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# Effect of Web Assisted Education Supported by Six Thinking Hats on Students' Academic Achievement in Science and Technology Classes

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Advances in computer technologies and adoption of related methods and techniques in education have developed parallel to each other. This study focuses on the need to utilize more than one teaching method and technique in education rather than focusing on a single teaching method. By using the pre-test post-test and control group semi-experimental research model, this study examined the effects of the web-assisted education method supported by six thinking hats technique on student achievement, on students' attitudes towards science and their attitudes towards the use of computers in science classes. The working group of the study was composed of 7th graders in a state secondary school in the 2013-2014 academic year. A working group consists of two randomly selected classes assigned as the experimental and control groups. The working group comprised of 50 students with 25 experimental and 25 control group students. Paired samples t-test, independent samples t-test and ANOVA techniques were used in analyzing the data collected via data collection tools to compare the experimental and control groups. The results showed that web-assisted education materials prepared with the use of the six thinking hats technique increased student attitudes towards science and computers. Students' attitudes towards computers were similar based on the variables of owning a computer and gender. Paternal education levels had no significant effects on student attitudes towards computers and their academic achievement.

Keywords: six thinking hats technique, web-assisted education, achievement, attitude

## Introduction

It is crucial to support effective learning and to sustain student interest in science lessons. Today, computers are used as important tools of education to achieve this target. Science classes are especially very suitable for using computer assisted teaching techniques because scientific concepts and principles that are commonly covered in these classes can be taught with appropriate teaching techniques using computer software to visually transfer these concepts and principles to students (Demircioglu & Geban, 1996). When computers are used effectively, students will be able to progress according to their own individual levels of understanding. It will be possible to reveal weaknesses in student understanding when scientific terms are introduced in color using graphics, models and animations with students given instant feedback (Relan & Gillani, 1997). A computer with internet access and a website prepared by expert web designers or selected by teachers in a given field are sufficient for implementing web-assisted teaching. Web-assisted education is a new approach that transfers educational knowledge and

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activities by using features of the internet. However, the web does not have the power to develop student learning on its own. As stated by Horton (2000), the type of education that combines the strengths of both web-based and traditional teaching methods and that supports traditional education processes via internet technologies is called web-assisted education (Odabasi, Coklar, Kiyici & Akdogan,2005).

By using technology in science education, experiments that are impossible to undertake or repeat in a classroom environment and concrete examples can be used when teaching specific science concepts. Technology use provides speed, attestation and validation. With the help of technology, students spend less time to classify data, do calculations and interpret experimental data during research and they arrive at better and more explicit results in terms of experimental outputs, calculations and data collection. Technology provides individualized learning environments for students with different learning styles (Guven & Sulun, 2012). In this sense, science and technology are interconnected as two disciplines that are in constant interaction.

Methods and techniques that aim to develop students' critical and creative thinking skills should be used in the teaching-learning process. One of these creative thinking skills used in this process is the six thinking hats technique. De Bono asserted that only critical thinking skills should be taught ~~at~~ in schools and expressed that the real need of societies - creative and constructivist thinking - can only be obtained by taking reactional and incompatible ideas into consideration. Bono (1992) argued that regardless of one's intellect level, each individual can be taught to think and the key to creative thinking is perception. Through the techniques developed by de Bono, individuals can attempt to expand or change their perceptions (Bono, 1992). Bono (1997) developed the six thinking hats technique to develop critical and creative thinking skills in learners.

Individuals react to colors differently. It is scientifically proven that perceiving various colors at the same time affects one's emotions through the hypothalamus. Also, it is known that the selected color shows the characteristics of individuals and their unconscious desires and provides information about their life conditions (Sun, 1994). Individuals generally tend to express their feelings through colors. Colors used by an artist in a painting can be perceived and made sense of differently through different associations by each individual. The role of colors that are important in human life are utilized in this technique (Bono, 1997).

