Design And Evaluation Of Web Based Science Learning Environments

Ali Çetin
Siirt Üniversitesi Eğitim Fakültesi
alicetin@siirt.edu.tr

Esef Hakan Toytok
Siirt Üniversitesi Eğitim Fakültesi
hakantoytok@hotmail.com

Mehmet Korkmaz
Siirt Üniversitesi Eğitim Fakültesi
mehmetkorkmaz@gazi.edu.tr

ABSTRACT
Web based learning has found its place in educational methods with the development of internet and internet technologies. The materials, that used with web based learning environments, should have some properties like visualization, pedagogic acceptance and convenience for students level. The purpose of this study is to construct two web based science environments for 9th grade students with using two different educational methods: inquiry with 5E learning cycle and expository with expository texts. These web environments are named as Web Based Inquiry Learning Environment (WILE) and Web Based Expository Learning Environment (WELE). Both environments are prepared for "conservation of energy" subject in 9th grade physics lesson. In evaluation part of this study, WILE is tested in two classrooms with 27 students and WELE is tested with 15 students. Students wrote their opinions to WILE and WELE, then 4 students interviewed for WILE and 2 students for WELE. Interview results and general opinions of students, a physics teacher and two physics education experts are represented in evaluation part.

Keywords: Web Based Learning Environment, Internet, Inquiry Teaching Method, Expository Teaching Method

INTRODUCTION
Reaching ways to knowledge are differed with the development of technology in all over the world. Educational programs were redesigned, the investment ratio of governments for education is increased, and also education policies are reconstructed (Çetin & Günay, 2011). This change mainly effected distance education system in a concrete. Distance education process includes (1) written sources are turning into printed materials, (2) multiplication, distribution and accessibility of these printed materials (Al & Madran, 2004). In the past, individuals was using post service, radio, television for distribution and accessibility, but now internet got popular among people.

In human history, there is no any other technology that facilitates communication than internet (Karasar, 1999). Education system mainly contains communication skills and it directly is affected by internet. There are different names used for internet in education, such as web based learning, distance education, online learning, e-learning, internet based learning. The advantages using internet in education are creating a learning environment that highlights interactivity, individuality (Dabbagh & Bannan-Ritland, 2005; Gunawardena & McIsaac, 2003; Khan, 1997) independent of time and place (Gunawardena & McIsaac, 2003; Boisvert, 2000; Moore & Kearsley, 1996).

These advantages of internet are supplied by web based learning environments (WBLE). WBLE presents new and attractive material to the students and provides interactivity. During design process of WBLE, instructional system design (Dick & Carey, 1996), cognitive flexibility theory (Spiro, Feltovich, Jacobson, & Coulson, 1991), and constructivist learning environment (Jonassen, 1999) strategies can be used. There are several instructional system design models but the most popular one is ADDIE (Analysis, Design, Development, Implementation, Evaluation) model and this model can be used for the base of many different instructional material (Selvi, 2008). According to cognitive flexibility theory principles; learning activities must provide multiple representations of content, materials should avoid oversimplifying the content domain, instruction should be case-based, and knowledge sources should be highly interconnected rather than compartmentalized (Culatta, 2013). Constructivist learning environments are constructed by using constructivism approach. This approach includes mainly two things 1) learning is an active process of constructing rather than acquiring knowledge and 2) Instruction is a process of supporting that construction rather than communicating knowledge (Lefoe, 1998). Due to Nam and Jackson (2007), there are some other points ,that do not mentioned in these models. First of all environments should not force users while reaching the knowledge, accessing should be easy and environments should not include distracted objects. Secondly, environments should provide regular feedback from users.

In the studies, WBLE positively affect students cognitive and affective domains (Çetin & Günay, 2011). Nummennmaa and Nummenmaa (2008) states that when students actively participate in WBLE cooperatively and individually, their affective behaviors are changed positively. In another study, Baki and Güveli (2008) prepare a WBLE for 9th grade students' mathematics subject. They interview with teachers about the usage of this environment. At the end of the study, there is no difference between experimental and control groups on achievement but teachers got positive attitudes towards WBLE. Similarly Kert and Tekdal (2008) prepare a WBLE for physics lesson and try to investigate the effects of WBLE on academic achievement and permanence. They found that in group that uses WBLE have higher academic achievements and permanence levels than that does not use it.

