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Evaluation of students' views about the use of SCORM (Sharable Content Object Reference Model)-compatible materials in physics teaching

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In the present study, a web site including instructional materials such as Whiteboard Movies (WBM), simulations and animations and testing materials such as true-false, fill-in-the-blanks, puzzles, open-ended questions and multiple-choice questions was designed. The study was carried out with 76 students attending Dicle College (DC), Diyarbakir Anatolian High School (DAHS) and Cumhuriyet Science High School (CSHS) located in the central town of the city Diyarbakir in southeast of Turkey and equipped with computer laboratories and Internet connection in the academic year of 2008 to 2009. Before the application, the data base records were taken regarding the participation of the students in the web activities. At the end of the application, 10 open-ended questions were directed to 19 volunteering students to evaluate the participating students' views about the learning approach used and about the web site designed. The analyses of the responses given to the open-ended questions revealed that the students were generally satisfied with the testing and instructional materials found on the web site developed and that the students still experienced such problems as slowly-opening WBMs, an inadequate number of test forms including multiple-choice questions and insufficient duration of application. Considering the findings as a whole obtained in the study, it was thought that it would be beneficial to use web-based educational applications in teaching physics in schools with better Internet infrastructure and opportunities.

Key words: Web based education, modular object-oriented dynamic learning environment (MOODLE), students' views.

INTRODUCTION

Today, instructional technologies are used in all levels of education. Computer and information technologies have brought certain standards to a number of parts of our lives such as education, economy, business and health (Cepek and Hnojil, 2005). Today's employment conditions are shaped depending on individuals' skills and on their up-to-date knowledge. Since technical skills change based on technological developments or become old-fashioned, approaches supporting continuous education such as Web Based Education (WBE) will make it possible to meet the demand for training to acquire these skills. WBE defined as the use of the computer and the Internet together is a new trend in education. One of the most important components of WBE is WBM. WBMs are

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screen images which include texts or audios that can be transformed into various formats such as flash movies explaining mathematical concepts and solutions to problems and which can be distributed via CDs or the Internet. WBM could be a one-minute record including no sound as well as a fully-interactive complex educational video record which helps the learner understand the answers to the problems or the solutions to similar problems of his or her own. It is the latest form of asynchronous learning that provides simple and inexpensive interactive education. WBM was first led by Tim Fahlberg in 1997 (Fahlberg, 2004; Fahlberg and Nonis, 2005). Soon after this method was proved to be successful and preferred more, it started to be used for the education of students ranging from elementary schools to higher education institutions. WBM was first thought as a supplementary method effectively applied out of the classroom different from the educational support of the family, the private teacher or of other private educational institutions. Initially, Tim Fahlberg applied this method by designing a multimedia-based mathematical website including visual and audio narrations. Later, between 2000 and 2003, Tim Fahlberg created a number of high-quality WBMs by using TechSmith's Camtasia Studio via Corel Grafio with a graphics tablet or a tablet PC and distributed these WBMs via CDs or the web.

As a result of the development of the Internet and multimedia technologies and of the use of these technologies in distant education programs, different definitions of this model have occurred in recent years such as "web-based education", "web-supported education" and "e-learning". Computer-Based Education (CBE) and WTE – which occurred as the synthesis of the Internet and distant education – provide the individual with educational opportunities independent of time and place with the support of the Internet. In this way, education has a more student-centered structure. In addition, in web-based distant education, with the Internet services such as interactive web pages, e-mail, file transfer, discussion and news groups and chat rooms, synchronous and/or asynchronous communication can be established between students and trainers. In the Internet environment, students who are constantly in communication/interaction with the trainer, who visit various web pages with different contents, who become members of clubs, who participate in e-mail groups and who visit information suppliers from different parts of the world (such as virtual libraries, news services and so on) acquire a number of skills including the use of various tools. Since students reach new information in this process, incidental learning occurs as well (Ergün, 1998; Özen and Karaman, 2001; Atack and Rankin, 2002; Yazon et al., 2002; Hawatson, 2004; Al and Madran, 2005). Seiler and Billings (2004) revealed that the most important features of web-based distant learning include the use of computers and a sufficient level of computer literacy, asynchronous/synchronous communication established between the students and between the student and the trainer and the flexibility and comfort due to the availability of learning opportunities at any time and in any place.

There are two important elements of web-based distant learning: (1) the human force that has the technical knowledge to maintain the continuity of the system and to prepare and present the course materials in the computer environment, and (2) the human force that has the educational knowledge to prepare the content.

SCORM (Sharable Content Object Reference Model) is a referential model created via adaptation of the standards developed to make e-learning software durable, re-usable and functional with other software and accessible. The main purpose of SCORM is to provide learning materials at any time and in any place. Since the features of SCORM explained the standard way for packaging course materials, it has become quite easier to achieve this purpose. The Learning Management System (LMS) has an important place in SCORM. LMS is software that helps manage learning activities. They allow such functions as presenting the learning material, sharing and discussing the learning material presented, managing the courses, taking homework and exams, providing feedback regarding the homework and exams, organizing learning materials, keeping records for students, teachers and the system and taking reports (Morten, 2002).

Some of the software used in the Student Placement Exam (SPE) is commercial, while some of them are Open Source Software. All these applications have a number of common features, and MOODLE is the most prominent among these applications.

MOODLE is an important tool for teachers to organize their course materials. From the instructional perspective, use of multimedia tools to organize more attractive activities makes the instructional process more attractive. In addition, MOODLE facilitates teachers and students' interaction in the virtual environment and helps determine their views and suggestions as a teaching committee. MOODLE allows students to share their knowledge and the difficulties they experience. In this way, via forums and discussions, students can help each other. Thus, teachers can understand in which context developed during the lesson students experience difficulties. Moreover, there are certain problems experienced in WTE applications due to the facilities provided by the school, the deficiencies in the web site developed, the socio-economic conditions of the students and the Internet regarded as a game center. This study focuses on students' views about WTE applications and on the problems experienced during the application as well as on the way of overcoming these problems.

The purpose of the present study is to evaluate students' views about the use of materials compatible with SCORM in physics education in secondary schools

and to determine the problems based on the students' views as well as to put forward related suggestions.

Since the quality of secondary school education influences the education during and after university, it has an important place in the education system. Therefore, during secondary school education, appropriate learning environments should be established to help students become successful. The changes in instructional technologies has undoubtedly influenced educational environments and thus made it necessary to arrange these educational environments regularly in line with the new developments and to enrich them with new applications in order to increase student achievement. This study is unique since it evaluates the related views of students taking the course of physics via WTE. The results to be obtained in the study are expected to act as a guide for attempts to develop the instructional environ-ment and for educational studies to be conducted both in the Ministry of National Education and in universities.

METHODOLOGY

In this study, diaries kept by the researchers and the documents including written views of the students were used as a data collection tool.

Participants

A total of 76, 10th grade students attending Dicle Private High School, Diyarbakır Anatolian High School and Cumhuriyet Science High School in the central town of Diyarbakır participated in the present study. The lesson units of "force" and "movement" were taught to the participants via web-based instruction. Among all the participants in the present study, 19 volunteering students were asked to write down their views to evaluate the students' views about web-based instruction. For this purpose, a form of 10 open-ended questions was used. Among these 10 questions in the form, 6 of them aimed at determining students' views about the factors leading to negative results in web-based learning and about the deficiencies in the web site, while 4 of them were prepared to reveal students' views about the documents found in the web site.

The planning and execution process of web-based instruction

The WTE material regarding the lesson units of "Force" and "Movement" was designed as clear and comprehensible for the 10th grade secondary school students participating in the study. The first and most important phase in designing the content included scanning the sources regarding the WTE approach in our country and in the world and interpreting the information found in these sources. Taking the review of the related literature into consideration, one-to-one interviews were held with experienced teachers. As a result of these interviews, for content development, the lesson units of "Force" and "Movement" were chosen by examining the "Curriculum for Physics" applied in secondary schools. In line with the purpose, parallel to the gains, various activities based on were designed (Baugher et al., 2003). During the design of the WTE material, special attention was paid to obtaining information about computer programs used in web sites In this phase, the researchers tried to get informed about and develop their skills regarding such various computer programs as MOODLE LMS (MOODLE Learning Management System), Camtasia Studio, Articulate Presenter and Hot Potatoes. As a result, the researchers were informed about what could be done with the help of any features of a program in a web page and about what kinds of activities they could design for the lesson units of "Force" and "Movement" by using the information they obtained. In this phase, examining the web sites previously developed for similar purposes helped think about what could be done in this study better than and different from the things previously developed for those web sites.

Following the planning of the technical parts and preliminary preparation for content, Videos including the lessons and WBMs found in the web site were prepared with the help of an experienced physics teacher. Thanks to the WBMs enforcing the subject, the students could follow the lessons with the help of audios and videos and see the solutions to the questions. All the WBMs were prepared in the form of SCORM to collect data regarding which students for how many minutes and how many times followed the solutions to the questions. After these contents were uploaded onto the web site, experts on physics education were asked for their views about content quality. As a result of the meetings held individually with the physics education experts, the changes and corrections suggested were made on the content of the WTE materials.

