

Investigation of the effects of scorm adapted whiteboard movie techniques on students' success in physics classes

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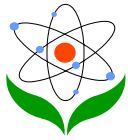
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Contents

- [Abstract](#)
 - [Introduction](#)
 - [Method](#)
 - [Problem](#)
 - [Participants](#)
 - [Application Subject](#)
 - [Data Collection Instruments](#)
 - [Analysis of Data](#)
 - [Results](#)
 - [Results and Discussion](#)
 - [References](#)
-



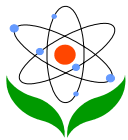
Abstract

In this study, a web site including instructional materials such as white sheet videos, simulations, and animations and problem solving materials such as true-false questions, fill-in-the-blanks, puzzles, open-ended and multiple-choice questions regarding such important physics units as "Force" and "Movement" was designed. The purpose was to investigate not only the effects of this web page on students' success in physics class but also the effects on their accomplishment levels of the objectives planned at the beginning of the class. An experimental design which included pre- and post-tests was used to measure the expected effects in this study. This study was conducted with 139 high school students (76 in the experimental group and 63 in the control group) in the academic year of 2008–2009. As a result of the analysis of the data collected, it was found out that there were statistically significant differences between both students' scores in the physics achievement test and their scores obtained from the check list of the students' gains in favour of experimental group ($P < 0.05$). Analysis of the interviews held with 19 volunteering students demonstrated that although there were some technical problems experienced, the web site prepared helped the students learn the selected subjects.

Keywords: White Board Movie, Web-based Learning, Moodle, SCORM

Introduction

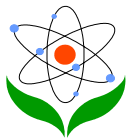
Nowadays, people discovered that the education they have taken supports their lifelong achievements. However, it can not always be reached. Therefore, there are still on-going studies on how to allow everybody to reach the modern education. Traditional teaching methods are still dominant because of its simplicity, lower cost and its success on partly covering the people's needs. This model cannot solve the problem of finding a sufficient number of qualified teachers even in developed countries. To reduce this problem, non-simultaneous learning approaches come into the mind. In recent years, these methods have been using the traditional postal services and the internet in order to deliver course materials. These non-simultaneous methods make course materials accessible anytime without a need for an instructor. More than half of big institutions (Institutions that have a student population over 7500 students) offer at least one online program (Allen & Seaman, 2006).



Most of the education given in this way is based on the use of the non-simultaneous World Wide Web (www) technology. It is possible to reach educational materials via the internet in the format of texts and graphics. Since storing the present files may constitute the basis of an educational web site, it is easy to make this approach available. However, it is quite a time consuming process for educators to establish a non-simultaneous learning web site. This process requires combining the electronic documents with an online learning management system which supports special courses. In this way, it is possible to reach further levels than the present level of non-simultaneous distance learning. In our study, the Virtual Learning Environment (VLE) was used. VLE is a software system developed for the purpose of helping teachers and students manage the educational context. This system can be monitored by both teachers and students. Virtual learning environments were defined as partly open computer-based systems which allow reaching the educational resources, sharing knowledge and establishing interactions between participants (Wilson, 1996). The virtual learning environment actually means providing "learning anytime and anywhere" by putting the resources for self-learning in order and by providing context learning and active learning (Chou & Liu, 2005). Moodle is a virtual learning environment in which we can do all of the above mentioned features. Moodle stands for "Modular Object-Oriented Dynamic Learning Environment". Moodle is an open-source software platform. Moodle was designed for the purpose of helping educators develop online educational software with its high interaction opportunities. Its open source license and unit design provide context experts with opportunities to develop additional functions.

The Moodle design is modular, and it can be enriched easily by adding new functions. The infrastructure of Moodle supports a lot of plug-ins such as activities, resource types, question types, data types (for database activities), linear themes, confirmation methods, recording methods, context filters and reports. The development of Moodle was supported by the efforts of the community of open source programmers. These efforts contributed to its rapid development. At the same time, Moodle can be used in lots of educational applications. Thus, the Whiteboard movies in this study were operated on Moodle.

Whiteboard movies are screen plays in which the text and the sound are recorded together and can be transformed into various formats such as flash movies including problem solutions and explanations of mathematical concepts. These whiteboard movies can be distributed in CDs or via the internet. Whiteboard

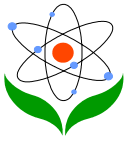


movies can be quite simple as a one-minute short recording without an audio (WBM) or can be very complex as an interactive educational movie in which the learner can find solutions to questions or explanations regarding the solutions to similar problems.