These learning environments try to find out the effects of itself on some dependent variables and do not directly mention the teaching method used in it. Yelon (2006) states that ineffective classroom training transformed to internet is still ineffective and effective learning environments can be produced by using teaching methods well. In science education, Inquiry and expository teaching methods are two of the mostly compared methods (Yager & Akcay, 2010; Nwagbo, 2006). These methods are selected for this study and how they are adapted to web based learning environments are presented in method section of this paper.

PURPOSE AND IMPORTANCE OF STUDY

The purpose of the study is to design web based inquiry and expository physics learning environments and evaluate them by using students, teachers and experts' opinions. The environments are prepared for 9th grade "Conservation of Energy" subject of physics lesson.

While the number of studies related to web based learning environments are increasing in the world, this number is limited in Turkey. So teachers cannot find web based materials for physics lessons. This study is important because they prepared for Turkish students. Secondly, this study is also important because teaching methods are used while preparing WBLEs like inquiry and expository.

METHOD

There are two phase of the study. In the first phase web based learning inquiry and expository environments are prepared and in the second phase these environments are evaluated by using students, teachers and physics experts' opinions.

DESIGN OF WEB BASED EXPOSITORY LEARNING ENVIRONMENT

Web based expository science learning environment (WELE) is constructed by using the definitions of expository teaching method. The procedure while constructing WELE is listed below:

1. Literature Search for expository teaching method: Expository teaching method is a teacher centered method, teacher explains all information and teacher is responsible for students' learning (Bruner, 1961). In this teaching strategy, teacher presents the subject matter rules, provides examples and these examples includes pictorial relationship, application of rules and prerequisite information (Maheshwari, 2013).
2. Subject selection; "conservation of energy" subject is an important subject in physics because it has sociological dimension and it is a difficult subject for students to understand (Paliç ve Akdeniz, 2012). Conservation of energy subject is selected for both learning environments.
3. Determine the aims and objectives of "conservation of energy" subject; according to ministry of education (2013) program, energy subject is a 9th grade subject and contains 6 aims and 15 objectives. Two aims are selected for WELE and presented below.
    - determine mechanical energy, potential energy and mechanical energy concepts.
    - explain conservation of energy and understand one kind of energy can turn to another one.
4. Preparation of definitions, explanations and examples: "Oran Publishing 9th Grade Physics book" is used for definitions, explanations and examples.
5. Collect photos and make solutions of example problems. related photos of conservation of energy are collected by using internet sources and examples are solved by researchers.
6. Construct web based learning environment: WELE is constructed by a computer engineer. The www.dersfizik.net/expo is used internet address of WELE.

Parts of WELE are presented below:

1. User ID and Password: Students log-in the system by using user ID and password. How much time students spend, which parts are completed and how many homework is done by themselves are recorded. Additionally, while students write their opinions and comments, user names are seen at the beginning.

2. Introduction Page: The overall aim of the web-site and the study and the links in the web site are described in introduction page.
3. Conservation of energy 1: Definitions of potential and kinetic energy were provided by using the real life examples. This page is shown in Figure 1.
4. Conservation of energy 2: Conservation of energy was provided by using the equation that initial energy is equal to the final energy in closed systems.
5. Conservation of energy 3: Conservation of energy was applied on an example of a closed system.
6. Exercises: Four exercise problems were presented in an order. Students first saw the problem and then the solution.
7. Problems: Five problems are given to the students. But students only saw the problems, the solution of the problems were not presented.

