'Earth, Sun and Moon': Computer assisted instruction in secondary school science - achievement and attitudes

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This study investigated the impact of a web-based teaching method on students' academic achievement and attitudes in the elementary education fifth grade Science and Technology unit, 'System of Earth, Sun and Moon'. The study was a quasi-experimental study with experimental and control groups comprising 54 fifth grade students attending a state school in the 2012-2013 academic year. Lessons in the experimental group of 26 students were taught with the help of web-based teaching materials designed in a computer environment, whilst students in the control group of 28 were taught according to the textbook. Comparisons based on pre- and post-test results were used to identify the impact of the web-based method on student achievement. Findings suggested a significant difference in favor of the experimental group in their achievement in Science and Technology lessons and positive attitudes towards computer technologies and astronomy.

Introduction

Astronomy is defined as the scientific discipline that embodies several disciplines including physics, chemistry, geology, and biology, plus a knowledge of mathematics and geometry. Therefore, it is quite impossible to disassociate astronomy from the physical sciences (Parker & Heywood 1998). Trumper (2006) referred to astronomy as the earliest of all sciences. People should know about astronomy in order to understand the universe, just as an anatomy expert should know anatomy to better comprehend the human body. Astronomy training is also seen as a factor for creating changes in students' conceptual constructs.

Trumper (2006) listed the following benefits of learning astronomy:

- Informing students of developments in astronomy peaks their curiosity and increases motivation towards learning science.
- Scientific research in other areas can be enriched with the help of astronomy.
- As a branch of science, astronomy suggests that abstract knowledge can be presented with tangible and explicable data and that scientific knowledge is changeable.

In this sense, astronomy helps students to better comprehend the world that they live in. Research shows that primary school students find topics in astronomy more interesting compared to other science subjects (Dede, 1995). However, difficulties arising from learning abstract concepts that astronomy embodies makes understanding of astronomy concepts more difficult, even though astronomy is an important component of science education (Dunlop, 2000).

Investigation of studies on teaching astronomy shows that these mostly involved implementing and analysing various teaching methods to determine the knowledge level of students in various age groups and to identify and correct their misconceptions (Bakas & Mikropoulos, 2003; Pena & Quilez, 2001). It was also found that facilities to assist learning of abstract astronomy concepts such as planetariums and observatories are limited in many countries (Bakas & Mikropoulos, 2003; Connors & Martin, 2009). Küçüközer (2007) searched for pre-service science teachers' understanding relating to astronomy, finding that they had alternative conceptions in basic astronomy regardless of whether having taken an astronomy class. Korur (2015), Kıroğlu (2015), Durukan and Sağlam-Arslan (2015), Kanli (2014) and Bekiroğlu (2007) in their studies displayed that pre-service teachers had naive views related to the subject. Some of these studies centred on misconceptions in astronomy. For example, Bostan (2008) studied misconceptions about astronomy concepts amongst students between 10 and 23 years of age from various education levels, and Baloğlu (2005) investigated misconceptions of 6th graders. Additional studies regarding astronomy show that both students and preservice teachers have some misconceptions about astronomy in general or they don’t have sufficient levels of information about astronomy (Aydın, Ural Keleş, Haşıloğlu & Yiğit, 2014; Bailer & Slater, 2003; Küçüközer, 2008; Trumper, 2006).

Although concepts related to astronomy have a direct relationship with daily life, it is one of the subjects in which students experience difficulties in understanding, as evidenced by the studies cited above.

In Turkey, comprehension of science topics has been found to be more difficult compared with other subjects, and students’ achievement in astronomy is low. One of the reasons for this outcome is believed to be reliance upon direct knowledge transfer from teacher to student in science education. Knowledge that is transferred to students in traditional teaching methods is only learned at a certain level and is not permanent. Students need to observe, discover and experience science concepts in order to learn, understand and remember them. Constructivist approaches examine how students construct information themselves in their minds. In general, in traditional methods which depend on transmission of information where the teacher is at the centre, meaningful learning does not take place readily and students simply memorise the given information. Therefore, teaching methods which will help create meaningful pictures in the students’ minds should be adopted. When the difficulties faced with the learning of astronomy are considered, resorting to models will be beneficial. Making use of models in teaching contributes to the concrete underpinning of abstract concepts and scientific models help put forward the significant characteristics of concepts.