Before the application, various changes were made in the content of the web-based material in line with the physics teachers' views and suggestions regarding the material – who were teaching in the schools where the study would be carried out – and in line with the researchers' observations in the classroom. As a result of these preliminary studies, the WTE material was finalized and made ready for the application.

After the web site finalized in line with the experts' views, the results of the pilot study and in line with the physics teachers' suggestions was opened on the web address of "www.canliegitim.com" for the applications in the schools chosen for the study. Prior to the applications, preparations were made in 3 to 4 weeks in the schools. Since the applications would be made in three secondary education schools at the same time, various changes were made in the physics course hours of the groups with the help of the school administration in order to avoid any collision of the physics course hours of the groups. While rearranging the physics course hours, various problems were experienced because the physics teachers had a busy schedule in the schools and because the computer lessons were always taught in the computer laboratories in the schools. In order to help the students become familiar with the researcher and to avoid any difficulties likely to be experienced during the application, the researchers participated as audience in the physics lessons of the groups chosen. Before the applications started, similar processes were followed in the three schools. During these processes, the researchers created the user names and passwords for the participating students to help them sign in the web site. Following this, the user names and the passwords were written down on small pieces of paper and distributed to the related students. In this way, the students were made members of the web site. In addition, the students were allowed to change their user names and passwords after they signed in the web site for the first time.

With the help of the computer course teachers in the schools, the students were informed about web site, the features of the web site, the mistakes likely to be made while using the web site and about what they should do or avoid doing while using the web site. In order to help the students weak in comprehension, they were made to study in pairs with the students who had better computer use skills.

The preliminary preparations were individually made with the teachers. The features of the web site were explained to all the teachers in front of the computer, and the teachers were informed about the web site. The teachers were made members of the web

site. They were allowed to examine the web site by providing them with their user names and passwords. During the design of instruction in the web environment, the instructional materials that the students would access were developed. For this purpose, MOODLE, an open-source LMS, was used in our web site. The whole web site was coded with the PHP programming language due to the LMS feature of MOODLE. The database used in the web site prepared with PHP was MySQL. The system ran on the Linux server. The Articulate Presenter program was used to create flash-interactive slides. In order to create 365 WBMs to help contribute to the problem solving skills of the students, Tablet PC and the Techsmith Camtasia Studio program to record the screen images were used. With the program, the screen images of any running program on the computer were recorded. In this way, it was made possible for the students to see, pause and watch again the solutions to the questions at any time they wanted. The directives and the mathematical procedures carried out by the teacher via WBM could be followed by the students step by step via audios and videos as if the questions were being solved in the real environment. In the study, in order to see the students' activities such as how many times, for how many minutes and which questions the students studied, WBMs were transformed into SCORM learning objects. Besides these, the web page included written texts, simulations, animations and slides prepared to teach concepts related to the subjects (Biktimirov and Klassen, 2008). There were tests which allowed the students to see their level of achievement of the target behavior regarding the subject (Wells et al., 2008). These tests included the exam systems within MOODLE as well as the true-false and fill-in-the-blank questions (Appendix). In addition, for the puzzle activities found at the end of the lessons to help the students learn the concepts related to the subject and the drag-and-drop exam, the Hot Potatoes interactive exam program was used. The screen images regarding the materials in the web site prepared are attached.

FINDINGS

Descriptive analysis of the written views regarding the deficiencies in the web site and the factors leading to negativity in web-based learning

A total of 19 volunteering students (8 CSHS, 6 DAHS and 5DC) were directed 10 open-ended questions and asked to write down their views regarding the deficiencies in the web site and the factors leading to negativity in web-based learning. The results of examining the written views revealed such views regarding the purpose as slow Internet connection, lack of Internet connection at home, insufficient time for application at school, problems experienced while taking permission from parents to go out for the Internet, slowly opening videos, lack of programs in the computer at home which are necessary to watch the simulations and animations and lack of vivid colors in the web site. Table 1 presents the percentage and number of students stating their views about this subject.

Descriptive analysis of the written views regarding the documents found on the web site

A total of 19 volunteering students in the study group (8 CSHS, 6 DAHS and 5DC) were directed 4 open-ended questions and asked to write down their views about the documents found in the web site. The results of examining the written views revealed such views regarding the purpose as existence of different problem solving methods, learning the subjects in an active and entertaining way, decrease in anxiety regarding the lesson, increase in success at school and in private teaching institutions, different question types, revising the subjects thanks to videos and slides. Table 2 presents the percentage and number of students stating their views about this subject.

Connections to the web site with respect to the subjects

Table 3 presents the total number of connections to the web site. When the results in Table 3 are taken into consideration, it is seen that the highest number of connections to the web site during the application was made for the subject of steady movement, displacement and position on a Line and that the lowest number of connections was made for the subject of concept of force and its features and measurement.

DISCUSSION

In this study, students' views about the use of SCORM-compatible materials in secondary school physics education were determined. The students' views determined revealed some information about the factors leading to negativity in web-based applications.

According to Smith and Kurthen (2007), there has recently been a great increase in the number of hybrid classrooms where online and face-to-face methods are used together.

As a matter of fact, the web site developed was designed in a way to include a number of elements that aimed at increasing the students' interest and motivation (Carlos and Schmidt, 2013). These elements are in general as follows.

(i) Entertaining elements: Puzzles placed in the web site,
(ii) Availability of user names and passwords that allow personal use,
(iii) Lectures via different methods prepared as appropriate to each student's own interest and needs,
(iv) Opportunities provided for students to evaluate themselves and questions prepared for evaluation found at the end of each part of the lesson unit of "force" and "movement".

It was seen that a majority of the students reacted quite positively to the idea of teaching physics via the Internet before the application started. The diaries kept by the

Table 1. Results of analysis of the written interviews regarding the factors leading to negativity in web-based learning.

Students' views about general situations	**f**	**%**
Slow Internet connection.	10	52.63
Lack of Internet connection at home or in the dormitory	4	21.05
Insufficient time for application at school	4	21.05
Willing to enter game sites while sitting in front of the computer	2	10.52
Experiencing problems while taking permission from parents to go out for the Internet	5	26.31
Power cuts. lack of generators at schools	1	5.26
Inability to use the computer well	1	5.26
Students' views about the deficiencies in the web site		
Slowly opening WBMs (White Page Movies)	3	15.78
Lack of programs in the computer which are necessary to watch the animations and simulations	1	5.26
Lack of color pictures and written texts (The designs could have been more colorful)	4	21.05
I wish the questions in the web site were all multiple-choice	1	5.26
After answering a question. it was boring to close and reopen a page to pass to another question.	1	5.26
I think there is no deficiency in the web site	2	10.52
There should have been more lecturing for the subjects	1	5.26

Table 2. Results of analysis of the written interviews regarding the documents found in the web site.

Students' views	**f**	**%**
Different problem solving methods found in WBMs contributed to my learning.	16	84.21
The documents helped me learn the subjects in a more active and entertaining way.	7	36.84
Clear, comprehensible and visual presentation of the subjects decreased my anxiety about the course of physics.	12	63.15
Use of more than one method for solving the problems increased both my success and my speed in solving the problems.	15	78.94
Since WBMs and slides provided a number of opportunities for revision, they contributed to my learning.	8	42.1
I found them beneficial as they were visual.	6	31.57
The lectures were superficial and did not contribute to my learning.	2	10.52
Different question types used in the trial tests in the web site (multiple-choice, fill-in-the-blanks. true-false, drag-and-drop. short answer …) contributed to my learning.	11	57.89
The questions I solved increased my success both in the exams at school and in those at the private teaching institution.	6	31.57
I didn't like the trial test questions at all. They could have been more challenging.	6	31.57
The trial tests partly contributed to my success.	4	21.05
Thanks to WBMs, I could answer a number of questions that I didn't understand previously.	3	15.78
The subjects related to physics were taught quite well in the web environment. WBMs were very good. They helped me understand the subjects.	12	63.15

researchers revealed that this interest going on in the first days of the application decreased after a while and that the students lost their interest in the idea of web-based physics education. The factors causing this result were as follows:

(i) Slowly opening WBMs,
(ii) The web-based teaching of the course, which was a different application at the beginning for the students, turned out to be a monotonous process after a while, and the students got bored,
(iii) Technical problems frequently experienced during the physics lessons (Slowly running computers, Internet connection cuts, no Internet connection),
(iv) Frequent loss of time due to technical problems,
(v) Since the teachers tried to speed up the flow of the lesson to avoid loss of time that occurred due to technical problems, some of the students who failed to follow the teacher got stressed,
(vi) Because there were not enough computers and

Table 3. The number of connections with respect to the subjects.