In 1997, Tim Fahlberg was the pioneer of WBM (Fahlberg, 2004; Fahlberg & Nonis, 2005). Widely accepted, this method was used in various educational contexts ranging from primary education to higher education. The present status of WBM, which was started as a big project, has been achieved as a result of longitudinal studies. WBMs are very simple to use. They include some activities and facilities such as watching and listening to the subject taught, listening to it at any time, rehearsing the subject at any time, watching and listening to each step and understanding the method used (<http://www.mathcasts.org>).

At the beginning, WBM was thought to be an effective and supportive non-classroom method rather than tutoring or other educational supports. It was initially developed by Tim Fahlberg as a mathematical website including videos and audios. Later, he distributed TechSmith's Camtasia Studio via the web and in CDs after producing many high-quality WBMs by using Corel Grafio with the help of a graphical tablet or tablet PC between the years of 2000 and 2003 years (<http://www.coolschooltools.com/whiteboardmovies.html>). WBM is a learning technique which is mostly used in mathematical education. Most common questions about WBM are: How easy is it to produce a WBM? What is the cost of producing a WBM? It is important that educators know how WBMs can be integrated into the educational process in order to reach the expected quality of learning outcomes in visual and audio dimensions. Since mathematics and geometry are important in physics education both in experimental and theoretical basis, WBMs that are used in mathematics education can also be used in physics education.

In this study, it was believed that web based learning (WBL) materials would eliminate some of the present problems in application since (WBL) materials allow students to study at their own pace. Thus, a website that has both visual and audio features was designed. The overall purpose of the present study was to investigate the effects of these teaching materials on students' achievements in the units of "force" and "movement".



Method

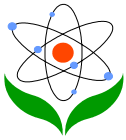
The purpose of this study was to investigate whether the use of Whiteboard Movie has a significant effect on secondary school students' problem solving skills and the learning outcomes in physics or not. For this purpose, the effects of Whiteboard Movie technique were tested by applying the triangulation method on the data obtained via different measurement instruments.

Problem

Physics is one of the fundamental courses both in secondary schools and in science programs at universities. A lot of students find this course difficult, abstract and boring because of the problems in physics education. There are many reasons for this negative impression and attitudes towards physics courses. Some of these reasons are as follows: instructors do not solve a sufficient number of physics problems; they do not carry out activities to develop students' problem solving skills; and they do not use technology effectively in educational environments. In this study, it was believed that web-based learning (WBL) materials would eliminate some of the present problems in application since (WBL) materials allow students to study at their own pace. Thus, WBMs were added to the web-site that has both visual and audio features. In this way, each student was able to solve as many problems as they wanted according to their own level and at their own pace. In the light of this information, the purpose of this study was to investigate whether using Whiteboard Movie had a significant effect on secondary school students' problem solving skills and on the target learning outcomes in physics or not.

Participants

This study was conducted with 139 10th grade students (3 experimental and 3 control groups) who were enrolled at Cumhuriyet Science High School (CFL), Diyarbakır Anatolian High School (DAL) and Dicle College (DK). In our study, the basic reason for choosing three different schools was to test the effectiveness of the teaching method we applied. The knowledge levels of students attending regular public high schools in Turkey are lower than those attending Science High Schools and Anatolian High Schools, which admit students according to the results of a placement exam. The present study tried to find answers to the question of whether



the teaching method selected had similar effects on student groups with different knowledge levels. All these three high schools are located in Diyarbakır urban area. The number of the students in the experimental and control groups in each school are given in Table 1 below.

Table 1. Distribution of the student groups according to their schools

Groups	n
CFL-Experimental	24
CFL-Control	24
DAL- Experimental	30
DAL- Control	26
DK- Experimental	22
DK-Control	13
Total Control	63
Total Experimental	76

Application Subject

In this study, some subjects that were present in the 10th grade physics curriculum were taught as they were in the lesson plans (18 weeks) to both experimental and control groups. These subjects were vectors, the concept of force and its properties, measurement of force, momentum, equilibrium, mass and gravity point, location on a line, replacement and linear movement, average volume and instantaneous volume, average acceleration and instantaneous acceleration, and constant acceleration movement. A total of five objectives and 39 learning outcomes were determined. The questions were prepared to measure the learning outcomes determined while designing the testing instrument. The control groups were taught via traditional face-to-face instruction, while the experimental groups were taught by using the "www.canliegitim.com" website in addition to face-to-face instruction.