For example Doğru and Şeker (2012) implemented activities to develop 5-6 year old children's understanding of "Earth, Sun and Moon". The activities were based on modeling and hands on learning. The results of the study revealed that children's acquisition of the concepts was improved through the activities. In parallel with the development of technology, it has been possible to improve student learning by making use of educational technologies. Gürbüz (2016) searched for pre-service science teachers’ misconceptions on basic astronomy and investigated a micro-teaching method supported by educational technologies for correcting these misconceptions. Findings revealed that pre-service science teachers had many misconceptions related to the subject and the instructional method helped to correct their misconceptions.

Computer technologies become important in this regard since it is difficult to provide the requirements of effective science teaching in a usual classroom environment. With the help of computer technologies, required learning experiences can be presented to students as if they are real, and more effective learning becomes possible (Altun & Büyükduman, 2007). Positive features of web-based teaching methods such as providing opportunities for repetition, practice and instant feedback, and the fact that they are student-centred and generate interest which makes it more endearing to students point to the need for popularising and generalising the use of web-based teaching methods in the learning process.

The development of computer technology and web-supported applications via Internet connections play a significant role in the teaching of concepts which are enriched by visual and auditory elements. For this reason web-based teaching is an appropriate method that can be used to teach abstract concepts, often found in astronomy, that are hard to visualise and envision (Küçüközer et al., 2009). Models of abstract concepts can be presented to students more readily with the help of web-based teaching materials. Also, some chemical events in science and astronomy concepts which are difficult to observe at the sub-microscopic level and are difficult to understand can easily be observed through using web-based teaching materials (Akçay et. al., 2003; Atam, 2006; Kibar, 2006; Yenice, 2003). The web-based teaching method which expands students' perspectives in astronomy allows information to go beyond memorisation and facilitates better comprehension. Virtual environments may facilitate the development of positive attitudes towards astronomy topics and therefore students learn about astronomy more efficiently (Gülseçen et al., 1999). Another important characteristic of web supported applications is that they are usually regarded as more interesting by present day students, who are more used to technologies than their predecessors. When all of these aspects are taken into consideration, it will be beneficial to make use of technology in teaching concepts related to astronomy.

Aims

This study aims to examine the effect of computer assisted learning on students' achievement in the "Earth, Sun and Moon" unit, attitudes towards science and technology classes, and attitudes towards computers. The following research questions are posed:

1. Does computer assisted instruction make significant differences in students' academic achievement in the "Earth, Sun and Moon" unit?
2. Does computer assisted instruction make significant differences in students' attitudes towards science and technology?
3. Does computer assisted instruction make significant differences in students' attitudes towards computers?

Importance of the study

Subjects within the scope of curriculum related to astronomy are used to allow students better understand the world and numerous natural events around them. Therefore, subjects related to astronomy which are given to students starting with the 5th grade are quite important. Investigation of elementary education Science and Technology programs in Turkey shows that astronomy topics are addressed in 4th, 5th, 6th, 7th and 8th grades but they are taught mainly in the 7th grade (MoNE, 2008). The attainment from "Earth, Sun and Moon" within the scope of the 5th grade Science and Technology curriculum has been separated into three main parts:

1. Concerning the shape and size of the Sun, Earth and Moon, students should be able to:
    - Create and present a unique model which represents the Sun, Earth and Moon together.
    - Make the inference that objects look smaller as they move away.
    - Make the inference that the Sun is further away from Earth in comparison to the Moon.

2. Concerning the movements of the Earth, students should be able to:
    - Express that the time it takes for the Earth to complete a full spin around itself is accepted as one day.
    - Explain the day and night formation through the spinning of the Earth around itself.
    - Express that while the Earth spins around itself, it also spins around the Sun.

3. Concerning the movements of the Moon, students should be able to:
    - Express that while the Moon spins around itself, it also spins around the Earth.
    - Explain that always the same side of the Moon can be seen when observed from Earth.
    - Explain the phases of the Moon through the Moon's spinning around the Earth.

