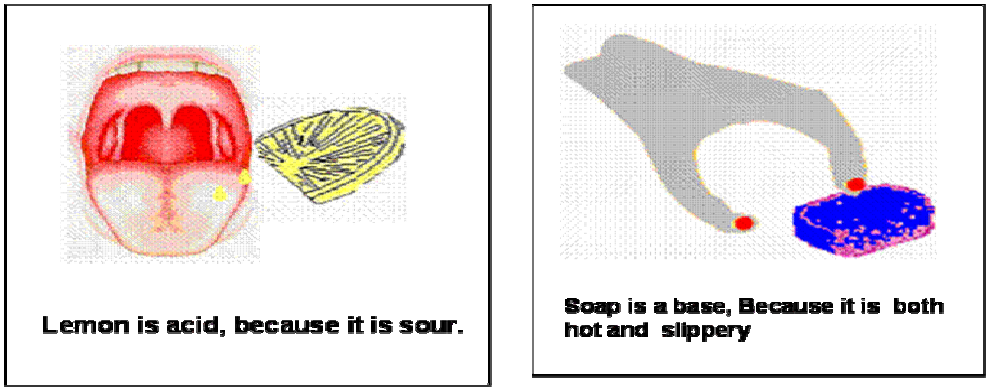
(a) (b)

Figure 1. *Animations Related to the Litmus Paper as an Indicator between Acids and Bases*



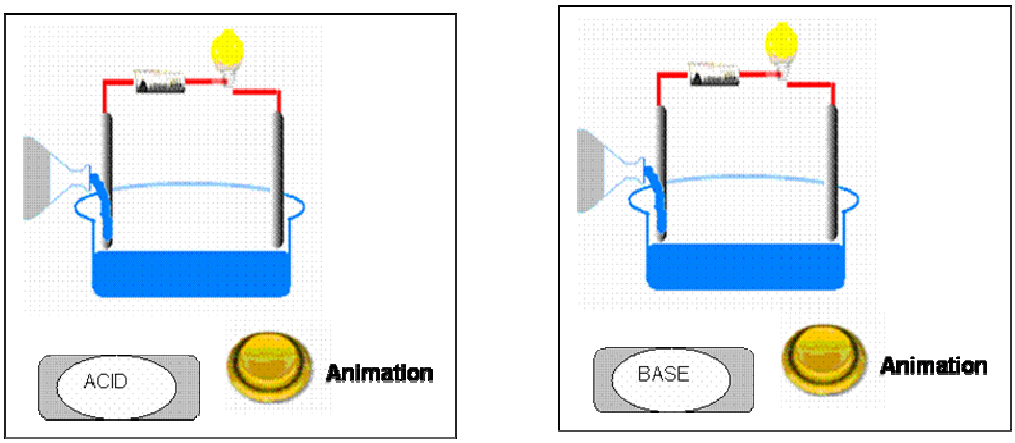
(a) (b)

Figure 2. *Animations Related to the Solutions of Acids and Bases in Water*



(a) (b)

Figure 3. *The Indicators of Acids and Bases in Our Daily Lives*



(a) (b)

Figure 4. *Animations Related to the Conductivity of Acids and Bases in Water*

FINDINGS AND DISCUSSION

The analysis results of *t* test of the data obtained from the STAT, which was applied as a pre-test, post-test and permanence test to both animation and control groups were given in Table 1. When looked at the data in the Table 1, it was seen that there were statistically no differences between the mean scores of animation and control groups at the significance level of 0.05 (t(53)=1.122; p=0.267). These results are the indicators of that there is no superiority or inferiority of the students to each other in terms of academic achievement in the same school applying the same teaching methods.

On the other hand, when looking at STAT post-test analysis results, it could be seen that there are significant differences (t(53)=2.819; p=0.007) between the mean scores of animation and control groups (X(animation)= 69.42; X (control)=55.86) at the significance level of 0.05 (Table 1). According to this result, it is possible to assume that animation technique has significant effect on academic achievement in learning. This finding is consistent with the literature (Tezcan &Yılmaz, 2003; Akçay, Aydoğdu, Yıldırım & Şensoy, 2005). Furthermore, the fact that the use of this technique has positive influence on achievement was supported by the data obtained from the SOS as well (Table 2 and Table 3).

Table 1. *Independent t Test Analysis Results of Pre-test, Post-test and Permanence Test of STAT.*

Tests	Groups	n	Mean[a]	*SS*	*t*	p
Pre-test	Animation	26	26. 54	10. 75	1. 22	0.267
	Control	29	29. 48	8.70		
Post-test	Animation	26	69.42	20.23	2.819	0.007
	Control	29	55.86	14.65		
Permanence-test	Animation	26	65.38	24.35	2.587	0.013
	Control	29	48.86	16.30		

[a] Maximum Score =100.