Different teaching techniques were used in order for the students to understand the concepts much more easily. The students were provided with different options in order for them to enjoy while learning. The students could follow the lessons either from the slides with audio features or from video recordings of lessons or from WBM. Sample figures about these materials are shown below.

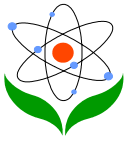
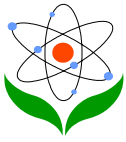


Figure 1. Teaching by slides

From these slides, as seen in figure 1, the students could follow the subject with audio features. In other words, the students could listen to the instructions from these audio-included slides. The students could also choose a slide that they wanted to listen to by clicking on the subject titles shown on the left side of the screen.

In addition to these slides, at the end of each subject, a total of 365 WBMs were prepared for the students to develop their problem solving skills and their conceptual understandings. While the students followed the procedures with audio and video features step by step, they could also watch the solution of a problem several times thanks to the WBMs.

Various simulations and animations were used on the website in order to explain the subjects better. Since these simulations and animations make abstract concepts concrete, it increases student motivation, provides learning reinforcement and helps students keep concepts in their mind longer. Sample screenshots of these simulations and animations used in this study are shown in figure 3 and figure 4.



http://www.canligitim.com - Created by Camtasia Studio 5 - Microsoft Internet Explorer

K $v_K = 8 \text{ m/s}$ L $v_L = 7 \text{ m/s}$

A B

Doğrusal bir yolda birbirlerine doğru hareket eden araçların hızları şekildedeki gibidir.

Araçlar A ve B noktalarından aynı anda geçtikten 10 s sonra karşılaştıklarına göre, A ve B noktaları arasındaki uzaklık kaç m dir?

A) 75 B) 100 C) 125 D) 150 E) 200

$t = \frac{x}{v_1 + v_2}$

$t = 10 \text{ s}$

$v_K = 8 \text{ m/s}$

$v_L = 7 \text{ m/s}$

$x = (8+7) \cdot 10$

$x = 150 \text{ m}$

$x = 150$

SSID: (AIRTIES)
Hız: 18.0 Mbps
Sinyal: Çok Düşük
Durum: İlgili Değil
Adres: 192.168.2.5

Figure 2. WBM screenshot

vektörler: vektörler: 2 vektörün sayısal olarak kordinat sisteminde toplanması animasyonu - Microsoft Internet Explorer

Dosya Düzen Görünüm Sık Kullanılanlar Araçlar Yardım

Adres http://www.canligitim.com/dicle/mod/resource/view.php?id=129

Vektörler

UZAKTAN EĞİTİM vektörler Kaynaklar 2 vektörün sayısal olarak kordinat sisteminde toplanması animasyonu

Kaynak güncelle

2 vektörün kordinat sisteminde sayısal toplamı.

$(7,4)$

$(5,14)$

$(12,18)$

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Figure 3. Flash animation screenshot

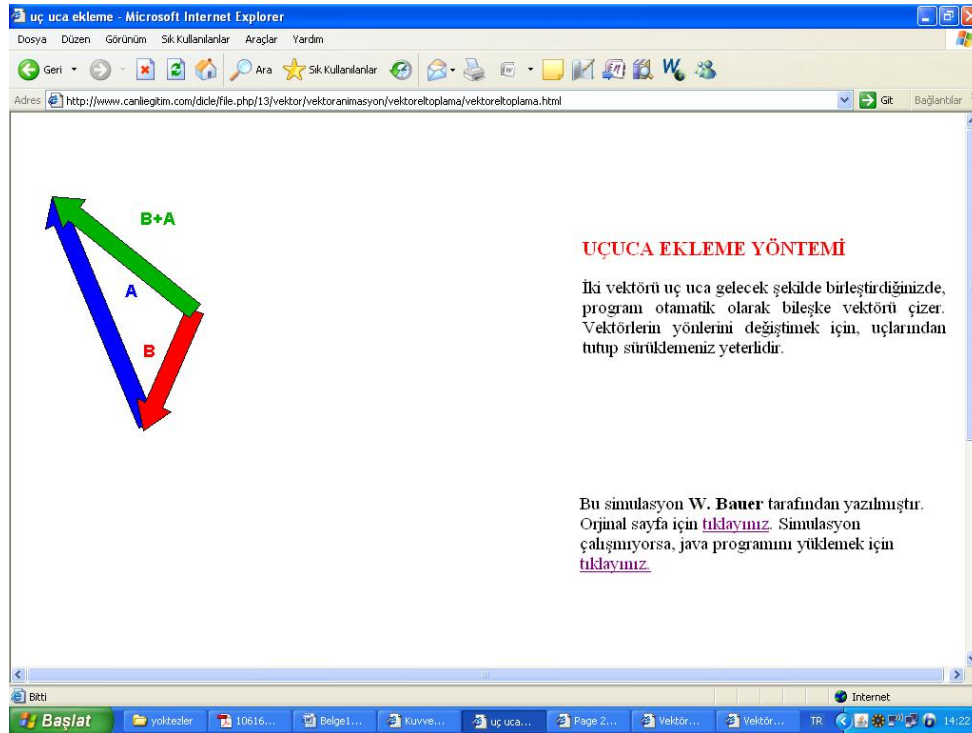
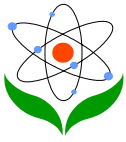
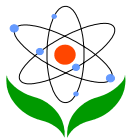