In addition to allowing individuals to think better and practically, the six thinking hats technique helps them to make decisions and discover new ideas. However, achievements in this technique depend on how individuals think as well. Although individuals may have completely dissimilar ideas at the beginning, they are able to present similar ideas objectively with a change in the hats (Bono, 2006; Labelle, 1996). The six thinking hats technique provides individuals with specific thought patterns and allows them to observe events from different angles. In this sense, using this technique especially in teaching science topics will allow investigation of topics from all aspects since it encourages students to think differently. Considering the fact that students may be bored while learning some topics, use of this technique will be easily adopted by students since it is easy to implement and full of fun. The six thinking hats technique does not only help students to think but provides important outputs in ensuring discipline, acquiring desired behaviors and solving problems in real life (Dyck, 2003; Ayaz Can, 2005). It is imperative to observe topics from different angles ~~in~~ using the six thinking hats technique which aims to provide multi-directional thinking by separating and distinguishing emotions from logic and reasoning and creativity from knowledge accumulation (Semerci, 1999).

The six thinking hats technique provides students to role play six values. The hats allow us to think differently and change over time leaving our adamant beliefs behind. The second important value is in directing our attention to a particular aspect. The six thinking hats technique allows us to approach a topic from six different angles. The third value is appropriateness. The symbolic structure composed of six different hats presents an easily implemented method to enable someone to consider an event from a different perspective. The fourth value is the probable chemical basis in the brain. The fifth

value results from using the six hat method based on specific rules. The six thinking hats method lays specific rules for the thinking game. The thinking game here is mapping a specific topic instead of producing reciprocal theses (Bono, 2006).

**White Hat:** The white is neutral and objective. The white hat is related to objective concepts and numbers. It guides us about how to behave while addressing knowledge. We can aim to play the role of the white hat in the best manner. It is clear that the role of the white hat requires some ability; maybe more than other hats. The key rule in white hat thinking is that no concept is tried to be presented differently from what it really is. You can present knowledge based on faith as long as you assert that it is a concept that is believed in (rather than proven) (Bono, 2006).

**Red Hat:** Red hat thinking is almost the exact opposite of white hat thinking which is neutral, objective and free from feelings and intuition. The red hat allows formal expression of all feelings ranging from enthusiasm to intuition. While using the red hat, you never have to explain or legitimatize feelings. With the red hat, you play the role of an emotional thinker who acts on reactions and feelings rather than rational thoughts (Ayaz Can, 2005).

**Black Hat:** Black hat thinking is always rational. The Black hat is negative but never emotional. Emotion/ sentimentalism /negativity is the role of the red. Black hat thinking approaches the "dark" side of events but this is always a rational approach (Berber, et. al. 2009). There is no need to provide a rationale for negative feelings while using the red hat but it is necessary to present logical and appropriate rationale for negative emotions while using the black hat. One of the most important values of the six thinking hats method is its separation of emotional negativity from logical negativity.

**Yellow Hat:** The yellow hat searches for valuable and beneficial things and tries to provide logical support for them. It is constructive and productive. It allows approaching events from different angles based on various alternatives. Concrete proposals and suggestions are born from this type of thinking. It allows imagination. The purpose of this type of thinking is to find beneficial ideas that support the topic at hand and present supportive rationale. The proposed views are tried to be strengthened. These ideas are not necessarily new, old ideas can also be effectively utilized.

**Green Hat:** One of the most important characteristics of the green hat is to produce alternatives. An alternative shows acceptance of the probability of other means to do something, it requires the ability to approach events from different angles. Alternatives which are the basic elements of creative thinking are among the techniques of lateral thinking. After basic alternatives are found, the next step should be taken by questioning the patterns.

**Blue Hat:** The blue hat is for control. It controls the thinking activities of the thinker, we tell us or others which one of the thinking hats should be worn. Blue hat thinking reminds us when to change the hats. If we are to consider thinking as a formal procedure, the blue hat will control the protocol. By wearing the blue hat, you can make a detailed thinking plan about which order to follow. You can also provide momentary directives by wearing the blue hat.

The six thinking hats technique provides variety based on the characteristics of the discussion. Changes can be made in the order of hats to use when circumstances change. For instance, the yellow hat should be worn before the black hat while assessing a new proposal because it is easier to find the advantages and disadvantages of the new proposal (Karadag, Saritas and Erginer, 2009).