When the knowledge gains of the unit are analysed, it is seen that these are related to the shapes, sizes and movements of the Sun, Earth and Moon, and are thus directly related to the daily lives of students. For instance, the phases of the Moon are a subject students can observe in daily life but cannot explain with their knowledge so far. In the same manner, the formation of day and night is an event noticed by students but cannot be associated with the spinning of the Earth around itself. The lack of scientific models related to the astronomical concepts of primary school students has been noted in various studies.

As mentioned above, students and even teachers have misconceptions about the movements of the Moon, Earth and Sun around the axis of each other and the relationship of certain daily events with these movements. For example, Sarıoğlan and Küçüközer (2013) searched for science teachers' views related to the phases of the moon and the results showed that the researchers had many misconceptions related to the subject. Misconceptions by students are observed in all groups regardless of age. Özsoy

(2012) examined first grade children from five primary schools for their understandings about the shape of the Earth. Results showed that only one third of the participants had scientifically acceptable views related to the subject. Although all students have seen that the Earth is round, on TV and through other media tools, they have different views about it. Therefore, different techniques should be used in order for information to be structured in the minds of the students. The use of visual elements and scientific models in learning these abstract concepts by the students carries a great significance. Educational software created with computer technologies provides great facility in the presentation of scientific models. Today, students live closely with technology starting from very early ages. Besides being in command of computer technologies, they also like using the mentioned technologies. Software created within the scope of the present study has been enriched with visual content appropriate for the students' ages. In addition, through Internet connections students watched numerous visuals and videos. Through the examples and analogies presented by the created software, we believe that students' learning will be improved.

Method

This study investigated the impact of a web-based teaching method on students' academic achievement and their attitudes towards science, astronomy and computer technologies, in the context of the Science and Technology unit of "System of Earth, Sun and Moon" among students in the 1st grade (5th grade in the previous system; 10 years old) of secondary education. With this aim in mind, one experimental group (N=26) and one control group (N=28) of students were formed in a state secondary school in the 2012-2013 academic year. A quasi-experimental model with pretest, post-test experimental and control groups was used. The pretest consisting of the "Computer Attitude Scale", "Science Attitude Scale", "Attitude Scale towards Astronomy" and "Academic Achievement Test" was administered to both groups.

After administering the pretest, the computer lab for the experimental group was organised in a manner that allowed each student to have a personal computer; education materials were uploaded and each computer was equipped with a headphone to enable students to listen to the materials that had been uploaded. Each of the computers had an Internet connection.

Preparatory work for the experimental group

Lessons for both the experimental and control groups were taught by the teacher, who was familiar with both methods. Prior to commencing, the teacher was given information about the purpose of the study and the implementation. The teacher was taught how to use the instructional program in the computer environment and was given information on how to teach the class by using the instructional materials.

Instructional materials

It is becoming more and more crucial to transform abstract science subjects to tangible models which can be observed by the students. Therefore, the current study aimed to create software to increase interest towards astronomy and provide meaningful learning through mental models for students in the 1st grade of secondary school (primary school 5th graders in the previous system) who were encountering astronomy for the first time in the Science and Technology unit "Earth, Sun and Moon". Adobe *Photoshop cs6*, *Flip PowerPoint* and Adobe *Flash cs6* software were used to prepare the software for this study. In addition to "Earth, Sun and Moon" concepts, the software provided information on their sizes, formation of night and day, solar and lunar eclipses and different phases of the moon. The topics were prepared according to a web-based teaching method using a programmed instructional model and multimedia principles, including both visual and audio materials. The use of visual and audio together aimed to create user friendliness for students according to their age levels and to facilitate comprehension. The content was given through storytelling to facilitate student comprehension and enhance their perceptions. In addition to the specially created software, the students watched real images and videos through Internet connections. Some illustrative examples of visuals in the software are presented in the Appendix.

The control group students completed the lesson by following their Science and Technology textbook (MoNE, 2012). Lessons were completed in a classroom environment where the teacher is more active. The teacher explained the lesson, asked students to take notes where necessary, and attempted to engage students through question and answer methods.