Subject	Number of connection
Vectors	400
Concept of force and its features and measurement	220
Influence of force on turning and momentum	810
Balance	860
Answers to 22 questions regarding balance. Momentum and parallel forces	540
Mass and center of gravity	1200
Steady movement, Displacement and position on a line	1600
Average speed and instant speed average acceleration and instant acceleration	530
Constant acceleration movement	270
Relative speed	250
River questions	270
Total number of connections	6950

Internet connection for all the students, the students who had Internet connection at home did not use the material effectively in the computer laboratory as they gave the priority to the other students,
(vii) Fast users (students) of the computer and the Internet during the lesson had to wait for the students using the computer and the Internet slowly,
(viii) The fact that certain elements in students' computers as images, games, videos and animations took a long time to open or never opened made the students dependent on the main screen,
(ix) The fact that some of the students who were normally active or successful in the classroom lacked computer use skills caused them to stay passive during the lessons in the computer laboratory,
(x) The fact that some of the students who had the opportunity to use the computer and the Internet alone at home had to share the computers in the computer laboratory at the school with other students made them unhappy,
(xi) Some of the students who had high level of expectations from the material did not find what they had expected in the web site,
(xii) The fact that due to the crowded classrooms, the students had to share the computers with other 2 to 3 students caused them to fail to log in,
(xiii) Some of the students did not like the idea of teaching the lesson via the computer,
(xiv) Some of the students were not pleased with the physical features of the computer laboratory.

Ersoy (2005) examined the effects of students' order of seating during the elementary school computer lessons and reported that several factors influenced the lesson negatively: the number of students was high during the computer lessons taught in the computer laboratory; more than one student used the same computer; and the students' desire to play games during the lesson. Some of the negative situations revealed in this study overlap some of the negative situations mentioned above. In addition, there are studies reporting that similar applications constantly carried out during the lessons lead to stability after a while. In a study conducted by organizing various activities according to the 5E model at the elementary school 5th grade level especially for the lesson units of "force" and "movement", it was found out that the students were pleased to participate actively in the learning process at the beginning and that after a while, the applications turned out to be monotonous for the students (Özsevgeç et al., 2006). Alper and Çakır-Balta (2006), in their study, investigated whether there was difference in students' motivation when the course of "Introduction to computer" was taught via web-based instruc-tion and via face-to-face instruction in the class-room environment. The researchers found out that the students learning in web-based instruction environment had lower self-efficacy and control belief scores than those learning in face-to-face instruction classroom envi-ronment.

The process of "monotonousness" revealed in this study occurred due to constant computer use. It was thought that the technical problems experienced in all the three schools were quite effective on students' evaluation of the web site. The students were told that they would be provided with help for the technical problems experienced frequently during the applications. During the appli-cations, the researchers had to participate in the process sometimes as a technician and sometimes as a guide for the use of the material rather than as an ordinary observer.

CONLUSION AND SUGGESTIONS

In this study, the students views and observation notes taken during the research process regarding the influen-ce of the use of SCORM-compatible materials in physics teaching on secondary school students' proficiency in

solving physics problems, their attitudes towards Internet use, WTE and on their target gains in the course.
Within the scope of the study, the following conclusions were drawn depending on the findings obtained from the evaluation of students' written views.

(a) The use of different solution methods for the problem solutions in WBMs prepared influences both students' self-confidence and their success positively (Biktimirov and Klassen, 2008).
(b) The fact that slides and videos regarding the lectures provided a number of opportunities for revision increased students' desire to learn.
(c) The fact that there were different types of questions in the trial tests put in the web site (multiple-choice, fill-in-the-blanks, puzzle, true-false, drag-and-drop, short answer and so on) helped the students understand the subject in detail.
(d) The fact that some of the students found the questions in the web environment difficult or easy decreased their desire to solve the questions.
(e) The slow Internet connection decreases students' interest in web-based learning.
(f) Slowly-opening WBMs found in the web environment decrease students' interest in watching these WBMs.
(e) Besides the quality of the instructional materials in the web site, the usability of these materials is quite important as well.

On the other hand, there are certain limitations of web-based learning. Considering the written responses of the students, these limitations could be summarized as follows:

(a) Slow Internet connection,
(b) Some of the students did not have a computer or Internet connection at home,
(c) Students experienced problems while taking permission from their parents to go out for the Internet,
(d) Insufficient time for application at school,
(e) Slowly-opening videos, or lack of programs in students' computers necessary to open the animations and simulations,

These limitations are likely to influence students' attitudes towards web-based learning negatively. Before the application of web-based learning approaches, it is necessary to overcome such deficiencies mentioned above and to provide an appropriate learning environment.

In the three schools chosen, all these facilities seemed to exist, yet it was realized that a number of issues escaped the attention. In web-based learning, it is seen that success will be achieved at the desired level when appropriate conditions are provided both in the school environment and at home. In web-based learning, the documents found in the web site should be appropriate to the objectives of the physics course and the educational principles.

Various suggestions were put forward in line with the researcher's experiences and the results obtained in this study. When the web-based learning approach is used;

(a) Make sure that the school has a well-equipped computer laboratory with fast Internet connection.
(b) Students should be able to enter the web site only in the course hours at school.
(c) Problems regarding the slowly-opening videos or failure to open certain animations or simulations should be overcome in advance while designing the web environment.
(d) Whether all the students have Internet connection at home and the programs installed on their computers necessary to open the videos, animations and simulations should be checked, and accordingly, the necessary precautions should be taken.

In this respect, suggestions regarding the future of web-based physics education will be put forward for teachers and National Education authorities as well as for researchers.

Suggestions for teachers and national education authorities

(a) Healthy functioning of the web-based distance education system requires teachers to be computer literate.
(b) Teachers should be provided with in-service trainings on presentation of lessons via the Internet, participation in discussion forums and web page design and be encouraged to use these tools.
(c) Teachers do not have to develop WTE contents. In learning management systems used, content-sharing standards like SCORM should be taken into consideration. In this way, it will be possible for high schools to share the course contents prepared. Although technology is suggested to be used in courses in current educational programs, there is no application regarding computer or web-based education.
(d) Educational programs prepared for the physics course or for other courses should be organized in a way to allow using computers and the Internet for educational purposes. Accordingly, besides the course books prepared for the lessons, software related to the lessons should be prepared and presented.
(e) It was seen how difficult to carry out WTE applications in crowded student groups. In secondary education schools, the class size does not agree with the number of computers in computer laboratories. In this situation, considering the fact that it is not possible to decrease the number of students, it is obviously necessary to increase the number of computers in computer laboratories. With this fact the Ministry of National Education should both

revise the physical conditions of the computer laboratories and increase the number of computers in these computer laboratories.

Suggestions regarding the future of web-based physics education

(a) The web site designed for the lesson units of "Force" and "Movement" was found to influence the students' success positively. It was seen that the teachers and the students participating in the study liked the web site designed. Therefore, the web site could be suggested for physics teachers while teaching the secondary school 10^{th} grade lesson units of "Force" and "Movement" and for students while studying these lesson units on their own.

(b) Depending on the results of the applications, it is thought that students will get bored when the physics course is taught entirely via web-based instruction. Therefore, WTE could be used in certain parts of a lesson unit depending on the scientific process skills that students are expected to gain. Considering especially the physics course, it would be better to teach the lessons in the triangle of classroom, physics laboratory and computer laboratory.

(c) In order to teach the physics course in the triangle of classroom, physics laboratory and computer laboratory, there is a need for materials prepared for all these three environments. In the material development process, cooperation should be established between the teachers and the academicians. It is believed that both effective and practical materials will be developed when teachers' experiences in secondary school conditions are combined with academicians' scientific knowledge. What is important is to provide physics teachers with alternative materials.

(d) It is thought that technical equipment in secondary schools does not currently allow teaching the courses as web-based. Considering both the capacity of computers and the quality of Internet connection, it is seen that such an application will not be convenient.

(e) During WTE, it was seen that not all the students had similar computer use skills and that in the first days of the application, some of the students were quite poor in terms of Internet and computer use. Considering this situation, the computer courses taught in secondary schools could be organized in a way to encourage students to do more practice.

(f) The fact that most of the students did not have a compute or Internet connection at home was another disadvantage for WTE. Therefore, there should be computers reserved for students in computer laboratories to help them use in their free time. However, in order for students to use their free time effectively, they should be supervised by a trainer. Considering the students' age groups and the dangers waiting for them on the Internet, it is quite important to control the time secondary school students will spend on the Internet.