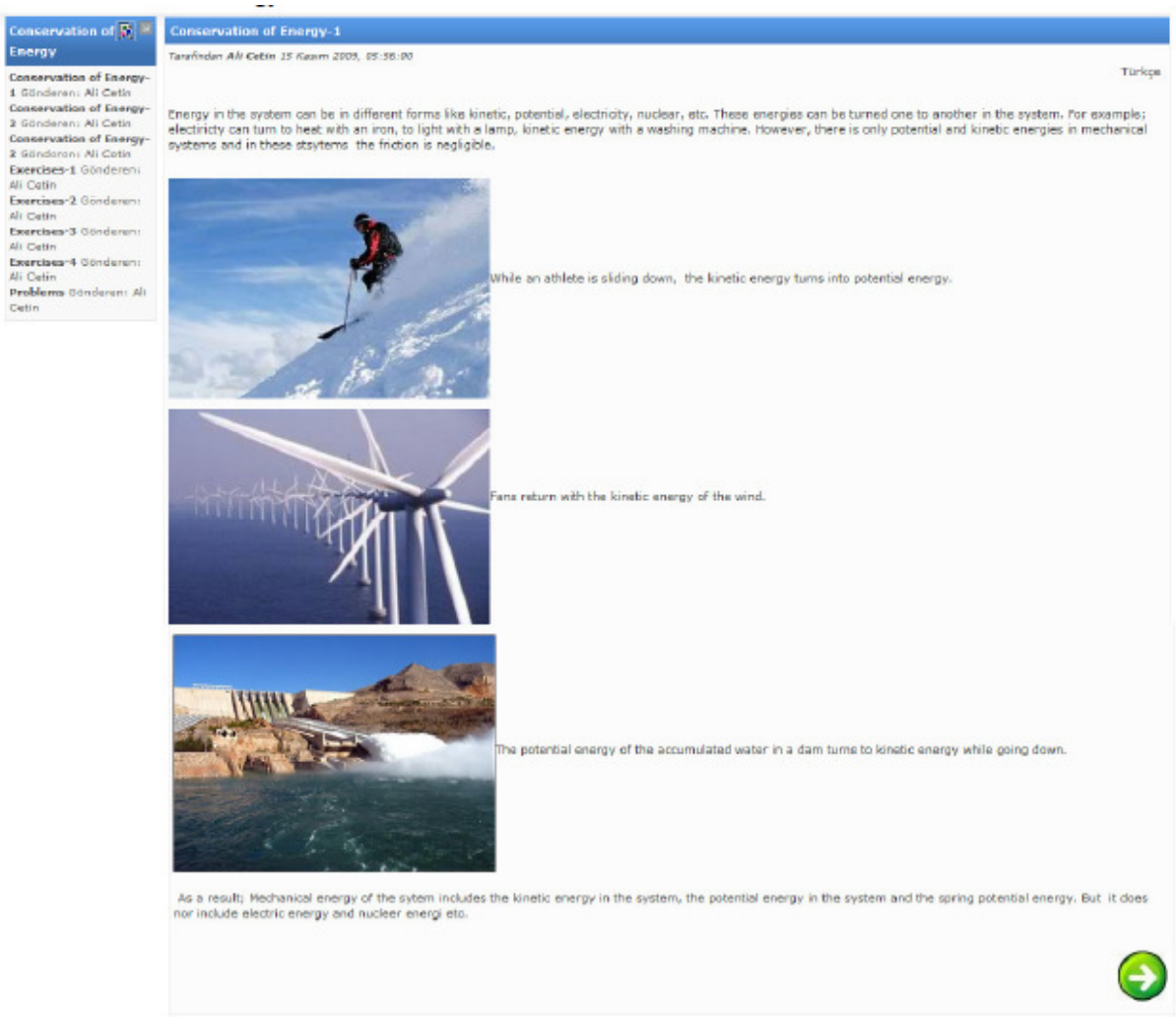

Figure 1: Conservation of Energy-1 page of Web Based Expository Learning Environment

DESIGN OF WEB BASED INQUIRY LEARNING ENVIRONMENT

Web based inquiry science learning environment (WILE) is constructed by using the definitions of inquiry teaching method. The procedure while constructing WILE is listed below:

1. Literature Search for inquiry teaching method: inquiry is a multifaceted activity that involves making observations, posing questions, panning investigations, reviewing what is already known, using tools to gather, analyze and interpret data, proposing answers, explanations, and predictions (National Research Council, 1996). 5E learning cycle is a classroom setting way of inquiry learning (Campbell, 2000).

