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Effect of Computer Animation Technique on Students' Comprehension of the "Solar System and Beyond" Unit in the Science and Technology Course

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The purpose of this study is to determine the effect of computer animation technique on academic achievement of students in the 'Solar System and Beyond' unit lectured as part of the Science and Technology course of the seventh grade in primary education. The sample of the study consists of 60 students attending to the 7th grade of primary school under two different classes during the 2011-2012 academic year. While the lectures in the class designated as the experiment group were given with computer animation technique, in the class designated as the control group Powerpoint presentations and videos were utilized along with the traditional teaching methods. According to the findings, it was determined that computer animation technique is more effective than traditional teaching methods in terms of enhancing students' achievement. It was also determined in the study that, the Powerpoint presentations and related videos used together with the traditional teaching methods provided to the control group significantly help the students to increase their academic achievement.

Introduction

Learning and teaching activities in the education and training process have an important role in presenting permanent information to students. In order to enable students to learn better, their advanced mental process skills have to be developed. In other words, the skills needed in order to create solution for problems and learn by comprehension instead of memorizing have to be given to students. Therefore an effective science education has to be provided in school. Accordingly, in science education teaching the skills for reaching information is much more important to providing the available information to students (Black, 2005; Karaçöp, 2010, Kim, Yoon, Whang, Tversky & Morrison,2007; Wu & Shah, 2004). In this context, there are various methods used in science education in order to enable the topics to be better comprehended. In this study, technology-aided education (computer animations) and traditional education methods supported with Powerpoint presentations and related videos were utilized.

In technology-aided education, visual materials such as animations, animated pictures and multimedia software have a great importance. Use of computer animations and simulations has a significant effect in teaching the abstract topics of science and technology courses. Use of computer animations together with teaching methods and techniques and having the students actively participate to the process ensure the provision of an effective and efficient education (Daşdemir & Doymuş, 2012; Karaçöp, 2010). The developments experienced in information technologies brought the use of computer technologies in the learning-teaching environments into prominence. Developments in computer technologies make it possible for the educators to teach by using graphics, videos, simulations and animations together with written texts.

In multimedia learning environments, students are given verbal materials (such as texts, stories, etc.) in addition to pictorial materials (static materials including photographs and displays or dynamic materials such as animations and videos) (Aldağ & Sezgin, 2002). Although verbal forms are used commonly, there is evidence showing that students' comprehensions can be enhanced with the addition of visual forms (Mayer & Moreno, 2002; Serin, 2011). Animations are the most known kind of pictorial forms. Computer animation

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is the rapid display of a sequence of pictures on computer screen. Animations have three characteristics. These are the pictures, display of certain movements and simulation (Weiss, Knowlton & Morrison, 2002). Also salience and briskness have an important place in animations. Animations should correspond to the context of the topics, otherwise animations may become distracting and the intended objectives cannot be achieved with the use of animations. Briskness in animations reifies comprehension of abstract topics (Ploetzner, Lippitsch, Galmbacher, Heuer & Scherrer, 2009; Sweller, 2005; Tezcan & Yılmaz, 2003; Vermaat, Kramers-Pals & Schank, 2004).

The Purpose of the Study

The purpose of this study is to determine the effects of computer animation technique and the traditional teaching methods on the academic achievement of students receiving the solar system and beyond unit of the 7th grade science and technology course. Also answers to the following sub problems were searched within the frame of the study.Solar System and Beyond unit topics are a) space consist of what, b) planets and stars, c) The Sun, d) meteor and meteorites.

Sub problems:

- Does lecturing the topics of the 'solar system and beyond unit' with the utilization of computer animation technique create a statistically significant difference in terms of the academic achievement levels of the students, in comparison with the traditional teaching methods?
- When implementing the traditional teaching methods, are Powerpoint presentations and videos effective in increasing students' academic achievement?

Method

In order to compare the effect of two different teaching techniques on the academic achievement levels of students within the scope of the "solar system and beyond" unit given in the 7th Grade science and technology course, pre-test and post-test control group pattern was utilized in this study (McMillan & Schumacher, 2006). Implementing quasi-experimental research involves several classes or schools that can be used to determine the effect of curricular materials or teaching methods.