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APPENDIX:

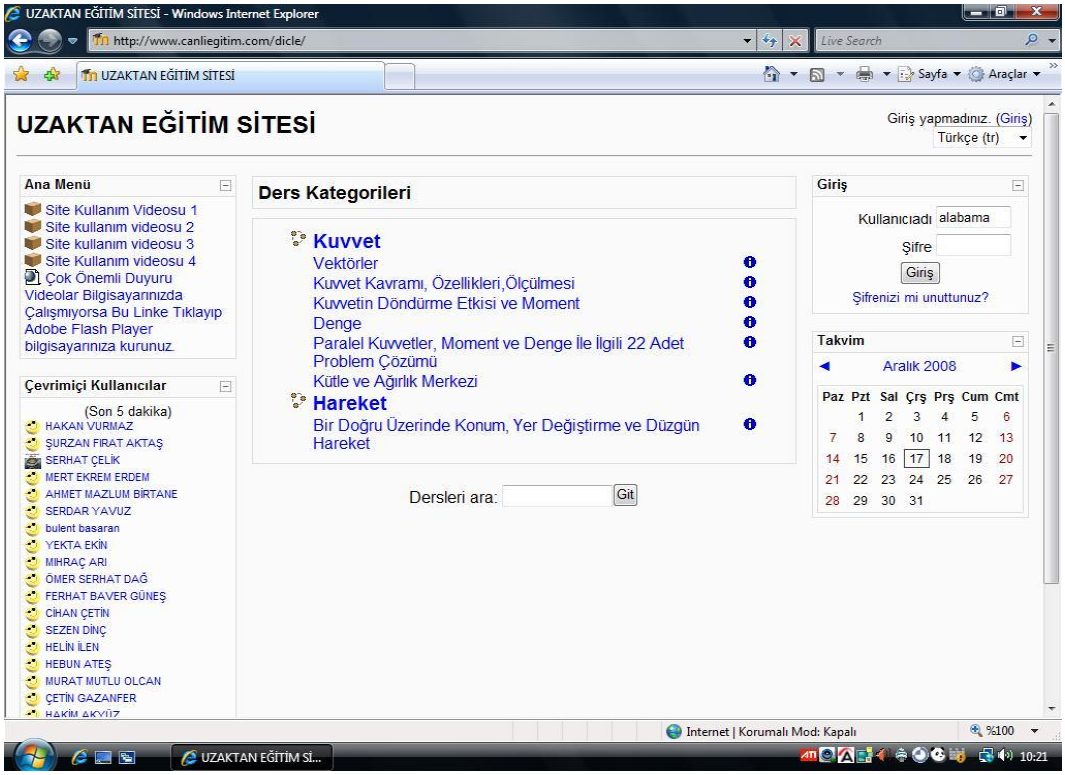


Figure 1. The screen image of the home page.

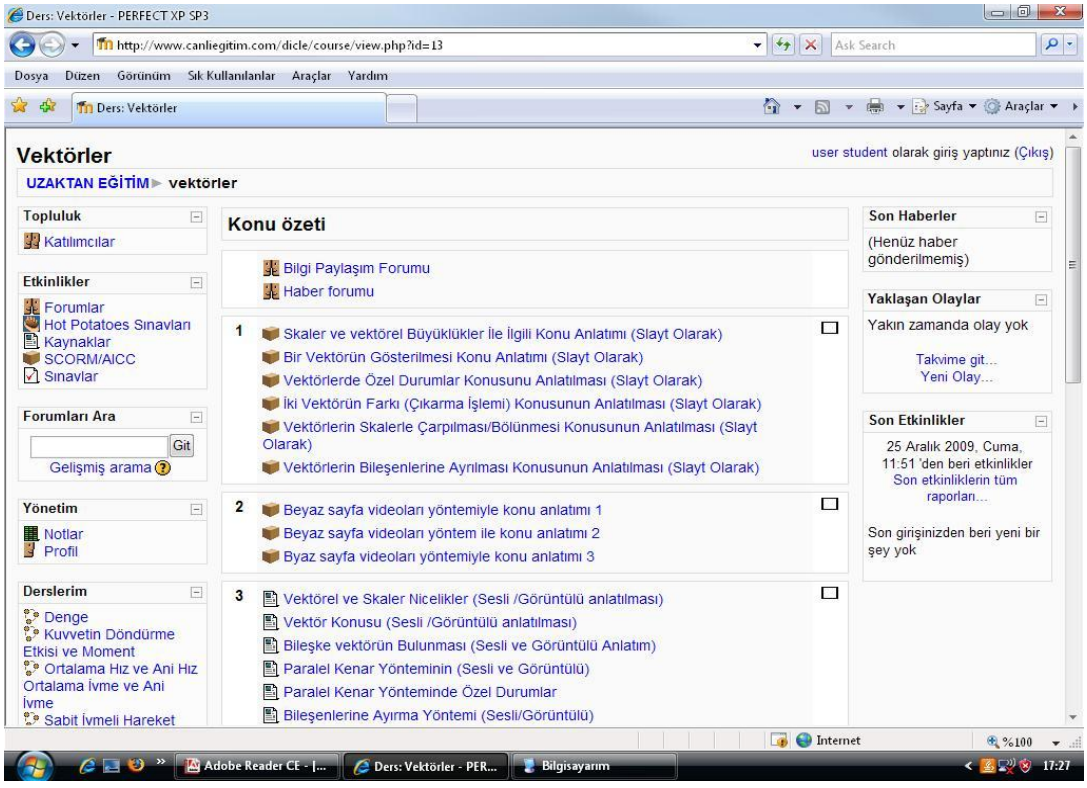


Figure 2. Screen image for the subject of vectors.

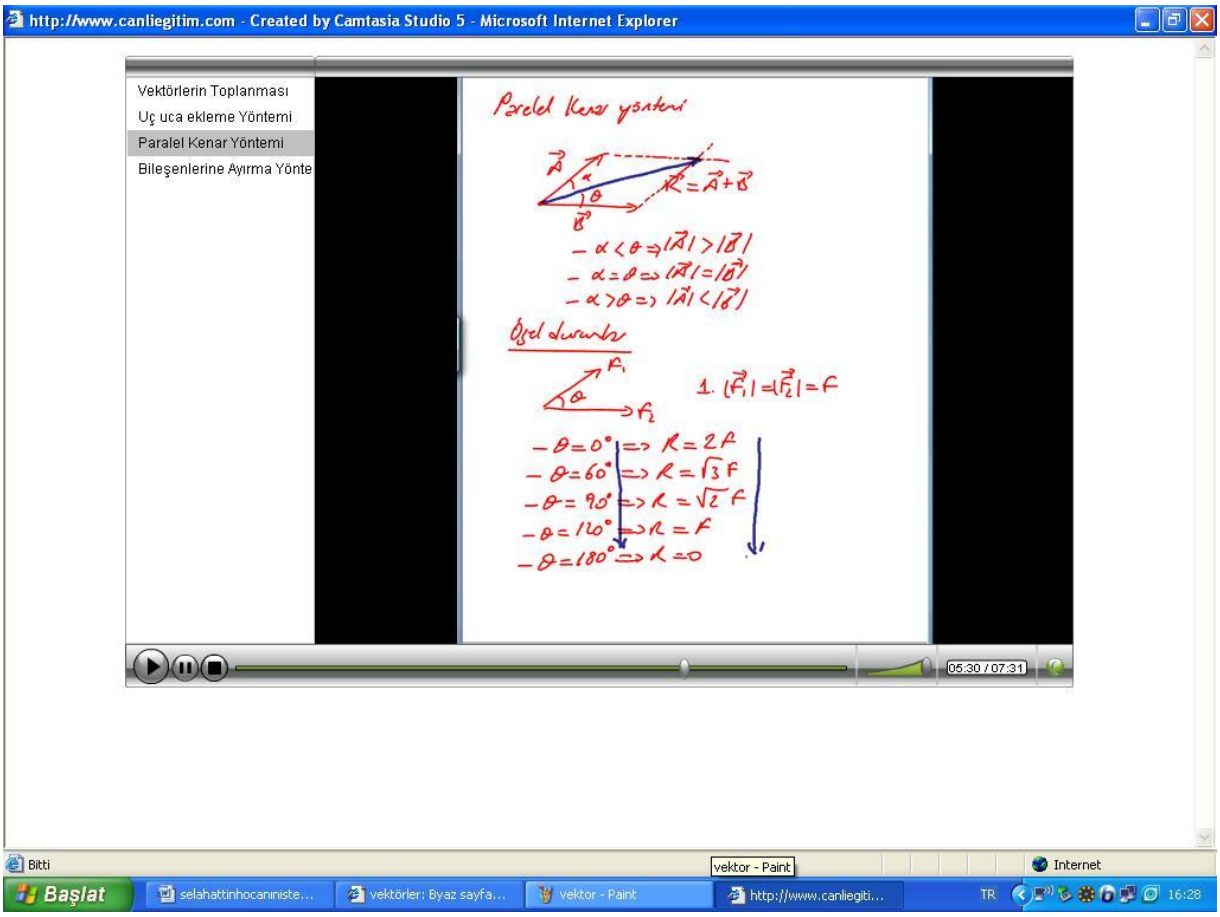
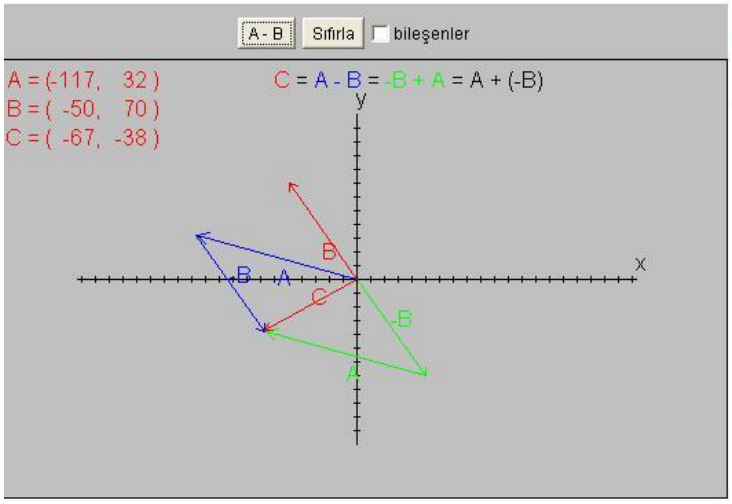


Figure 3. Teaching the subject via WBM.