2. Subject selection; and Determine the aims and objectives of "energy" subject; these are the same with WELE.
3. Preparation of 5E activities:

Engage Phase: To supply the curiosity of the students, simple pendulum activity was used.

A man stands in front of the pendulum. When he releases the pendulum, whether it hits him was asked to the students. Then the video about the simple pendulum was shown in the same page. After the video, several question were asked and the opinions of the students were sent by using message board.

Explore Phase: the simple pendulum applet which is designed by Walter Fendth was used in the explore phase. Some variables in the pendulum could be changed in the applet such as length, gravitational acceleration, mass and amplitude. Students adjusted these variables and applet calculated kinetic and potential energy values. They filled the table related to kinetic and potential energies of the pendulum. Finally, students send their opinions by using message board.

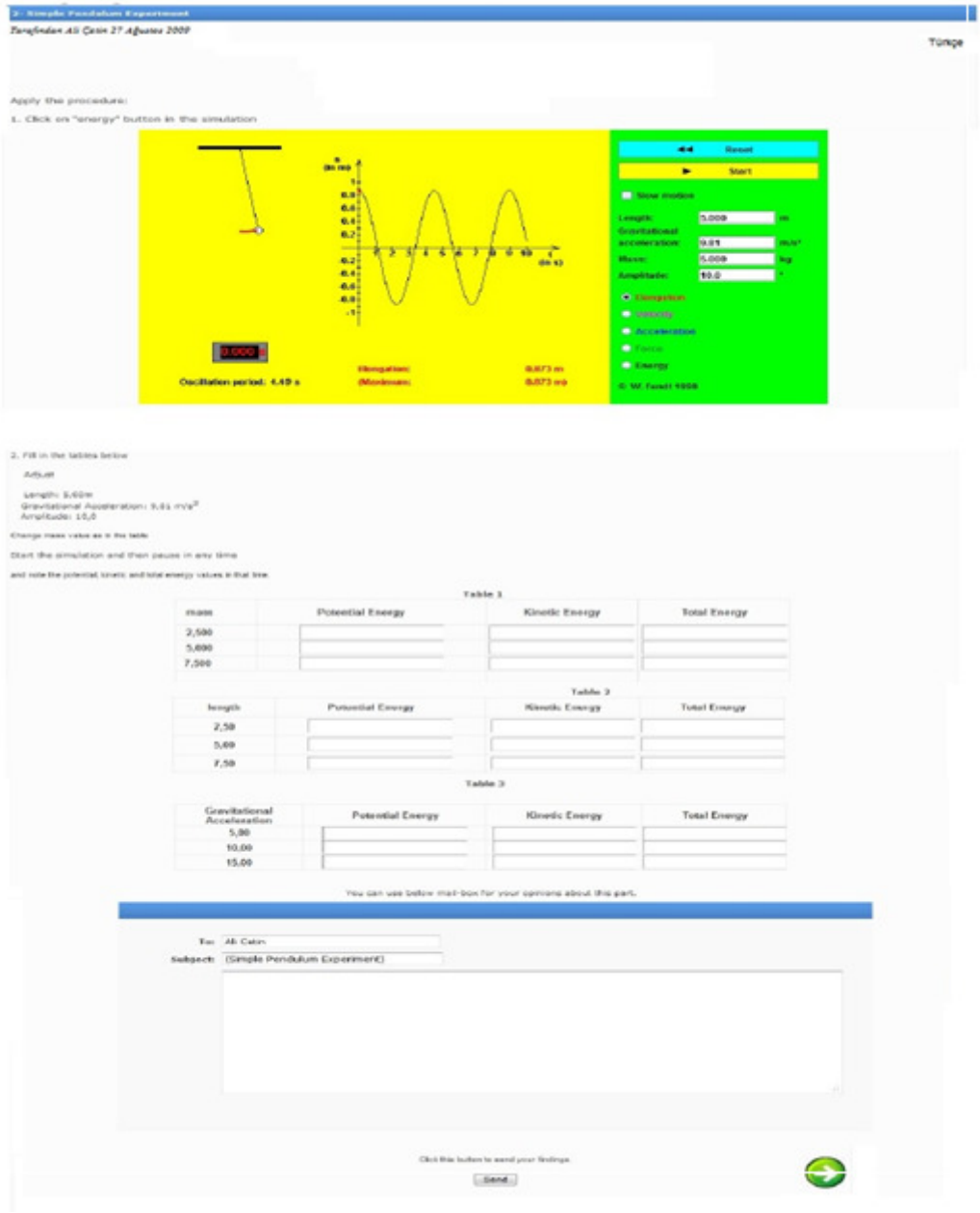

Figure 2: Engage Phase Of Web Based Inquiry Learning Environment

Explain Phase: A discussion forum is used in this phase. The following questions were asked to stimulate the discussion.

1. How do the potential and kinetic energy change during the motion of simple pendulum?
2. How do the potential, kinetic and total energy change with mass, length, gravitational acceleration, and amplitude?

Elaborate Phase: The details of energy conservation were presented. The energy skate park simulation was used for this purpose. In the simulation, a skater skies on the path and the program calculate his potential and kinetic energies in each time.

Evaluation phase: A test related to conservation of energy was constructed. Students answered this test and sent them to the researcher.

EVALUATION OF WEB BASED LEARNING ENVIRONMENTS

Evaluation is done in three ways. First three classes from a private school participated in the study. WILE and WELE are used by students in their schools' computer laboratory. Two 9th grade classrooms with 27 students used WILE and one 9th grade classroom with 15 students used WELE. Students participated into the system by using their user ID and passwords.

Three questions were asked to all users,
1. What is your general opinion about using these kinds of web based learning environments?
2. What is the best way of this web-site for you?
3. Do you face with any problem while using this web-site?
WILE and WELE students' answers are listed in the table below.

Table 1: Students' General Opinions for Web Based Learning Environments

	WELE Students	WILE Students
Q1	Negative (f=5) Neutral (f=7) Positive (f=3)	Negative (f=3) Neutral (f=2)Positive (f=22)
Q2	Independence of time Independence of place Solved exercises	Simulations Video Independence of time Engagement
Q3	No problem Log in the system	Video download is too slow JAVA was not downloaded in computer lab Log-in the system