The six thinking hats technique can be used in many different fields. In their study on university students Smith and Cook (2012) used the six thinking hats technique during problem based learning processes and found that student motivation and academic achievement increased. In a study on married couples, Li, Lin, Nelson and Eckstein (2008) found that using the six thinking hats technique during therapy ensured couples' respect for different ideas and understanding towards each other due to using the same language. Karadag, Sarıtas and Erginer (2009) implemented the six thinking hats technique on nursing students and stated that the technique improved students' critical thinking skills, allowed for sharing of different ideas and views and ensured making more objective decisions as a result of observing negative and positive aspects of events. Gregory and Masters (2012) provided training for

pre-service teacher candidates by using the six thinking hats technique in a Second Life setting. Results showed that students found the activities implemented with the help of the six thinking hats technique was interesting and fun both in real life and in a Second Life setting but perceived that learning the concepts was more difficult in the Second Life setting.

Reasoning and problem solving techniques used by individuals are different. While some individuals tend to use concepts and numbers, some others focus on sentimentalism and feelings. Some individuals approach problems analytically and do not accept abstract ideas. On the other hand, some individuals enjoy looking at events holistically and creating the big picture in their minds (Ozden, 2003). It is crucial for individuals to acquire different thinking skills in Science and Technology classes where scientific literacy skills are emphasized. De Bono argued that all individuals can be taught how to think regardless of their levels of intelligence. According to de Bono, the key to creative thinking is perception. Through the techniques created by de Bono, individuals can attempt to expand and change their perceptions (Bono, 1992). Therefore, different methods and techniques based on the constructivist approach should be used in Science and Technology classes to provide students with various thinking skills. One of the most important techniques in this regard is the six thinking hats technique.

A literature review reveals that web-assisted education in science classes has positive impact on student achievement (Jang, 2006; Cuez, 2006; Keles, 2007). It is seen that web-assisted education is often used in teaching topics that are abstract and difficult to comprehend. (Lin et. al., 1998; Yenice, 2003; Karamustafaoğlu , Aydın & Ozmen, 2005). A literature review undertaken within the framework of this study has not ~~a~~ revealed any study that includes the use of the six hat technique in science classes based on web-assisted education. In this sense, it is believed that the results of this study will be beneficial to the science education community.

The current study aims to determine whether web-assisted education materials prepared with the use of the six thinking hats technique affects student achievement in science classes.

## Method

This study set out to investigate the impact of the web-assisted six hats thinking technique on secondary school 3$^{rd}$ year students' (7$^{th}$ graders') academic achievement, attitudes towards science and attitudes towards using computers in the Human Beings and the Environment unit. A pretest-posttest, control group-semi-experimental group model was used in the study. One experimental group and one control group, composed of 25 students each, were selected with simple random sampling method in a secondary school located in the province of Istanbul in the 2012-2013 academic year.

Before implementation in the experimental and control groups, the "Computer Attitude Scale", "Science Attitude Scale" and "Academic Achievement Test" were administered as pre-tests. Following the administration of the pre-tests, the computer laboratory was organized so that each student could work on a personal computer. The computers were uploaded with the education material and they were equipped with headphones to enable students to listen to audio materials. Following the preparations, students in the control group were taught the lesson based on the Science and Technology textbook (MoNE, 2012). The experimental group was taught the lesson following the software prepared by the researchers based on the web-assisted six thinking hats teaching method. Lesson plans were prepared and the researchers implemented the methods determined by them without making any changes. After the 6-week implementation period, students in the experimental and control groups were administered post-tests consisting of the same "Computer Attitude Scale", "Science Attitude Scale" and "Academic Achievement Test". The study was conducted over 8 weeks including 1 week for pre-tests, 6 weeks for instruction and 1 week for post-tests. The experimental design of the study is presented in Table 1.

Table 1. Research Model

| Groups | Pre-Tests | Method | Period of Implementation | Post- Tests |
|---|---|---|---|---|
| Control Group (N=25) | CAS<br>SAS<br>AAT | Traditional Teaching Method | 6 weeks | CAS<br>SAS<br>AAT |
| Experimental Group (N=25) | CAS<br>SAS<br>AAT | Web-Based Six Thinking Hats Teaching Method | 6 weeks | CAS<br>SAS<br>AAT |

**Data Collection Tools**

**Science Attitude Scale (SAS):** The Science Attitude Scale, developed by Barmy et al. (2005) was used in the study to identify students' attitudes towards science. The Cronbach's alpha value of the original scale translated to Turkish by Kaya, Boyuk (2011) was 0.76 while the corresponding value for this study was found to be 0.87.