After the completion of the 4-week instruction phase, the same test was administered to the experimental and control groups as a post-test. The overall study was conducted over six weeks (the pretest in the first week, instruction over the next four weeks and the post-test in the 6th week. The research plan is summarised in Table 1.

Table 1: Research plan

Groups	Pretests	Implementation	Implementation period	Post-tests
Experimental group (n=26)	AAT CAS SAS AAS	Web-based	4 weeks	AAT CAS SAS AAS
Control group (n=28)	AAT CAS SAS AAS	Textbook	4 weeks	AAT CAS SAS AAS

Data collection tools

Science Attitudes Scale (SAS)

This 5-point Likert scale was developed by Geban et. al. (1994) and comprises 15 items composed of negative and positive statements. Reverse coding was done for negative statements before conducting the analysis. Scoring was as follows: 1- Completely disagree;

2 - Disagree; 3 - Undecided, 4 - Agree; and 5 - Completely agree. The original Cronbach's alpha reliability coefficient of the scale was 0.83 (Geban et. al., 1994), while the reliability coefficient of the scale was found to be 0.93 in the current study.

Computer Attitude Scale (CAS)
This scale was developed by Loyd and Gressard (1985), translated into Turkish by Berberoğlu and Çalıkoğlu (1991) and re-adapted by Şerefhanoğlu et al. (2008). It is a 5-point Likert-type scale with 21 items composed of positive and negative statements. Reverse coding was done for negative statements before analysis, and scoring was the same as for the SAS scale. Attitude scores which are close to five show positive attitudes. The Cronbach's alpha reliability coefficient of the original scale was 0.87 while it was found to be 0.87 in the current study.

Astronomy Attitude Scale (AAS)
This scale, adapted to Turkish by Canbazoğlu Bilici, Armağan, Çakır and Yürük (2012) is a 5-point Likert-type scale, similar to the ones in the previous scales, comprising 15 items composed of negative and positive statements. The scale that was administered to the experimental and control groups as pretest and posttest consisted of two factors: competence towards comprehension of astronomy concepts, and interest towards astronomy and its usefulness. The Cronbach's alpha reliability coefficient of the original scale was 0.80, the same in the current study.

Academic Achievement Test (AAT)
The aim of this scale was to test participants' academic achievement in the subject of Earth, Sun and Moon. Test items were prepared by the researchers and examined by three experts in the field and one teacher who expressed positive opinions about the use of the items in the scale. The test originally comprised 25 multiple-choice questions to allow students to comfortably complete the test in one hour. Based on item difficulty and item discrimination analysis results, two questions were eliminated and the resulting multiple-choice academic achievement test with 23 items was administered to the students as pretest and post-test. During scoring, correct answers were assigned 1 point and incorrect answers 0 point. The highest score that could be obtained in the test was therefore 23. The 27% segments from the upper and lower groups were selected for item difficulty and item discrimination analyses of the test. Item difficulty analysis was calculated for each item according to the formula below and the values are presented in Appendix Table A1.

$$Item\ Difficulty\ Index(p) = \frac{Number\ of\ Students\ Correctly\ Answering\ Related\ Item\ (Upper\ group + Lower\ group)}{Number\ of\ Students\ in\ Upper\ and\ Lower\ groups}$$

For an ideal test, item difficulty index of the items in the test should be between 0.2 and 0.8 and the item difficulty index means of the whole test is expected to be above 0.5. Examination of Table 2 shows that item difficulties of the test varied between 0.38 and 0.67 and the item difficulty value of the test was 0.50. The values obtained suggest that item difficulty of the test is fair. Test item discrimination analysis (D) was calculated according to the formula below and the values are presented in Appendix Table A2.

$$Item\ Discrimination\ Index\ (D) = \frac{Number\ of\ Students\ Correctly\ Answering\ Related\ Item\ (Upper\ Group - Lower\ Group)}{Number\ of\ Students\ in\ any\ of\ the\ groups}$$

Appendix Table A2 displays those discrimination values of the test items that are above 0.30. Accordingly, it was decided that item discrimination of the test was ideal. KR-20 analysis was conducted for reliability analysis and the value was calculated to be 0.85 for the 23-item test.