Figure 4. Sample java applet simulation

Data Collection Instruments

In this study, an achievement test about the topics of "Force" and "Movement", a behaviour control list about the same subjects and interview text documents were used. While the students' academic skills were tested with the achievement test, the behaviour control list was used monitor the students' behaviour in order to check whether the results obtained from the quantitative analysis were accurate or not. The effectiveness of the teaching method was tested by comparing the mean scores of the experimental and control groups. In addition to this, face to face interviews were held with 19 volunteering students from the experimental group to get their views about the method and materials used.

An item pool of 60 items was prepared by considering the target skills determined by the Ministry of Education. All the items in this pool were regarding the topics of "Force" and "Movement", which are found in the 10th grade physics curriculum. Some items whose "P" value deviates from 0.5 were also included in the test. In addition, the "P" value was around 0.5, and mean "D" value was around "0.4". The items, whose discriminations and difficulties were computed and then checked by



experienced physics teachers and measurement specialists. Considering their opinions, the number of the items in the test form was reduced to 40 without destroying the content validity. The reliability of the test was tested by applying the split-half method. The reliability of half of the test was found to be $r=.576$. Then, Spearman-Brown rule was applied to compute the reliability coefficient ($r=.731$) for the whole test. In preparing the behaviour check list, we used the list of students' target gains found in the 10th grade physics course book determined by the Ministry of Education. Expert opinions were taken about the questions directed during the face-to-face interviews about Web based learning in order to be sure whether these questions were related to our purpose or not.

Analysis of Data

Quantitative data analyses (data from the achievement list and data from the behaviour control list) were conducted by using SSPS 15.0 statistical analysis program. The qualitative data from the interviews were analysed by using the methods of grouping, categorization and frequency tables.

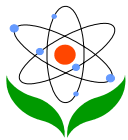
Results

According to the assumption of equal variances, the independent groups t-test technique was used to determine whether there was a significant difference between the pre-tests administered to both experimental and control groups. The results of the t-test are shown in table 2 below.

Table 2. Results of the independent t-test regarding the pre-test means of experimental and control groups.

Groups	Mean difference	t value	df	P
CFL Control-Experimental	-1.792	-1.386	46	0.212
DAL Control-Experimental	0.415	0.404	54	0.688
DK Control-Experimental	-2.808	-1.866	33	0.071

$P>0.05$



As can be seen in Table 2, there was no statistically significant difference between the pre-tests administered to the control and experimental groups ($p > 0.05$). Therefore, all the control and experimental groups (from all schools) were considered to be equal in terms of background knowledge.

Before starting with the class activities, the subject achievement test was applied as pre-test for the purpose of assessing the students' levels of background knowledge about the topics. During these applications, while the subjects were taught with the traditional method in the control group, the web-based learning technique was used in the experimental group. At the end of the applications, the same test was administered as post-test to understand the students' levels of knowledge. These data obtained from the tests were arranged according to the methods.