**Computer Attitude Scale (CAS):** The Computer Attitude Scale, developed by Loyd and Gressard (1985), translated to Turkish by Berberoglu and Calikoglu (1991) and readapted by Serefhanoglu (2007), was used in this study to determine student attitudes towards computers. The scale is a 5-point Liker-type scale composed of 21 positive and negative items. Negative items were coded in reverse. The scores are as follows: Completely Disagree-1, Disagree-2, Unsure-3, Agree-4 and Completely Agree-5. The scores close to 5 present positive attitudes. The Cronbach's alpha value of the original scale is 0.869 while the corresponding value for this study was found to be 0.88.

**Academic Achievement Test (AAT):** The test was developed to measure participating students' academic achievement in the Human Beings and the Environment unit. Twenty-five test items presented in question format were prepared by the researchers and examined by two instructors who are experts in the field together with two teachers. Based on the evaluators views, it was decided to implement 15 multiple-choice, 5 fill-in-the-blank type and 5 true-false type questions. Four multiple-choice questions and 1 fill-in-the-blank type question were removed as a result of item difficulty and discrimination analyses. The final 20-item academic achievement test was implemented as pre- and post-test and correct and incorrect answers were scored as 1 and 0, respectively. The highest score that can be obtained from the test is 20.

Brackets of 27% were identified from the upper (N=27) and lower (N=27) groups for item difficulty and item discrimination analyses. Item difficulty analysis was calculated for each question using the formula below and the obtained values are presented in Table 2.

$$\text{Item Difficulty Index (p)} = \frac{\text{Number of test takers who get the item correct (Upper group + Lower group)}}{\text{Number of Students in Upper and Lower groups}}$$

For an ideal test, difficulty indices of items in a test should be between 0.2 and 0.8 and the difficulty index for the whole test should be higher than 0.5. Table 2 shows that item difficulties ranged between 0.31 and 0.67 and the difficulty index for the whole test was 0.50. Therefore, the test was declared to have sufficient item difficulty. Item discrimination analysis (D) was calculated according to the formula below and the values are presented in Table 3.

Table 2. Item Difficulty Index Values of the Test

| Question | Upper group-number of correct answers | Lower group-number of correct answers | Item difficulty (p) |
|---|---|---|---|
| 1 | 22 | 14 | 0,67 |
| 2 | 16 | 7 | 0,43 |
| 3 | 24 | 10 | 0,63 |
| 5 | 22 | 10 | 0,59 |
| 7 | 21 | 12 | 0,61 |
| 8 | 22 | 5 | 0,50 |
| 9 | 21 | 6 | 0,50 |
| 11 | 15 | 2 | 0,31 |
| 12 | 20 | 10 | 0,56 |
| 14 | 25 | 5 | 0,56 |
| 15 | 23 | 0 | 0,43 |
| 16 | 17 | 5 | 0,41 |
| 17 | 22 | 0 | 0,41 |
| 19 | 17 | 0 | 0,31 |
| 20 | 23 | 0 | 0,43 |
| 21 | 23 | 11 | 0,63 |
| 22 | 23 | 5 | 0,52 |
| 23 | 23 | 8 | 0,57 |
| 24 | 24 | 7 | 0,57 |
| 25 | 14 | 7 | 0,39 |
| | TOTAL | | 0.50 |

$$\text{Item Discrimination Index (D)} = \frac{\text{Number of test takers who get the item correct (Upper group - Lower group)}}{\text{Number of Students in any of the groups}}$$

Table 3 shows that item discrimination was higher than 0.30. Based on this, it was decided that item discrimination of the test was at the desired level for an ideal test. KR-20 analysis was undertaken for reliability analysis and value of 0.80 was obtained for the 20-item test.