Data analysis

Data collected were analysed by using frequencies, percentages, arithmetic means, ANOVA, ANCOVA and t-tests. Results obtained from analyses were interpreted and inferences were drawn. Data collected during the study were analysed using a *SPSS* statistical package program. While assessing the scores obtained from the Achievement Test, the Science Attitude Scale, Computer Attitude Scale and Astronomy Attitude Scale, the level of significance was selected to be $p < 0.05$ for comparing the experimental and control groups.

Findings

Independent samples t-test analysis was performed to determine whether there was a significant difference between the experimental and control groups in terms of academic achievement, astronomy attitudes, computer attitudes and science attitudes (Table 2).

Table 2: Pretest scores of experimental and control groups

	Group	N	Mean	SD	df	t	*p*
Pre-AAT	Experimental group	26	6.42	1.90	52	0.852	0.398
	Control group	28	6.89	2.13			
Pre-SA	Experimental group	26	3.82	0.98	52	0.704	0.484
	Control group	28	3.63	0.97			
Pre-AA	Experimental group	26	3.07	0.55	52	2.333	0.024
	Control group	28	3.50	0.77			
Pre-CA	Experimental group	26	3.88	0.69	52	0.698	0.127
	Control group	28	3.75	0.67			

Examination of Table 2 shows no significant difference between the experimental and control group students in the pretest for academic achievement ($t(52) = 0.852$; $p = 0.398 > 0.05$), science attitudes ($t(52) = 0.704$; $p = 0.484 > 0.05$) and computer attitudes ($t(52) = 0.698$; $p = 0.127 > 0.05$) scores. However, a significant difference was detected for the experimental and control group students' astronomy attitude scores ($t(52) = 2.333$; $p = 0.024 < 0.05$). The average astronomy attitude scores of the experimental group students was calculated to be X = 3.07 whereas average astronomy attitude scores of the control group students was found to be X = 3.50. Therefore, attitude scores of the control group students were higher than those of the experimental group students in the pretest and this difference was found to be statistically significant.

Independent samples t-test analysis was performed to determine how the two different teaching methods affected the academic achievement, science attitudes, astronomy attitudes and computer attitudes of the experimental and control group students and the results are presented in Table 3.

Table 3: Post-test scores of the experimental and control groups

	Group	n	Mean	SD	df	t	*p*
Post-AAT	Experimental group	26	18.92	3.87	52	7.838	0.000
	Control group	28	11.46	3.11			
Post-SA	Experimental group	26	4.08	0.64	52	1.328	0.190
	Control group	28	3.77	1.02			
Post-AA	Experimental group	26	3.78	0.57	52	1.550	0.127
	Control group	28	3.52	0.65			
Post-CA	Experimental group	26	4.01	0.58	52	1.817	0.075
	Control group	28	3.67	0.75			

Examination of Table 3 indicates a statistically significant difference between the post-test academic achievement scores of the experimental and control group students ($t(52) = 7.838$; $p = 0.000 < 0.01$). While the experimental group students' post-test academic achievement score average was X = 18.92, the control group students' post-test academic achievement score average was found to be X = 11.46. These values show that the web-based method made a significant contribution to the experimental group students' academic achievement. No significant differences were detected between the experimental and control group students in terms of science attitudes ($t(52) = 1.328$; $p = 0.190 > 0.05$), astronomy attitudes ($t(52) = 1.550$; $p = 0.127 > 0.05$) and computer attitudes ($t(52) = 1.817$; $p = 0.075 > 0.05$).

Paired samples t-test analysis was performed to determine whether there was a significant difference in the experimental group students' pretest and post-test academic achievement, science attitudes, astronomy attitudes and computer attitudes scores; the results are provided in Table 4.