The independent groups t-test was applied again to determine whether there was a significant difference between the post-tests administered to both experimental and control groups. The results of the t-test are shown in Table 3 below

Table 3. Results of the independent t-test regarding the post-test means of the experimental and control groups

Groups	Mean Difference	t value	df	P
FL Control-Experimental	-4.208	-3.575	46	0.001*
ADL Control-Experimental	-4.949	-3.940	54	0.000*
DK Control-Experimental	-7.290	-6.255	33	0.000*

As can be seen in Table 3, there was a statistically significant difference between the post-tests administered to the control and experimental groups ($p > 0.05$) in favour of the experimental groups.

The independent groups t-test was applied again to determine whether there was a significant difference between the post-tests mean scores of both combined experimental and control groups. The results of the t-test are shown in table 4 below.

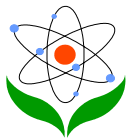


Table 4. Results of the independent t-test regarding the post-test means of the combined experimental and control groups

Groups	Mean Difference	t value	df	P
Control-Experimental	-4.878	-4.326	137	0.000*

As can be seen in Table 4, there was a statistically significant difference between the post-tests administered to the control and experimental groups ($p > 0.05$) in favour of the combined experimental groups.

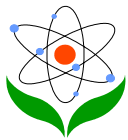
At the end of the applications, the behaviour control lists were prepared for each student in the control and experimental groups in order to determine to what extent each of these students acquired the target gains.

The result of the analysis regarding whether there was a significant difference between the control and experimental groups in terms of getting the target gains are presented in Table 5.

Table 5. Results of Mann Whitney U test applied to find out the extent to which each of these students acquired the target gains

Groups	N	Row Mean	Row Total	U	P
CFL					
Experimental	24	31.46	755		
Control	24	17.54	421	121	0.001
DAL					
Experimental	30	29.02	870.50		
Control	26	27.90	725.50	374.5	0.799
DK					
Experimental	22	17.50	385		
Control	13	18.85	245	132	0.706

There was a significant difference in terms of getting the target gains in favour of the experimental group in Cumhuriyet Science High School (CFL) ($U=121$, $p < 0.05$). However, there was no significant difference between the control and experimental



groups in Diyarbakır Anatolian High (DAL) and Dicle College (DK) ($U=374, 5$; $U=132$, respectively, $p>0.05$).

The results of Mann Whitney U test demonstrating the extent to which each of the combined control and experimental groups acquired the target gains are shown in Table 6 below.

Table 6. Results of Mann Whitney U test showing the extent to which each of the combined control and experimental groups acquired the target gains

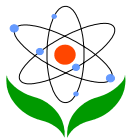
All Schools	Groups	N	Row Mean	Row Total	U	P
	Experimental	76	77.40	5882.50		
Control	63	61.07	3847.50			

According to the Table above, there was no statistically significant difference between the combined experimental and control groups ($U=1831,5, p<0.05$).

Face-to-face interviews were held with the students in the experimental groups in order to confirm the reliability of the results obtained from the achievement test and from the behaviour control list. For this purpose, 19 volunteering students (8 CFL, 6 DAL and 5 DK) from the experimental groups were directed 4 open-ended questions regarding their views about the materials on the website. During these interviews, some students' views were observed. These views were related to the presence of different problem solving methods, learning the subjects actively, decreasing the anxiety level regarding the lessons, increasing achievement levels at school, availability of repetition opportunities. These views are shown in Table 7 below.

Table 7. Results of the interviews regarding the documents on the website

Student Views	f	%
Different problem solving techniques in WBMs helped me learn.	16	84.21
The documents made me learn the subjects actively and in a more enjoyable way.	7	36.84
Visual explanations of the subjects reduced my anxiety towards the physics course.	12	63.15
Use of various methods in solving the problems increased my achievement and	15	78.94



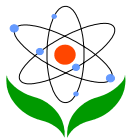
problem solving speed.		
Since they provide numerous repetition opportunities, WBMs helped me learn.	8	42.1
I found them very useful since they are visual.	6	31.57
Explanations of the subjects were very shallow, so it did not help me learn.	2	10.52
Different question forms like multiple-choice, fill-in-the blanks, true-false and short answer in tests helped me learn.	11	57.89
The problems that I solved increased my achievement level at school.	6	31.57
I did not like the trial questions. they could have been prepared more challenging.	6	31.57
The trial tests had partial effects on my success.	4	21.05
With the aid of WBMs, I could solve the problems which I had not understood before.	3	15.78
The physics subjects were explained well in the web environment. Since WBMs are well-designed, they helped me understand the concepts.	12	63.15

Results and Discussion

The teaching method for the course chosen for the experimental group was one defined in literature with such concepts as hybrid learning or blended learning, which is one of the most remarkable and appreciated instructional methods including whiteboard movies. According to Smith and Kurthen (2007), today, there is a great increase in the number of hybrid classrooms incorporating online and face-to-face methods.