Table 3. Item Discrimination Index Values of the Test

| Question | Upper group-number of correct answers | Lower group-number of correct answers | Item Discrimination Value (D) |
|---|---|---|---|
| 1 | 22 | 14 | 0,30 |
| 2 | 16 | 7 | 0,33 |
| 3 | 24 | 10 | 0,52 |
| 5 | 22 | 10 | 0,44 |
| 7 | 21 | 12 | 0,33 |
| 8 | 22 | 5 | 0,63 |
| 9 | 21 | 6 | 0,56 |
| 11 | 15 | 2 | 0,48 |
| 12 | 20 | 10 | 0,37 |
| 14 | 25 | 5 | 0,74 |
| 15 | 23 | 0 | 0,85 |
| 16 | 17 | 5 | 0,44 |
| 17 | 22 | 0 | 0,81 |
| 19 | 17 | 0 | 0,63 |
| 20 | 23 | 0 | 0,85 |
| 21 | 23 | 11 | 0,44 |
| 22 | 23 | 5 | 0,67 |
| 23 | 23 | 8 | 0,56 |
| 24 | 24 | 7 | 0,63 |
| 25 | 14 | 7 | 0,26 |
| TOTAL | | | 0.54 |

***Presenting "Human Beings and the Environment" Teaching Material***

The secondary school third year "Human and Environment" unit was selected as the topic. This unit includes ecosystems, biological variety and environmental problems sub-topics. The introduction part of the material consists of animations to attract student interest. Following the introduction, students are motivated towards the lesson. The teaching material is composed of lecture and assessment sections. The lecture section includes written and visual formats prepared according to the dual coding theory. Visuals are used to ensure better comprehension of the topic (Fig. 1).

The last part of the lecture includes the hats presented with an animation. The hats are included after each sub- topic. Students are asked to select the hat (blue, white, red, black, yellow and green) suitable for their ideas. These hats point to the six thinking hats technique and each hat represents a different thinking style. Events/cases are expressed with the help of feelings and thoughts such as objective, optimistic, emotional, pessimistic and creative, and students are empowered to make decisions. Students can think multi-directionally in addition to learning the topic. The technique allows students to assess events/cases from different perspectives. Students are given multiple-choice questions in the assessment section.

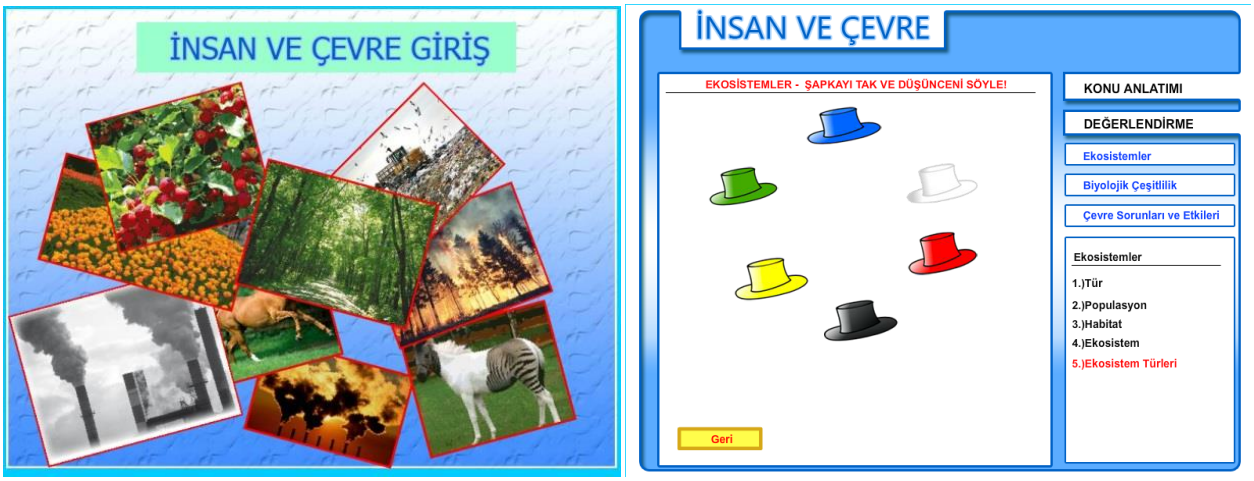


Figure 1. The main web page of six hats.

## Working Group

The working group of the study consisted of students enrolled in the Turkish-Swedish Friendship Secondary School in Istanbul. The working group was composed of randomly selected 2 classes assigned as the experimental and control groups. The 50-student working group included 25 experimental and 25 control group students. Some of the demographic characteristics of the participating students are provided in Table 4.