VEKTÖREL TOPLAMA

Fareyi simulasyon üzerinde gezdirin. Tıkladığınız yerde vektör çizilecektir. Bu yolla iki vektör çizdikten sonra, program otamatik olarak **A+B** vektörünü çizecektir.

Simulasyonun üst tarafındaki ***A+B*** butonuna tıklarsanız, bundan sonraki işlemlerde **A-B** vektörünü çizer.

info kutucuğunu işaretlerseniz, çizdiğiniz vektörlerin bileşenlerini görebilirsiniz.

Çizilen vektörleri silip yeni değerler girmek için ***reset*** butonuna tıklayın.

simulasyon **Fu-Kwun Hwang** tarafından yazılmıştır. Orjinal sayfa için tıklayınız. Simulasyon çalışmıyorsa, java programını yüklemek için tıklayınız.

Figure 4. Sample Java Applet simulation.

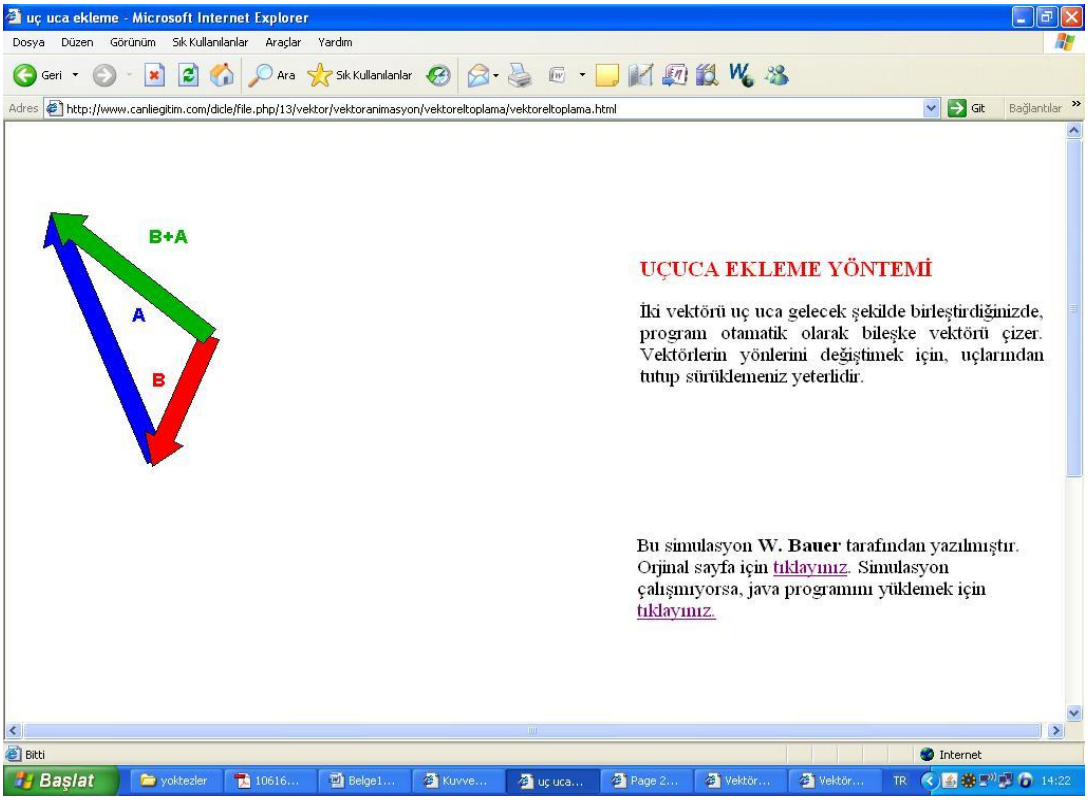


Figure 5. Sample Java Applet simulation.

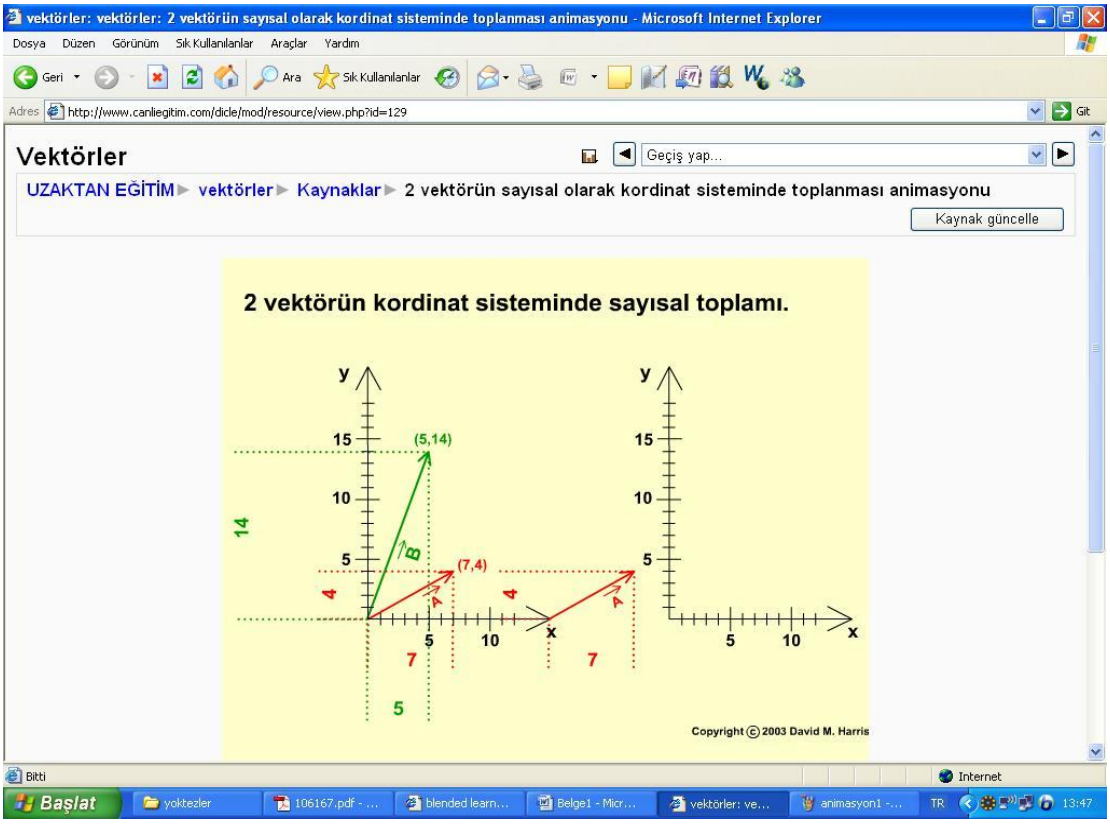


Figure 6. Flash animation screen image.

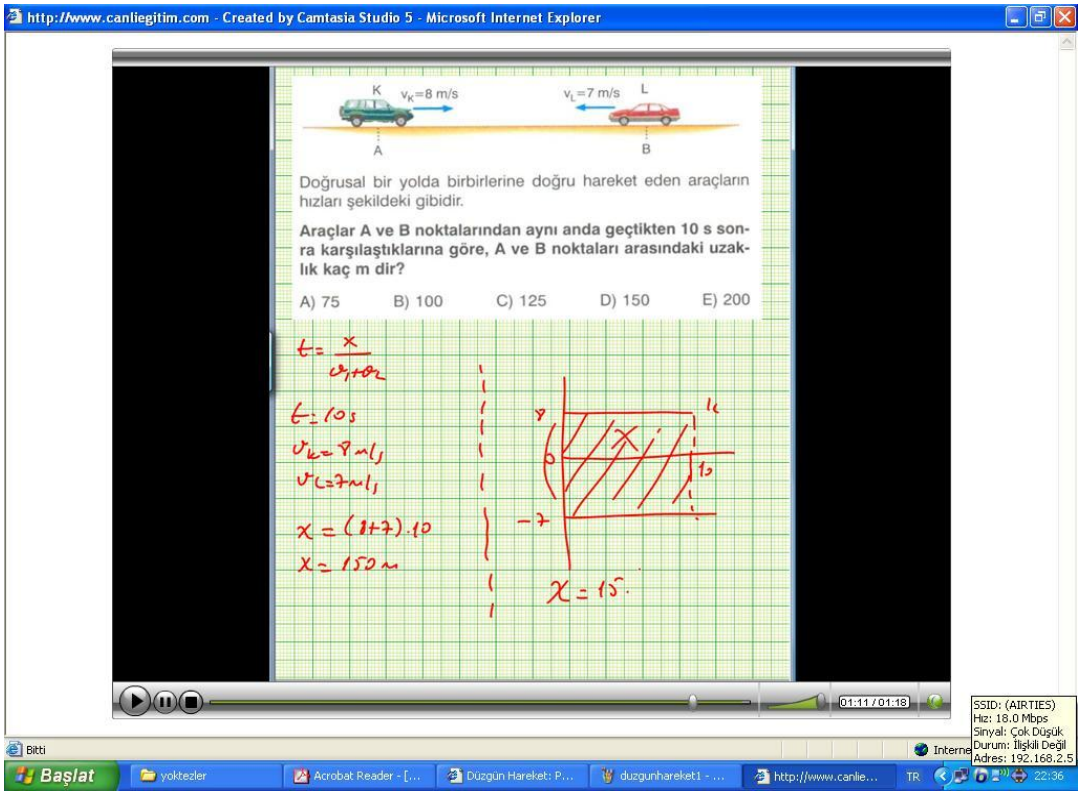


Figure 7. WBM screen image.