Second interviews were done with 4 WILE and 2 WELE students. Interview questions were constructed by researchers and redesigned by a physics education expert. 27 questions were asked during interviews. Then the answers are listed.

1. Which do you prefer to learn "conservation of energy" subject in classroom environment or in web based learning environment?

One expository student selected classroom environment and the other one said both is the same. One inquiry student selected web based learning environment and three of them said both is the same.

2. Do you think whether the other physics subjects can be thought by using web or not?

All students said, all physics subjects can be thought by using web.

3. What can be done to develop this web-site?

Expository students claimed that videos and games should be added to WELE, inquiry students said that the number of videos and simulations should be increased.

4. Did you get fun to be participated in this study?

All students said yes. They are enjoyed and said that using web is better than classic lecture.

5.Do you think, which kinds of discussion are more effective, in classroom or in web based learning environment?

Expository students said classroom discussions. One inquiry students said there is no difference, one claimed in class discussions and two inquiry students preferred web based learning environments.

One physics teacher and two physics education experts (a research assistant and a associated professor in physics education) filled expert judgment form (EJF). This form is prepared to to get the opinions of experts related to the web sites. One is related to expository teaching and one is inquiry teaching. EJT includes mainly three parts. The first part is related to the general characteristics of the expert and includes 14 questions related to the experts'

experiences, education levels, and their expertise related to science and mathematics materials. The second part was related to the properties of W-INQU web site. This web site was constructed according to 5E learning cycle. It includes 5 parts for each phase of the cycle. Twenty-seven Likert scale and four essay type questions related to each phase were asked to the experts. The final part of EJT was related to the properties of W-EXPO group web site. This web site mainly included texts, problems and solutions related to electricity. Twenty-six Likert scale and four essay type questions related to each page were asked to the experts. At the end of the web-site evaluation, some general questions about the usability of the web sites were asked. Likert scale items have four alternatives as "very good", "good", "medium", "bad" and "very bad". Alternatives were coded as "5" for very good, "4" for good, "3" for medium, "2" for bad, and "1" for very bad. Descriptive statistics of EJF for WILE and WELE are presented in Table 2.