Table 4. Demographic Characteristics of Participating Students

| Variable | Characteristic | N | % |
|---|---|---|---|
| Gender | Female | 25 | 50 |
| | Male | 25 | 50 |
| Class | Experimental Group | 25 | 50 |
| | Control Group | 25 | 50 |
| Has a computer at home | Yes | 33 | 66 |
| | No | 17 | 34 |
| Has internet access at home | Yes | 24 | 48 |
| | No | 26 | 52 |

As Table 4 shows, 50% of the students were female and 50% were male. 66% of the students (X=33) had computers at home. Number of students with internet access at home was 24.

## Findings

An independent samples t-test was performed to determine whether or not there were significant differences between the experimental and control groups based on students' academic achievement, computer attitude and science attitude scores prior to the implementation phase. Results are provided in Tables 5, 6 and 7.

As Table 5 shows, no significant differences were found between the experimental group students' pre-test academic achievement scores and the control group students' pre-test academic

achievement scores [t(48) = 0.705; $p$ = 0.484]. It can be stated that both groups had similar academic achievement levels in Human Beings and the Environment topic prior to implementation.

Table 5. Experimental and control group students' pre-test academic achievement scores

| Group | N | $\overline{X}$ | SS | sd | t | $p$ |
|---|---|---|---|---|---|---|
| Control group | 25 | 8,68 | 3,54 | 48 | 0.705 | 0.484 |
| Experimental group | 25 | 7,92 | 4,06 | | | |

As Table 6 shows, no significant differences were found between the experimental group students' pre-test computer attitude scores and the control group students' pre-test computer attitude scores [t(48) = 0.616; $p$ = 0.541]. It is apparent that the students from both groups had similar attitudes towards computers prior to the study.

Table 6. Experimental and control group students' pre-test computer attitude scores

| Group | N | $\overline{X}$ | SS | sd | t | $p$ |
|---|---|---|---|---|---|---|
| Control group | 25 | 3,67 | 0,66 | 48 | 0,616 | 0,541 |
| Experimental group | 25 | 3,81 | 0,95 | | | |

As Table 7 shows, no significant differences were found between the experimental group students' pre-test Science and Technology attitude scores and the control group students' pre-test Science and Technology attitude scores [t(48) = 0.845; $p$ = 0.402]. It is observed that students had similar attitudes towards science prior to the study. An independent samples t-test was performed to determine the effects of the teaching methods implemented in the study with the experimental and control group students' academic achievement, computer attitude and science attitude scores and the results are provided in Table 8, 9 and 10.

Table 7. Experimental and control group students' pre-test Science and Technology attitude scores

| Group | N | $\overline{X}$ | SS | sd | t | $p$ |
|---|---|---|---|---|---|---|
| Control group | 25 | 3,46 | 0,57 | 48 | 0.845 | 0.402 |
| Experimental group | 25 | 3,62 | 0,76 | | | |

As Table 8 indicates, there are significant differences between the experimental group students' pre-test academic achievement scores and the control group students' pre-test academic achievement scores in favor of the experimental group [t(48) = 3.034; $p$ = 0.004]. This finding shows that the teaching method implemented in the study significantly contributed to the experimental group students' comprehension in Human Beings and the Environment topic.

Table 8. Experimental and control group students' post-test academic achievement scores

| Group | N | $\overline{X}$ | SS | sd | t | $p$ |
|---|---|---|---|---|---|---|
| Control group | 25 | 9,44 | 4,39 | 48 | 3.034 | 0.004 |
| Experimental group | 25 | 13,12 | 4,19 | | | |

As shown in Table 9, there are significant differences between the experimental group students' post-test computer attitude scores and the control group students' post-test computer attitude scores [t(48) = 2.323; $p$ = 0.024]. Accordingly, the computer attitude mean scores of the experimental group students who were taught using the web-assisted six thinking hats technique were found to be higher than those of the control group students and this result was found to be statistically significant.

Table 9. Experimental and control group students' post-test computer attitude scores

| Group | N | $\overline{X}$ | SS | sd | t | *p* |
|---|---|---|---|---|---|---|
| Control group | 25 | 3,59 | 0,68 | 48 | 2.323 | 0.024 |
| Experimental group | 25 | 4,03 | 0,64 | | | |

As shown in Table10, there are significant differences between the experimental group students' post-test Science and Technology attitude scores and the control group students' post-test Science and Technology attitude scores [t(48) = 2.099; $p$ = 0.041]. Accordingly, the Science and Technology attitude mean scores of the experimental group students who were taught with the web-assisted six thinking hats technique were found to be higher than those of the control group students and this result was found to be statistically significant.