Table 4: Pre and post test scores of experimental group students

	Group	n	Mean	SD	df	t	*p*
AAT	Pretest	26	6.42	1.90	25	14.077	0.000
	Posttest	26	18.92	3.87			
SA	Pretest	26	3.82	0.98	25	1.108	0.278
	Posttest	26	4.08	0.64			
AA	Pretest	26	3.07	0.55	25	5.461	0.000
	Posttest	26	3.78	0.57			
CA	Pretest	26	3.88	0.69	25	0.710	0.484
	Posttest	26	4.01	0.58			

Table 4 indicates a significant difference between the pretest academic achievement scores and post-test academic achievement scores of the experimental group students (t(25) =

14.077; *p* = 0.000 < 0.01). The experimental group students' average pretest academic achievement score was 6.42, whereas their average post-test academic achievement score was 18.92. This result suggests that the change in the academic achievement scores of the experimental group students as a result of web-based instruction was statistically significant. In addition to the experimental group students' academic achievement scores, their astronomy attitude scores also represented a significant difference (t(25) = 5.461; *p* = 0.000 < 0.01). The experimental group students' average pretest astronomy attitude score was 3.07 whereas their average posttest astronomy attitude score was calculated to be 3.78. This finding suggests that the web-based instruction had a positive impact on the experimental group students' astronomy attitudes. However, the web-based instruction was not found to have a statistically significant effect on the experimental group students' science attitudes (t(25) = 1.108; *p* = 0.278 > 0.05) and computer attitudes (t(25) = 0.710; *p* = 0.484 > 0.05).

The study also checked whether statistically significant differences existed between the experimental and control groups' post-test achievement scores when the pretest achievement scores and attitudes were controlled by conducting ANCOVA analysis on the data. Findings are presented in Table 5.

Table 5: ANCOVA analysis results when pretest scores are controlled

Source of data	MS	df	F	*p*
Model	812.762	5	13.639	0.000
Group	592.317	1	46.699	0.000
Error	572.072	48		

* R^2= 0.587

According to Table 5, the model implemented in the ANCOVA analysis is statistically significant (*p* = 0.000 for the model) and the model explains 59% of conceptual achievement (R^2 = 0.587). Table 5 shows that the web-based instruction had significant impact on the experimental group students' academic achievement when the pretest scores of the groups were controlled (*p* = 0.000 < 0.01).

Discussion

The current study examined the impact of instructional materials prepared according to web-based teaching principles on students' academic achievement and their attitudes towards science, computer technologies and astronomy.

When the results regarding students' academic achievement in Table 3 were examined it was found that the experimental group students had higher academic achievement in the post-test compared to the control group students. Results of the ANCOVA analysis in Table 5 performed by controlling the pretest scores also pointed to significant differences in favor of the experimental group. This result may suggest that web-based instructional materials implemented with the experimental group was more effective in terms of student achievement compared to the traditional, teacher centred activities. The finding that abstract astronomy concepts are comprehended more readily when they are transformed into observable models accords with findings from similar studies (Straits & Wilke, 2003). In an American context, Isik-Ercan, Inan, Nowak and Kim (2014) used 3D visualisation for young children's learning about the Earth-Sun-Moon system. Post-interviews demonstrated increased knowledge of the shapes and the movements of the Earth and Moon, alternation of day and night, and other aspects (Isik-Ercan et al., 2014).

The web-based instructional materials used in the current study provided the students with better comprehension as well. The increase in the ratio of erroneous answers in the control group when they moved from tangible concepts to abstract ones also supports this finding, and similar findings can be found in the literature (Bolat & Ergül, 2007). The reason for higher academic achievement in the experimental group may be based on the fact that the instructional materials enabled them to study when needed and therefore increased their motivation. It can also be argued that the instructional materials increased the use of visuals in the lesson and facilitated the association of the subject with daily life experiences by decreasing the abstract nature of the subject and presenting the concepts tangibly. There are similar studies in the literature regarding the impact of web-based instructional materials on student comprehension of astronomy concepts (Dede, 2006; Gülseçen et al., 1999; Heeter, 1992).

Table 3 regarding students' science attitudes does not show a significant difference between the experimental and control groups. However, based on the means of the experimental group, it can be argued that science attitudes of the experimental group students were more positively affected than those of the control group students. Previous experimental studies in the field also postulated that science education integrated with computer technologies positively increased students' attitudes towards science (Akpınar, 2003). Increases in students' science attitude scores may be related to the use of the instructional materials. However, all units in Science and Technology lessons should be taught with improved instructional materials in order to produce a significant impact.