As for the findings related to the retention test in Table 1, it is seen that the academic achievement levels of the students who attended the Science lessons based on animation (animation group) are higher than those of the students who attended the traditional teacher-centered science lessons (control group) ($t(53)= 2.587$; $p= 0.013$). According to these results, it can be stated that animation-oriented Science instruction increases the academic achievement and retention of knowledge. The results of this study parallel to the results of some other studies (Rieber, Boyce & Assad, 1990; Iskander & Curtis, 2005)

Student Opinion Scale (SOS): This test was given to the students at the end of the study to learn their opinions on the use of animation technique. The percentages and average scores of the answers given by the students were presented in Table 2.

Question 1. Was the use of animation technique during the lesson useful for you?
The answers given by the students to this question were given in Table 2.

Table 2. *Studens' Opinions of the Use of Animation Technique in the Lesson*

Score	Response	Percentage
5	Very well	45
4	Well	40
3	Satisfactory	15
2	Not too well	-
1	Poorly	-

Note: Mean score: 4.31 (on a 5- point scale)

As presented in Table 2, the findings show that the students adopted the use of animation technique. The data in this table indicated that 95 % of the students evaluate this technique as "very well" and "well"; and that the mean of the scores for this question 4.31 is higher than the mid-point 3 indicates the positive opinions of the students on the animation technique.

Question 2. Learning through animation.

The results and evaluations collected from student opinions on this question were given in Table 3. As presented in table, it can be inferred that students' opinions are between 77-100 % according to point 4 and point 5. It was also determined that the mean scores for all opinions were higher than the mid-point 3.

Table 3. *The Statistical Values of the Opinion on the "Question 2" Learning through Animation*

Opinions	Scores						Opinions
	1	2	3	4	5	X	
Not information	-	6	9	40	45	4.27	Information
Difficult	-	-	-	50	50	4.50	Easy understandable
Not Beneficial	-	-	9	55	36	4.18	Beneficial
A poor instructive	-	-	5	55	40	4.36	Instructive
Dull	-	6	21	50	23	4.13	Stimulating
Not enjoyable	-	6	13	36	45	4.22	Enjoyable
Not creative	6	-	17	55	22	4.00	Very creative

X indicate score mean on 5 point scale; other figure indicate percentage

The findings obtained from Table 3 show that students found the instruction through animation technique as "information", "easily understandable", "beneficial", "instructive", "enjoyable", and "creative". The findings related to this question reached in this study parallel those of other previous studies (Bourner, Hughes & Bourner, 2001; Mills, 2003; Doymuş, Şimşek & Bayrakçeken, 2004). So it might be stated that the animation technique was adopted by the students.

RESULTS AND RECOMMENDATIONS

From the findings of this study, which is investigating the effects of teaching through animation technique, it was found that this technique had more positive effects on teaching when compared to the traditional teaching method. The effectiveness of the animation technique during the teaching of acids and bases topic and its contributions to the visualizations of the events included in the unit can be reported as the reasons for the increase in the students' academic achievement. It was also proved that this technique had positive effects on the retention the knowledge gained in the class, and thus led the mastery learning of students. The existence of positive effects of the use of this technique in Science lessons was also supported by the opinions of students of it. These positive results related to the animation technique parallel the findings of Tezcan and Yılmaz (2003) and Aykanat, Doğru and Kalender (2005). As a result, it can be argued that animation technique increases academic achievement more when it is compared to the traditional teaching method. Another reason for the increase in the academic achievement in Science courses is its contribution in forming bases for the investigation of microscopic events. The results related to the academic achievement have similarities with those of Johnstone (1993). If teachers support and use the activities including computer animations, they can prevent the micro-level comprehension difficulties of students. By this way, an effective and meaningful learning can be achieved. This study showed that the use of computer animations contributes to the visualizations of the complex and difficult processes by a scientific and correct way. In addition to these, that the teaching of science through computer animations has the advantages such as enhancing the motivation, joyful, easily understandable, and contributory to developing cognitive skills.

Considering the results related to academic achievements and opinions of students the following recommendations were listed.

1. The duration of animation presentations should be determined by taking the development characteristics of the students into consideration.
2. The animations should be utilized in complex and difficult subjects and when there are no materials to be used in practices (e.g., experiments).
3. Further studies should be conducted on the computer animation use during the classes and laboratory practices in both first and other stages of education.
4. Some activities which will help the development of the skills to use animation techniques should be added to the processes of education faculties.
5. Some instructional CD's covering computer animations relevant to Science and Technology courses should be designed by the institutions serving to provide teaching materials for schools.

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