Table 10. Experimental and control group students' post-test Science and Technology attitude scores

| Group | N | $\overline{X}$ | SS | sd | t | *p* |
|---|---|---|---|---|---|---|
| Control group | 25 | 3,44 | 0,65 | 48 | 2.099 | 0.041 |
| Experimental group | 25 | 3,82 | 0,63 | | | |

Paired samples t-test analysis was performed to determine whether or not there were significant differences between the experimental and the control group students' pre- and posttest academic achievement, computer attitude and science attitude scores and the results are provided in Table 11, 12 and 13.

As shown in Table 11, there are significant differences between the experimental group students' pre-test and post-test academic achievement scores [t(24) = 4,102; $p$ = 0,000]. While the experimental group students' pre-test academic achievement mean score was $\overline{X}$ = 7,92, their post-test academic achievement mean score was found to be $\overline{X}$ = 13,12. According to this finding, the change in the experimental group students' academic achievement based on the pre-test and post-test scores is statistically significant.

Table 11 Experimental group students' pre-test and post-test academic achievement scores

| Group | N | $\overline{X}$ | SS | sd | t | *p* |
|---|---|---|---|---|---|---|
| Pre-test | 25 | 7,92 | 4,06 | 24 | 4.102 | 0.000 |
| Post-test | 25 | 13,12 | 4,19 | | | |

As shown in Table 12, no significant differences were found between the experimental group students' pre-test and post-test computer attitude scores [t(24) = 0,887; $p$ = 0,384]. While the experimental group students' pre-test computer attitude mean score was $\overline{X}$ = 3,81 their post-test computer attitude mean score was found to be $\overline{X}$ = 4,03. According to this finding, the change in the experimental group students' computer attitude based on pre-test and post-test scores is not statistically significant.

Table 12. Experimental group students' pre-test and post-test computer attitude scores

| Group | N | $\overline{X}$ | SS | sd | t | *p* |
|---|---|---|---|---|---|---|
| Pre-test | 25 | 3,81 | 0,95 | 24 | 0,887 | 0,384 |
| Post-test | 25 | 4,03 | 0,64 | | | |

As shown in Table 13, no significant differences were found between the experimental group students' pre-test and post-test Science and Technology attitude scores [t(24) = 1,347; $p$ = 0,190]. While the experimental group students' pre-test Science and Technology attitude mean score was $\overline{X}$=3,62, their post-test Science and Technology attitude mean score was found to be $\overline{X}$ = 3,82. According to this finding, the change in experimental group students' Science and Technology based on pre-test and post-test scores is not statistically significant.

Table 13. Experimental group students' pre-test and post-test Science and Technology attitude scores

| Group | N | $\overline{X}$ | SS | sd | t | *p* |
|---|---|---|---|---|---|---|
| Pre-test | 25 | 3,62 | 0,76 | 24 | 1,347 | 0,190 |
| Post-test | 25 | 3,82 | 0,63 | | | |

Data were analyzed using covariance analysis (ANCOVA) to determine whether or not there were statistically significant differences between the experimental and control group students' post-test achievement scores when their pre-test achievement and attitude scores were controlled. Findings are presented in Table 14.

According to Table 14, the model used in ANCOVA analysis is significant ($p$ = 0,034 for the model) and the implemented model can explain 22% of the variance for conceptual achievement in the Human Beings and the Environment topic ($R^2$ = 0,219). Table 14 also shows that the implemented software affects students' academic achievement in favor of the experimental students when their pre-test scores are controlled ($p$ = 0,006).