Participants

The sample of the study is constituted by a total of 60 students in two different classes and attending to the 7th grade of primary school during the 2011-2012 academic year. While one of the classes was designated as the Experiment Group (n=30; (17 female, 13 male students)) where computer animation techniques were to be implemented, the other was designated as the Control Group (n=30; (16 female, 14 male students)) where traditional teaching methods were to be implemented. The study was continued in all three groups for four weeks. The study continued for a period of four weeks for both of the groups. The works in both of the groups were carried out by the same researcher.

Data Collection Tools

Academic Achievement Test (AAT) was used as the data collection tool in order to determine students preknowledge and postknowledge concerning the "solar system and beyond" unit.

Academic Achievement Test (AAT)

The Academic Achievement Test (AAT) was designed with the purpose to measure student attainments intended by utilizing primary education science and technology curriculum and textbooks concerning the topics of the unit, "solar system and beyond". The test was examined by 2 expert lecturers and 2 science and technology teachers (attending to the 7th grades) in terms of distribution of the questions to the topics included and after the necessary corrections were made and inadequacies were rectified the AAT was arranged as 20 multiple choice questions. After making the corrections, the AAT was applied to 54 eight grade students, who were previously taught the unit, in two different classes in order to determine the reliability of test measurements. The reliability coefficient (with Cronbach alpha) of the AAT was

determined to be 0.63.After that, the AAT was applied to both experiment and control groups in two stages as pre-test and post-test for determining the change in academic achievement.

The Study

In this part, information concerning the lecturing process of the participating students is presented.

Teaching with computer animation technique

Solar System and Beyond unit topics are a) space consist of what, b)planets and stars, c) The Sun, d) meteor and meteorites. The animations and simulations concerning the Solar System and Beyond unit were obtained from several websites. Distributions of these animations and simulations according to student attainments in the Solar System and Beyond unit, and the related website addresses are presented in Table 1. In addition to the animations and simulations, programs such as 3D Solar System, Solar System 3D Simulator, Interactive 3D Solar System Simulation were downloaded from the internet and utilized in the education of the students. Suitability of the animations to the contexts of the topics were examined by a lecture engaged in the area of science education and the researcher. On the other hand, examination of the use and technical characteristics of the animations were examined by a teacher in the area of computer teaching. The researcher provided the students with the basic information concerning the topics of the Solar System and Beyond unit along with the prepared animations. The animations were presented by means of a computer and a projector. During the courses incomprehensibleanimations were played again and the courses were completed by making class discussions. Lecturing of the topics included in the Solar System and Beyond unit was completed in four weeks.

Table 1: Student attainments in the Solar System and beyond unit and the animations used in these attainments

Student Attainments	Animations
Observes celestial bodies with naked eye and distinguishes their features.	URL-1; URL-2
Realizes that there are many more celestial bodies than those that can be observed with naked eye.	URL-2
Gives examples of the known constellations.	URL-3; URL-1
Gives examples of comets.	URL-4
Distinguishes stars from planets during observation.	URL-5
States that also the Sun is a star.	URL-6; URL-3
States that the distance between stars is expressed with a measure called as "light year".	URL-7
Explains the difference between meteors and meteorites.	URL-8
Puts the planets in the solar system to order according to their position with regard to the Sun.	URL-9
States that the distances of the planets in the solar system to the sun are expressed with a distance measure called as "astronomical unit" (AU).	URL-10
Comprehends that the planets in the solar system orbit on certain planes.	URL-11
Compares the planets in the solar system in terms of different features (size, number of satellites, whether or not they have rings, etc.)	URL-12; URL-1
Prepares and presents a model representing the solar system.	URL-5
Prepares and presents a model demonstrating that the moon is the satellite of the earth.	URL-3
Gives examples to galaxies and comprehends their characteristics.	URL-7
Defines the universe outside of the Earth as "space" and specifies the position of the Earth.	URL-9