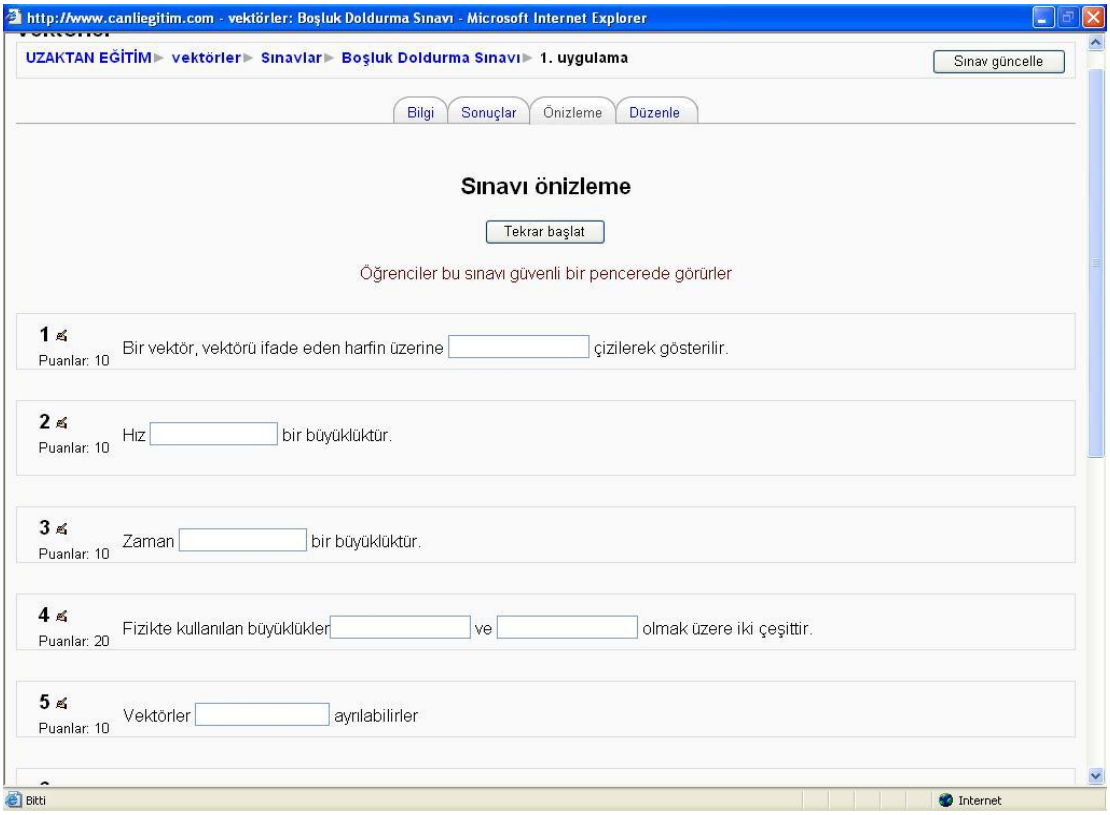


Figure 8. Fill-in-the-blank exam screen image.

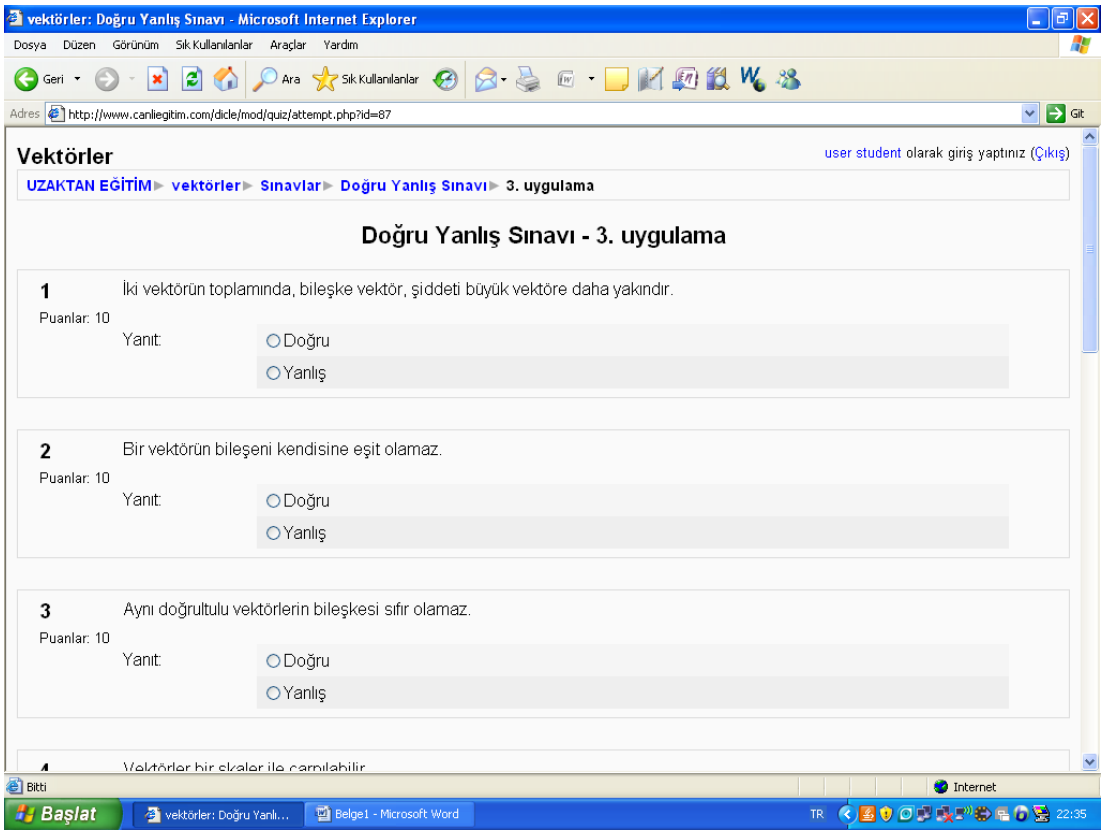


Figure 9. True-False exam screen image.

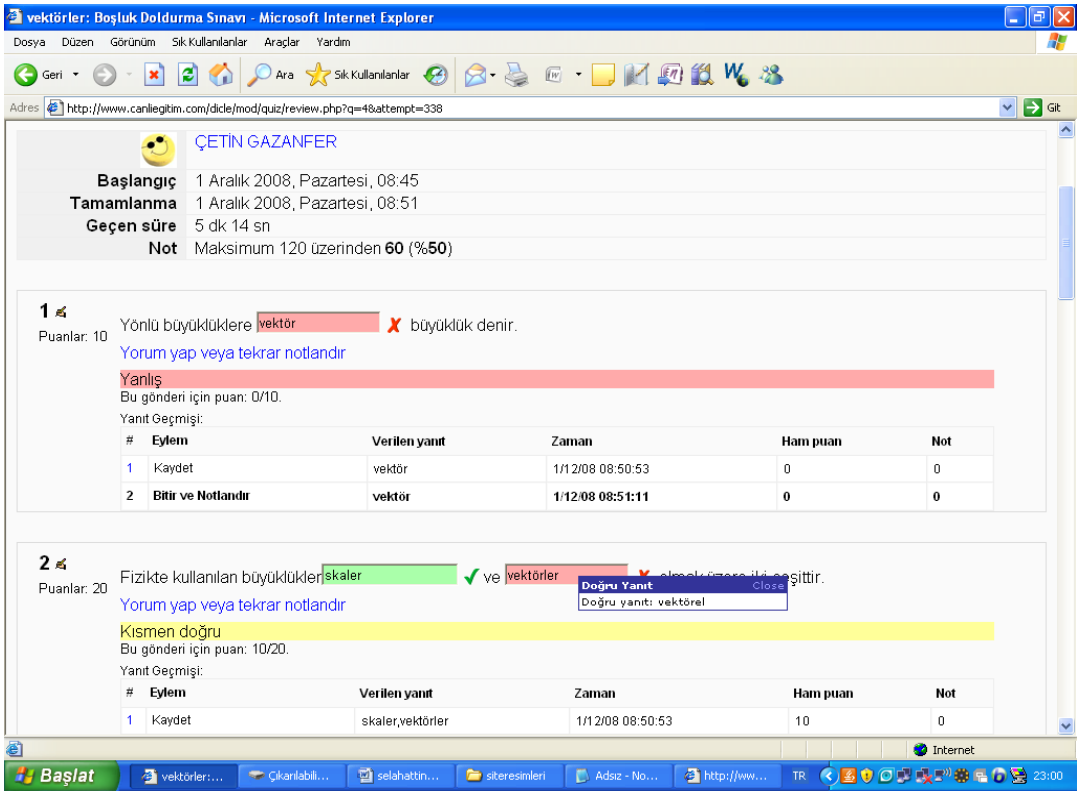


Figure 10. Fill-in-the-blank exam student feedback screen image.