Table 2: Descriptive Statistics For Web Based Learning Environments Due To EJF

WELE		
	Mean	Sd
Technical And Visual Evaluation	4.56	0.53
Conservation of energy 1	4.20	0.48
Conservation of energy 2	4.20	0.52
Conservation of energy 3	4.20	0.45
Exercises	4.50	0.57
Problems	3.75	0.95
WILE		
Technical And Visual Evaluation	4.10	0.78
Engage Phase: Simple Pendulum Effect	4.00	0.00
Explore Phase: Simple Pendulum Experiment	4.67	0.57
Explain Phase: Discussion	4.25	0.50
Elaborate Phase: Energy Skate Park	4.75	0.50
Evaluation Phase: Questions	4.75	0.50

Expert judgment form results show that both site are good in technical and visual aspects. Explore, elaborate and Evaluation phases of inquiry learning environment are the mostly admirable parts. Finally, it seems that all parts of WILE and WELE are appropriate for students according to experts.

CONCLUSION AND DISCUUSION

There are two aims of this study, design and evaluation of web based learning environment. For design aim, three main things are considered: technical properties, visual properties and teaching methods. In technical properties, accessing should be easy, videos, photos and simulations should be downloaded fast, learning environment should not include heavy documents to make slower the usage. In visual properties, the distracted objects should not be used, color contrast should be appropriate and the main property of the object should be seen first. For teaching methods, inquiry and expository teaching methods can be used as in the study. For expository teaching method, expository texts, photos, exercises and solutions can be used. For example; a book format can be transformed to web environment, however the content and the interaction effect of the web based learning environments should not be forgotten. For inquiry teaching method, 5E learning cycles' phases can be used. Related activities can be designed for each phase of learning cycle. For example, in engage phase, students curiosity can be supplied by a question, voice, videos. In explore phase, as in the study, simulations can be preferred or students comments can be designed in a list. In explain phase, direct explanations, definitions and determinations can be done or students can explain their findings in explore phase. In elaborate phase, new applications can be developed like new simulations, or new data list. In evaluation phase, Sample problems can be solved by students.

For evaluation aim of this study, three different ways were used.

- First, all students wrote their general opinions to comment section and answered three questions. According to first question, while most of the students who use web based inquiry learning environment (WILE students) are positive for web based learning, most of the students who use web based expository learning environment (WELE students) are neutral. Due to second question, WELE students believe that the main advantages of web based learning are independence of time and place and exercise solutions. Boisvert (2000) states the same advantage as the main advantage of web based learning as that learning

can take place in anytime and anywhere. Additionally, WILE students think the same opinion and also they believe that simulations, video and engagement are also good ways of web based learning.

- Second, interviews were organized with 2 WILE and 4 WELE students. According to these interviews, most of the students think that classroom environment and web based environment can be used for "conservation of energy" subject. All students think that all physics subjects can be transformed to web environments. Students want to see more videos and simulations and this shows students get enjoyed from these activities. Students also prefer web sections to classic lectures.
- Third, one physics teacher and two physics experts filled "expert judgment form". Experts graded each pages of WELE and WILE. Finally the grades are presented as mean and standard deviation values. They show that each pages of WELE and WILE are appropriate for students levels and subject matter.

At the end of the evaluation part of the study, we can conclude that inquiry and expository teaching methods can be used while designing web based learning environments and students can use web based learning environments for physics lessons

SUGGESTIONS

- The number of learning environments should be increased by using different subjects and lessons
- Web based learning environments should be developed by using at least one teaching method.
- The number of the studies that investigate the effects of web based learning environments on some variables like achievement, attitudes etc. should be increased.

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