Table 14. ANCOVA analysis results when pre-test scores are controlled

| *DATA SOURCE* | MS | df | F | *p* |
|---|---|---|---|---|
| Model | 275,928 | 6 | 2,548 | 0,034 |
| AA (Pre-test)** | 6,554 | 1 | 0,359 | 0,552 |
| Science Attitude** | 30,894 | 1 | 1,692 | 0,200 |
| Computer Attitude ** | 24,003 | 1 | 1,315 | 0,258 |
| Group | 150,266 | 1 | 8,231 | 0,006 |
| Error | 821,485 | 45 | | |

* $R^2$= 0,219 ** Controlled variables

## Results and Discussion

This study investigated the effects of web-assisted education material involving the use of the six thinking hats technique on students' academic achievement, attitudes towards science and attitudes towards computers in Science and Technology classes. The results of the experimental study showed that both the six thinking hats technique and the teaching activities implemented in line with the proposed program significantly increased student achievement. Comparison of both groups' post-test scores showed statistically significant differences in favor of the experimental group. This result also supports the effect of approaching and investigating the topic from different perspectives and participating in the process of producing solutions with the help of the six hats technique. Similar studies support these findings. Studies by Korkmaz (2002), Bilek (2009), Sahin, Cerrah, Saka and Sahin (2004), Yaman (2003), Yildiz, Baykal and Altın (2002) Brooks, (2010), Sengul (2006) have identified that students' active learning as in this study positively affects their academic achievement. The fact that web-assisted instruction to teach the Human Beings and the Environment unit in the experimental group was more effective compared to the control group in terms of academic achievement also shows that knowledge acquired as a result of teaching activities using the six thinking

hats technique is more permanent compared to teaching activities proposed in the traditional program. This finding points to the fact that using creative thinking skills during the process of producing solutions when students study is effective. In their studies, Ayaz Can and Semerci (2007) found that students were more willing to wear the white hat and associated this desire with the habit of passively acquiring knowledge in the traditional teaching method for years. As it is known, having students memorize knowledge rather than make sense of what is learned results in forgetting the knowledge in a short period.

Web-assisted education may have developed student attitudes towards computers since the web-assisted education method increases students' skills in the use of the internet, computer and computer technology thereby increasing their confidence in their abilities and feelings of "I can do it too". It provides self-confidence to students who do not ask questions in the classroom environment and do not have the skills to participate in groups. It gives them self-confidence in computer technology settings and satisfies these students' psychological needs such as feelings of independence and belonging to society. This finding supports various studies that also found that the use of computers and computer technologies in learning environments positively affect student attitudes towards computers (Meyveci, 1997; Saracaloglu, Serin and Serin, 2001; Yenice, 2003; Cayirci, 2007; Hancer and Yalcin, 2007; Luckevich, 2008).

Science education provided with the help of the web-assisted education method positively affected student attitudes towards science. This finding is similar to the results of various studies which have found that learning environments using computers and computer technologies result in positive increases in student attitudes towards science (Akcay, Tuysuz & Feyzioglu 2003; Yenice, 2003; Tas, Kose & Cepni, 2006; Olgun, 2006). On the other hand, it was found that special education support in the resource room provided with traditional teaching methods and techniques negatively affected student attitudes towards science.

Methods, techniques and educational materials utilized in traditional teaching decrease student motivation and interest towards learning by not allowing students to take responsibility for their own learning and interact with each other and by not satisfying their psychological needs such as perceiving themselves as successful and being a part of society. Therefore, it is natural that students have negative attitudes towards science in such classes where teachers play the role of knowledge transmitters and the students are the receivers.

There are many viable reasons why special education support provided via web-assisted education increases student attitudes towards science classes compared to traditional education methods:

- Science lesson content can be presented with activities such as animations and games with the help of computers and the lesson can be made more fun and interesting,
- The lessons to be learned can be simplified and supported with audio, photos, video and animations in the web-assisted education method and can be presented at a more suitable level and in more easily comprehensible manner for special education students. This will obviate their fear of not understanding science lessons and will increase interest and motivation.

## Recommandations

The literature review and the results of the current study have presented that use of web-assisted learning using the six thinking hats technique results in positive changes in students' academic achievement. Accordingly,

- Activities that allow students to think multi-directionally should be supported to ensure better comprehension of abstract science topics,
- Students should be encouraged to think multi-directionally rather than thinking in a uniform manner by using methods and techniques such as the six hats thinking technique,
- Lessons should be made more fun by adapting the new methods and techniques to technology,

- In addition to increasing in-class activities among students, settings that allow them to work individually should be promoted,
- Activities and settings should be developed that will save students from the mediocrity of traditional teaching methods and that will increase permanency in learning as opposed to mere memorization methods.

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