Examination of students' computer attitudes did not find a significant difference between the experimental and the control group, though the means of the experimental group students indicate that their attitudes were more positively affected as a result of the implementation compared to the control group (Table 3). There was no significant difference regarding student attitudes towards the instructional materials before and after they were taught using the materials. However, the majority of students had positive attitudes, and the short implementation period which resulted in students' spending insufficient time with the developed materials may have caused this result. If students are taught with the presented materials, they may have more positive attitudes towards the Earth, Sun and Moon unit.

With regards to student attitudes towards astronomy in Table 3, a significant difference was not observed between the experimental and control groups. However, means of the experimental group students show that their attitudes towards astronomy were more positively affected than those of the control group students.

Conclusions

This study shows that web based applications have positive impacts on students' learning of basic concepts of astronomy, besides positively developing their attitudes towards science lessons, computer use and astronomy. In the learning environment, the use of visuals that are appropriate for the age and level of students is quite important in terms of concrete illustrating of concepts and understanding relationships between the concepts. In the realisation of learning, interest in and positive attitudes towards the learning environment and the subject also play a role. Today, computer technologies are frequently used in the preparation of teaching materials. The positive effects of these technologies, which the students enjoy using, have been observed in this study as well. In Turkey, methods based on teachers' transmission of information are being used widely. As many concepts in science are abstract and inter-related, meaningful learning may not be achieved by relying solely upon traditional methods. Therefore, the use of learning technologies which the students enjoy using can increase interest in both the lesson and learning. Considering the findings from this study, some suggestions can be stated:

- Future studies can be undertaken to assess student attitudes towards science, computer technologies and astronomy by using different instructional materials over a longer implementation period.
- It is necessary to expand the use of web-based instruction in order to make classes more fun and not monotonous, and to increase participation. The use of web-based instructional software should be increased and cooperation with experts should be encouraged, both in preparing and implementing this software.
- Instructional materials prepared for use in the fields of science and technology should be implemented in schools, with adoption facilitated by in-service training in using web-based instructional technologies in classrooms.
- Student-centred teaching approaches and instructional materials should be employed in teaching instead of using only traditional methods.

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Appendix 1: Figures 1-4

Figure 1: The home page of the software

Figure 2: An anology is written. The atmosphere is associated with the aquarium which provides living opportunity for the fishes in it.

Figure 3: The phases of the moon

Figure 4: An anology to make clear the differences of the sizes of Earth, Sun and Moon

Appendix 2: Tables 2-3

Table 2: Item difficulty index values of the test

Question	No. correct answers in upper group	No. correct answers in lower group	Item difficulty (p)
1	29	10	0.67
2	22	6	0.48
3	28	4	0.55
4	23	10	0.57
5	26	10	0.62
6	27	8	0.60
7	17	3	0.34
8	20	4	0.41
9	21	8	0.50
10	27	7	0.59
11	22	5	0.47
12	20	4	0.41
13	24	1	0.43
14	21	3	0.41
15	23	9	0.55
16	24	7	0.53
17	18	4	0.38
18	22	9	0.53
19	19	5	0.41
20	8	3	0.19
21	24	2	0.45
22	23	7	0.52
23	19	5	0.41
24	20	7	0.47
25	22	6	0.48
Total			0.50

Table 3: Item discrimination index values of the test

Question	No. correct answers in upper group	No. correct answers in lower group	Item difficulty (p)
1	29	10	0.66
2	22	6	0.55
3	28	4	0.83
4	23	10	0.45
5	26	10	0.55
6	27	8	0.52
7	17	3	0.48
8	20	4	0.55
9	21	8	0.45
10	27	7	0.69
11	22	5	0.59
12	20	4	0.55
13	24	1	0.79

14	21	3	0.62
15	23	9	0.48
16	24	7	0.59
17	18	4	0.48
18	22	9	0.45
19	19	5	0.48
20	8	3	0.17
21	24	2	0.76
22	23	7	0.55
23	19	5	0.48
24	20	7	0.45
25	22	6	0.55
Total			0.57

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Please cite as: Ercan, O., Bilen, K. & Ural, E. (2016). 'Earth, Sun and Moon': Computer assisted instruction in secondary school science - achievement and attitudes. *Issues in Educational Research*, 26(2), 206-224. http://www.iier.org.au/iier26/ercan.pdf