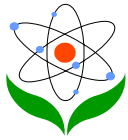
The present study aimed at investigating whether there was a significant difference between the experimental and control groups in terms of the students' levels of achieving the target gains and their levels of success in problem solving in the course.

In order to reveal to what extent the website designed for the lesson units of "Force" and "Motion" changed the achievement levels of the students from the schools of CFL, DAL and DK, a 40-item test for the course of physics was applied to 139 students before and after the application. When the mean scores obtained in the achievement test before the application by the participating student groups from the schools of CFL, DAL and DK were taken into consideration, it was revealed that there was no significant difference between the groups and that the groups demonstrated the same achievement levels. After the students used the web site, it



was revealed that there was an increase in the achievement levels of the students from the three schools (Table 3). When the difference between the mean scores obtained in the achievement test before and after the application by the participating student groups from the schools of CFL, DAL and DK were examined, it was seen that the mean scores obtained in the achievement test by the students attending the school of CFL were found as 1.762 before the application and as 4.949 after the application; that the mean scores obtained in the achievement test by the students attending the school of DAL were found as 0.415 before the application and as 4.949 after the application; and that the mean scores obtained in the achievement test by the students attending the school of DAL were found as 2.808 before the application and as 7.290 after the application. The statistical analyses demonstrated that the differences between the mean scores obtained before and after the application were significant for all the schools ($p < 0.05$).

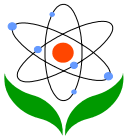
There are many studies indicating that computer assisted instructional materials increase students' achievement levels (Jimoyiannis & Komis, 2001). However, we can say that there is limited literature on WBL. One of the existing studies about WBL was done by Demirci (2002). In the present study carried out in a high-school level in Florida, USA, it was found out that the students using the web-based material were more successful in the subjects of "force" and "motion" when compared to those receiving instruction via traditional teaching methods. Similarly, comparing the internet-supported education with traditional education in 8th grade level, Cuez (2006) reported that the students receiving Internet-supported instruction had a higher level of achievement than the other students. In a study carried out by Jang (2006) on various subjects (heat, reflection of light and changes in life) in the 8th grade course of science, the researcher found out that the students in the experimental group had higher achievement scores than those in the control group. It was revealed in the study that the students participating in the study generally believed that WBL applications increased their achievement levels. Similarly, another study carried out by Tas (2006) with 7th grade students demonstrated that WBL revealed better results than the traditional method of instruction. In the study, it was found out that the students' achievement levels increased when the 7th grade lesson unit of "Let's All Learn and Protect Our Blue Planet, Our Common Home" was taught via WBL. The researcher attributed this increase in the students' achievement scores to the large number of subject-based activities, analogy techniques, semantic analysis tables, concept maps, graphics, images and animations. In their studies, Daugherty and Funke (1998) and Hitz



(1994) and Jonassen (1999) pointed out that distant learning was more effective in solving complex problems and in understanding the results of learning (Suanpang et al., 2004). Hayes and Billy (2003), as a result of a series of studies they carried out in North America in 2000, concluded that WBL was at least as effective as traditional learning methods. The researchers stated that WBL activities increased students' levels of achievement. In addition, the students participating in these studies reported that WBL materials were more effective than traditional learning methods. In another study conducted by Hewlett (2000) on WBL activities, students supported with WBL obtained higher scores than the scores they obtained via the traditional teaching method. Seng and Mohamad (2002) stated that students attending courses with WBL were more interested in their own study fields; that they more comfortably participated in traditional in-class discussions; and that they were able to carry out activities with crowded groups while teaching some special subjects. In this respect, it is seen that the results reported in these studies were quite consistent with the findings obtained in the present study.

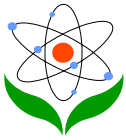
Depending on the findings obtained via the applications carried out with the WBL material, the factors with positive influence on students' achievement levels could be stated as follows: there are a number of WBM (White Board Movies) on the web site; questions can be followed up audio-visually thanks to WBMs; there is a WBM appropriate to each student; animations, especially those on the web-site including audio-visual elements, draw students' interest; slides and video-supported lecturing increase students' motivation in the lesson; the teacher and the researcher use the web-site effectively; the researcher and the teachers successfully take the role of a "guide"; and students participate in the lesson actively.