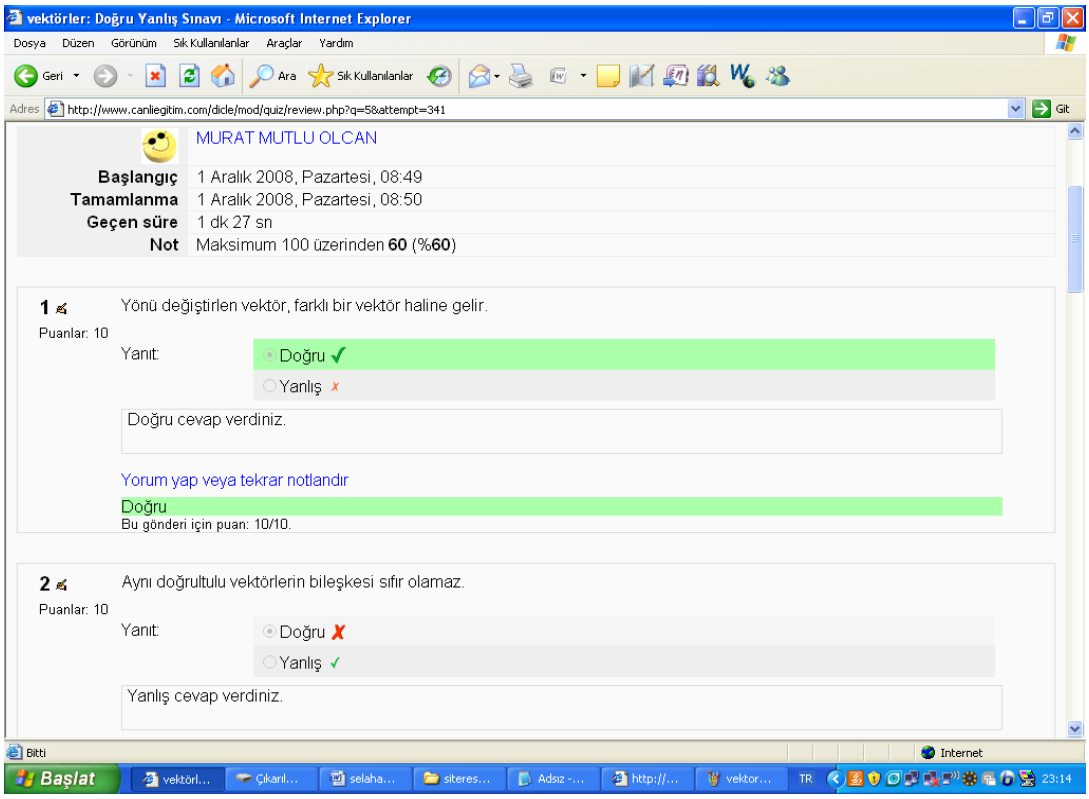


Figure 11. True-False exam student feedback screen image.

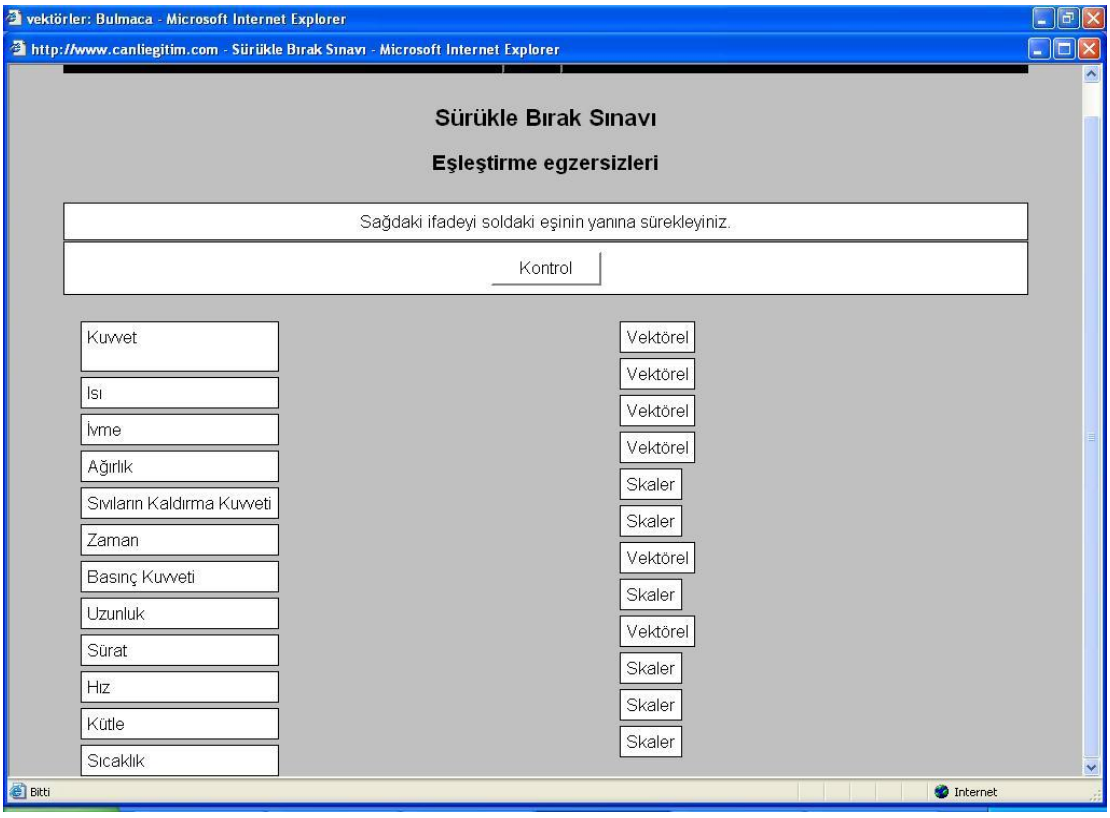


Figure 12. Drag-and-drop exam screen image.

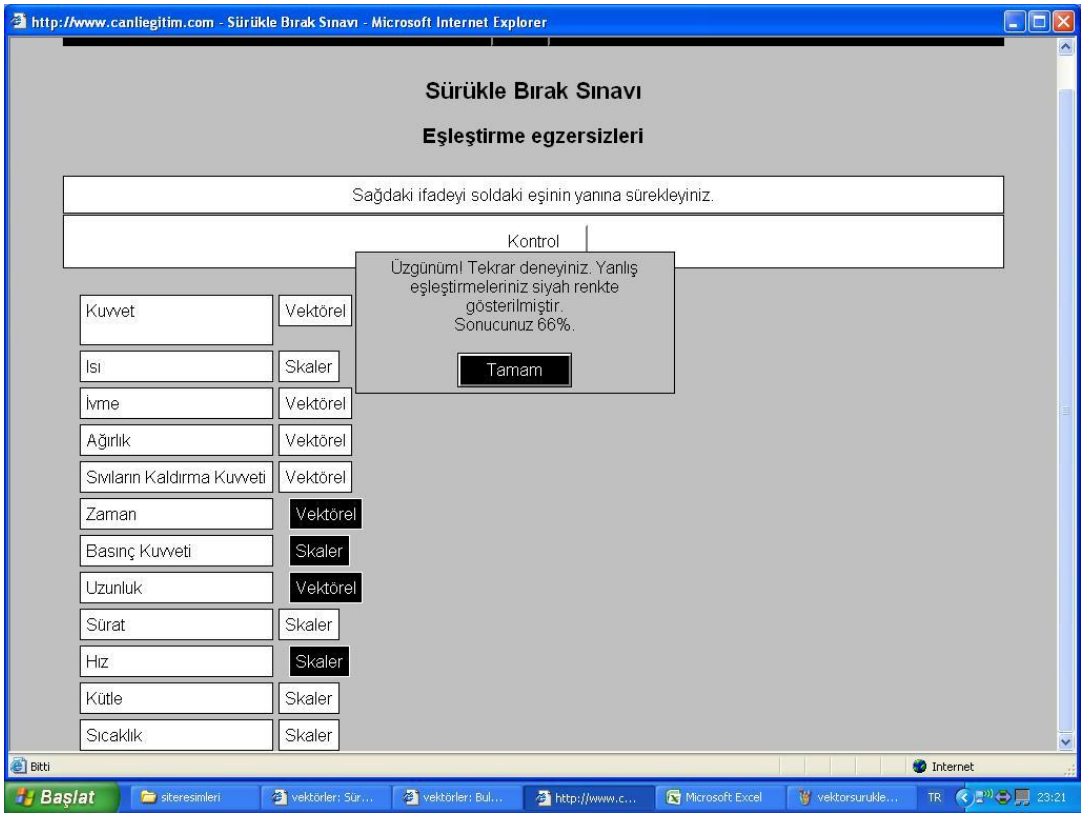


Figure 13. Drag-and-drop exam student feedback screen image.