Teaching with the Traditional Teaching Methods

In the class designated as the control group, lecturing of the topics included in the Solar System and Beyond unit was realized according to the traditional teaching methods. In this class the lecture was given with the Powerpoint presentations prepared by the researcher and the videos downloaded from the internet. While the researcher performed the presentation, students listened and took notes. In addition to these, while teaching some of the topics the students were divided into groups of five and asked to present the topics as a group. Students continued their studies out of the class through textbooks and other sources provided by the researcher. During the lectures, students were asked questions at certain times and feedbacks were made according to their answers. Students were also given homework for studying the topics out of the class. At

the end of each lesson, the students were asked to read about the topics of the next lesson and be prepared for it. In the control group, lecturing of the topics included in the Solar System and Beyond unit lasted for four weeks. Lectures in both experiment and control groups were given by the researcher.

Findings

In this part, the findings obtained from examining the effects of the computer animations technique and the traditional teaching methods on the academic achievement levels of the students in the "Solar System and Beyond" unit of the 7th grade science and technology course are presented.

The Academic Achievement Test (AAT) was implemented to the students included in both the experiment and the control group individually once before the lectures as pre-test and once after the lectures as post-test. The data obtained from independent *t* test analysis of the AAT pre-test and AAT post-test score averages are presented in Table 2.

Table 2: Independent *t* test analysis of the point averages scored from AAT pre-test and AAT post-tests and impact magnitude values

Tests	Experiment Group		Control Group		*t*	p
	X	SD	X	SD		
AAT pre-test	57.33	11.72	60.83	9.83	1.25	0.21
AAT post-test	80.53	10.30	70.50	9.68	3.88	0.01

Examining the p values in Table 2 according to a significance level of 0,05 shows that there is no difference between the experiment and control groups in terms of the AAT pre-test scores obtained (p>.05). According to these data it is possible to assert that the foreknowledge on the topics of the Solar System and Beyond unit of the students in both groups were in the same level.

On the other hand, examining the p values in Table 2 according to a significance level of 0,05 indicates the presence of a statistically significant difference between the experiment and control groups in terms of the AAT post-test scores obtained (p<.05). Examining the scores obtained from the AAT post-test implemented to both groups following the completion of the courses pointed out that a statistically significant difference between the two groups was established in terms of the students' academic achievement levels on the topics of the "Solar System and Beyond" unit (Experiment Group = 80.53; Control Group = 71.50). With this, it was determined that the experiment group was superior to the control group in increasing their academic achievements.

In order to determine the level with which the groups increased their academic achievement levels by examining the pre-test and post-test results of each group separately, the data obtained from the matched group *t* test analysis of the point averages obtained by both of the groups from the pre-test and post-test are presented in Table 3.

Table 3: Paired sample*t* test analysis of the AAT pre-test and AAT post-test point averages of both groups.

GROUPS	AAT pre-test		AAT post-test		*t*	p
	X	SD	X	SD		
Experiment Group	57.33	11.72	80.53	10.30	7.74	0.01
Control Group	60.83	9.83	70.50	9.68	4.05	0.01

With the examination of the AAT pre-test and AAT post-test point average data presented in Table 3, it was determined that the computer animation technique applied to the experiment group resulted in a significant difference in terms of increasing students' academic achievements concerning the topics included in the "Solar System and Beyond" unit. It was also determined from considering the AAT pre-test and AAT post-test point averages presented in Table 3 that, also the traditional teaching methods applied to the control group caused a statistically significant difference in terms of increasing student's academic achievements in

the "Solar System and Beyond" unit. However, with the examination of the p values, it was determined that the experiment group increased its academic achievements in a much greater level than the control group.

Conclusions

In this part the findings of the study were interpreted and discussed, and also some suggestions that may set light to the future studies concerning the techniques and methods used in this study were made. The teaching techniques, methods and tests used in the 7th grade "Solar System and Beyond" unit are presented below.