In addition, it was seen during the applications that there were various other situations influencing the students' achievement negatively. In this respect, there were several factors influencing the students' achievement negatively in the applications carried out via the web-site. These factors were the low levels of students' computer literacy, problems experienced while watching the teacher and the web-site simultaneously, lack of opportunity for students to access the internet during out-of-class hours, technical problems with the students' computers, easy loss of students' interest, noise in the learning environment and the difficulties experienced while controlling the learning environment. Research on the influence of web-based education on students' gains constitutes one of the important sub-problems of the present study. According to the results of Mann Whitney U



test applied to understand whether the teaching method used influenced the levels of the students' gains, the comparison of the students' levels of gains revealed that there was a statistically significant difference in favour of the experimental group ($p < 0.05$) and that no significant difference was found between the DAL and DK groups ($p > 0.05$). Moreover, one experimental group and one control group were formed by gathering the experimental groups in the schools within the scope of the present study under a single group and the control groups under another group. According to the results of Mann Whitney U test carried out to see to what extent this experimental group and the other control group achieved the target gains, it was seen that the experimental group achieved the target behaviour with a higher level than the control group did ($p < 0.05$). The fact that this result obtained was also consistent with the results obtained from the achievement test demonstrated that the whiteboard movie technique increased the students' achievement level. The fact that the gain scores and the scores obtained from the achievement test as well as the results obtained from the interviews were all consistent with one another was also important for the validity of the findings. The findings obtained in the present study were parallel to the results of several studies carried out in the field, while the present findings did not support the results of several other studies. Esch (2003), Fladd (2007), Tang and Byrne (2007), Bayrak and Karlı (2007), in their studies, concluded that the web-based, or Internet-supported, teaching method was more influential with respect to the students' level of achieving the target behavior when compared with the traditional face-to-face teaching method. In addition, Shen et. al. (2007), Ware (2006), Mentzer et. al. (2007) and Delialioğlu (2004), in their studies, reported that there was no significant difference between the web-based or Internet-supported teaching method and the traditional face-to-face teaching method in terms of the students' level of achieving the target behaviour. Furthermore, in the present study, it was seen that the use of different ways of solving the problems related to the physics subjects increased the students' self-confidence, their gains and their achievement (Table 4, Table 6 and Table 7). These results demonstrated that web-based learning would be useful at the desired level when appropriate conditions were prepared both in the school environment and at home. However, in web-based learning, it should always be remembered that the documents found in the web-site prepared be appropriate to the educational principles and to the course objectives.

As a result, since the problem solutions in the whiteboard movies prepared, the video-supported lecturing and the slides provide numerous opportunities for



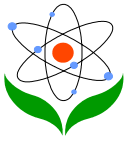
reviewing, they all increase the students' desire to learn and their achievement levels. In addition, including different question types in the exams given on the web-site (multiple-choice, fill-in-the-blanks, puzzles, true-false, drag-and-drop, short answer and so on) helps students understand the subject better (Table 7).

Based on these results, several suggestions could be put forward as follows:

- In order to achieve the desired success via web-based education, schools should have computer laboratories with fast Internet-access,
- Students should be able to benefit from computer laboratories whenever they need during the time they are at school,
- The Ministry of National Education should give importance to infrastructural investment on WBL in order to revise its educational policy, its structure and its function with the help of the opportunities provided by technology and to give education integrated with new technologies,
- As a result of the applications, it is thought that teaching the course of physics completely via the web-based method will bore students in time. Therefore, it could be suggested that WBL be used in certain parts of the lesson units depending on the scientific process skills that the students are expected to acquire. Especially in the course of physics, it would be better to teach the subjects within the triangle of the class, the physics laboratory and the computer laboratory.

References

- Allen, I. E., & Seaman, J. (2006). *Making the grade: Online education in the United States*. Needham, MA: The Sloan Consortium (02492).
- Bayrak, B., & Karlı, U. (2007). To Compare The Effects of Computer Based Learning and The Laboratory Based Learning on Students' Achievement Regarding Electric Circuits. *The Turkish Online Journal of Educational Technology*, 6 (1),15-24.
- Chou, S., & Liu, S. (2005). *Learning Effectiveness in Web-based Technology-mediated Virtual Learning Environment*. Proceedings of the 38th Hawaii International Conference on System Sciences.
- Chou, S., & Liu, S. (2005). *Learning Effectiveness in Web-based Technology-mediated Virtual Learning Environment*. Proceedings of the 38th Hawaii International Conference on System Sciences.
- Demirci, N., (2002). *Öğrencilerin Kuvvet ve Hareket Konularında Başarıları ve Yanlış Anlamaları Üzerine Bir Web Tabanlı Fizik Programının Etkilerinin İncelenmesi*, V Ulusal Fen ve Matematik Eğitimi Kongresi, ODTÜ, Ankara.