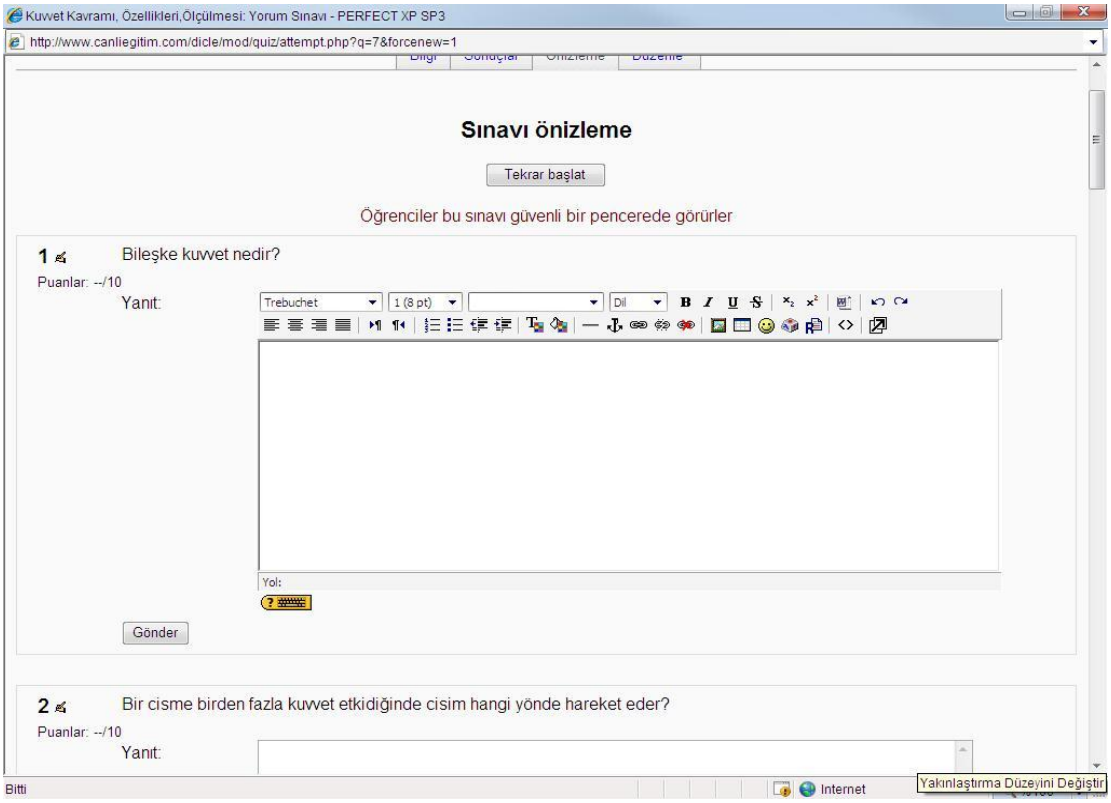


Figure 14. Comment writing exam screen image.

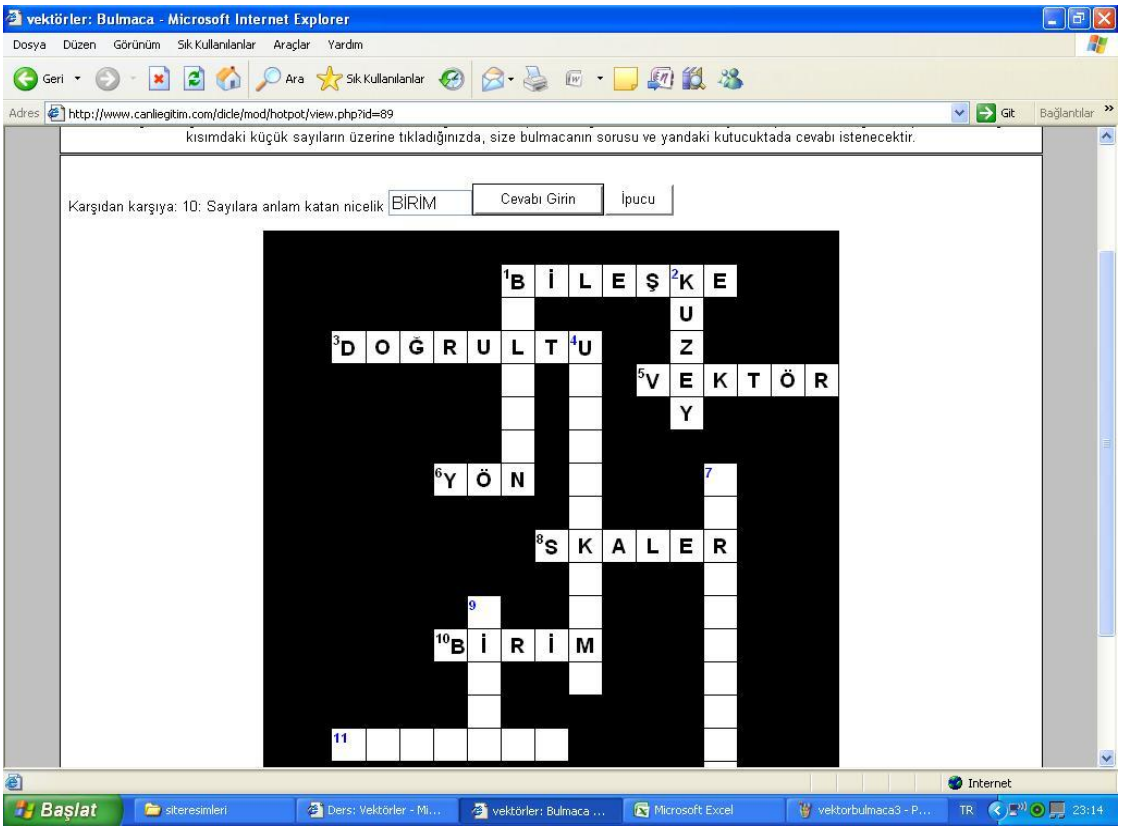


Figure 15. Puzzle exam screen image.

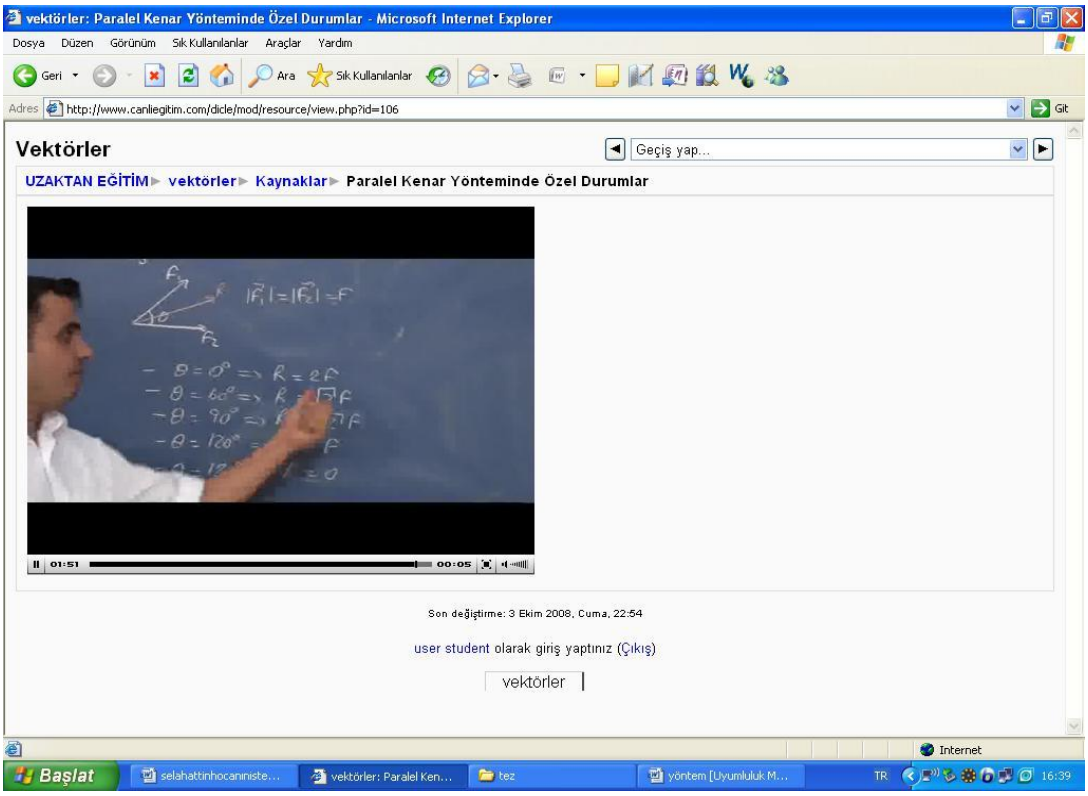


Figure 16. Teaching the subject via video records.