With the examination of the data obtained from applying the AAT pre-test to both experiment and control groups, it was determined that the achievement levels of both of the groups were above 57%, and that there was no significant difference in the foreknowledge of the students of the two groups concerning the topics of the "Solar System and Beyond" unit (Table 2). It is believed that the absence of a significant difference between the foreknowledge of the experiment and control group was due to the fact that the students of both groups received the same education curriculum in the past. Also, high levels of foreknowledge in science and technology courses facilitate teaching, comprehension of related activities and experiments, and creation of solutions to the problems that may be experienced. It is also observed from other studies that the foreknowledge of students that received the same education curriculum are on the same level (Akdaş, Bulut & Yüksel, 2011; Aksoy & Doymuş, 2011; Doymus, 2007; Karaçöp, 2010; Zoldosova & Prokop, 2006).

According to the findings obtained from the statistical analysis of the AAT post-test scores of the two groups, it was determined that a statistically significant difference was created in terms of increasing the groups' academic achievements in the related topics, in consequence of the implementation of the computer animation technique and the traditional teaching methods in teaching the topics included in the "Solar System and Beyond" unit of the 7th grade science and technology course. The experiment group was found out to be more successful than the control group in terms of the AAT post-test points (Table 2). Provision of additional information and the computer simulation programs provided together with the animations can be interpreted among the reasons why the students, on whom the computer animation technique was implemented, attained higher academic achievement levels than the students of the control group. The consideration that utilization of animations in this way as part of education is effective in teaching scientific facts, phenomena, concepts and principles was also set forth in other studies (Schank & Kozma, 2002). The findings of this study indicating that "computer animation technique enables higher academic achievement in comparison to traditional teaching methods is in line with the results of the previously conducted studies (Aydoğdu, 2006; Frailich, Kesner & Hofstein, 2009; Karaçöp, 2010; Özmen, 2008; Özmen & Kolomuç, 2004; Özmen, Demircioğlu & Demircioğlu,2009; Öztürk-Ürek & Tarhan, 2005; Sanger, Brecheisen & Hynek, 2001; Talib, Matthews & Secombe, 2005; Yang, Andre & Greenbowe, 2003). The questions asked by the researcher in order to reveal students' foreknowledge on the topics, answering the questions concerning the topics and the contents of the animations, class discussions held after the presentation of the animations and repetition of the incomprehensible topics, in addition to the provision of the animations and simulations are among the other reasons of how the students of the experiment group were more successful than the students of the control group. The finding that the use animation technique brings along a considerable difference in students' achievements is in line with the results of the previously conducted studies (Karaçöp, 2010; Kelly & Jones, 2007; Rotbain, Marbach-Ad & Stavy, 2008).

It was determined that, after completion of the teaching activities both of the groups increased their academic achievement levels on the topics included in the scope of the study in terms of their AAT pre-test and AAT post-test point averages (Table 3). The p values provided in the table for the 7th grade science and technology course, "Solar System and Beyond" unit, indicate that the educative process were useful at high levels for both of the groups. The Powerpoint presentations made and videos shown in relation with the topic during the implementation of the traditional teaching methods can be shown as the reason how both of the groups benefited from the process at such high levels. The researcher's utilization of Powerpoint during the course enabled a planned and successive presentation of the topic, drawing the students' attention to the topics, enhancing students' levels of perception, teaching the lesson more efficiently and presentation of different information (Hakverdi-Can & Dana, 2012; Para & Reis, 2009).

The techniques and methods that facilitate teaching the difficult topics in science courses are frequently

utilized in education environments. In this study, computer animation technique and the traditional teaching methods supported by Powerpoint presentations were used in order to facilitate teaching and learning of the topics included in the "Solar System and Beyond" unit. In order to obtain more effective and efficient results from the studies that will be conducted in the future with the computer animation technique, particular attention should be paid for ensuring that the animations are not distracting, suitable to the levels of the students and easily accessible by the students. It is my belief that, in future studies formation of data digital learning objects repository from where animations and simulations can be readily applied to the topics to be taught by the researchers will affect education activities positively and that it will be useful to repeat the concept of this present study on the social sciences course at primary education level and on physics and geography courses at high school level.

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