- Delialioğlu, Ö. (2004). *Effectiveness of Hybrid Instruction on Certain Cognitive and Affective Learning Outcomes in a Computer Network Course*. Ankara: Middle East Technical University (Unpublished PhD Thesis).
- Esch, T. J. (2003). *E-Learning Effectiveness: An Examination of Online Training Methods for Training End-Users of New Technology Systems*. Touro University International (Yayımlanmamış Doktora Tezi).
- Fahlberg, T. (2004). *Creating Whiteboard Movies That Teach and Foster Collaboration (Whiteboard Movie Presentation)*. New Orleans, USA: NECC.
- Fahlberg, T., & Nonis, J. (2005). *Creating Whiteboard Movies to Teach, Add to ePortfolios, and Collaborate, 2005*, Philadelphia, USA: NECC.
- Fladd, L. A. (2007). *The Effect of Instructional Delivery Method on Interaction and Satisfaction in Distance Education Courses at a Community Collage*. Clemson University (Unpublished PhD Thesis).
- Hayes, M., & Billy, A. (2003). Web-Based Modules Designed to Address Learning Bottlenecks in Introductory Anatomy and Physiology Courses, Interactive. *Multimedia Electronic Journal of Computer-Enhanced Learning*, 1(2).
- Hewlett, M. (2000). *Teaching Molecular Biology*. Erişim, web. 14.09.2009 tarihinde <http://naweb.unb.ca/proceedings/2000/mjhNAWeb.html> adresinden alınmıştır.
- Jang, S.J., (2006). The Effects of Incorporating Web-Assisted Learning with Team Teaching in Seventh-Grade Science Classes. *International Journal of Science Education*, 28(6), 615-632.
- Jimoyiannis, A. & Komis, V.,(2001). Computer Simulations in Physics Teaching and Learning: A Case Study on Students' Understanding of Trajectory Motion. *Computer & Education*, 36, 183-204.
- Mentzer, G. A., Cryan, J. R., & Teclehaimanot, B. (2007). Two Peas in a Pod? A Comparison of Face-to-Face and Web-Based Classrooms. *Journal of Technology and Teacher Education*, 15 (2), 233-246.
- Seng, L. & Mohamad, F. S. (2002). Online Learning Is it Meant for Science Courses? *Internet and Higher Education*, 5, 109-118.
- Shen, Q., Chunk, J. K., Challis, D., & Cheung, R. C. (2007). *A Compative Study of Student Performans in Traditional Mode and Online Mode of Learning*. Wiley Periodicals Inc.
- Smith, G. G., & Kurthen, H. (2007). Front-Stage and Back-Stage in Hybrid E-Learning Face-to- Face Courses. *International Journal on E-Learning*, 6 (3), 455-474.
- Suanpang, P., Petocz, P., & Kalceff, W. (2004). *Student Attitudes to Learning Business Statistics: Comparison of Online and Traditional Methods*. <http://www.ifets.info> Erişim: 12.12. 2009
- Tang, M., & Byrne, R. (2007). Regular Versus Online Versus Blended: A Qualitative Description of the Advantages of the Electronic Modes and a Qualitative Evaluation. *International Journal on E-Learning*, 6 (2), 257-266.
- Taş, E., (2006). *Web Tasarımlı Bir Fen Bilgisi Materyalinin Geliştirilmesi, Uygulanması ve Değerlendirilmesi*, Doktora Tezi, Fen Bilimleri Enstitüsü, Karadeniz Teknik Üniversitesi, Trabzon.
- Ware, H. B. (2006). *Learner Centered E-Learning: An Exploration of Learner-Centered Practices In Online and Traditional Instruction in Higher Education*. Louisiana State University (Unpublished PhD Thesis).
- Wilson, B. G. (1996). *Constructivist Learning Environments: Case Studies in Instructional Design*, Educational Technology Publications, Englewood Cliffs.