MODE-METHOD INTERACTION: THE EFFECTS OF INQUIRY VS. EXPOSITORY AND BLENDED VS. FACE-TO-FACE INSTRUCTION ON 9TH GRADE STUDENTS' ACHIEVEMENT IN, SCIENCE PROCESS SKILLS IN AND ATTITUDES TOWARDS PHYSICS

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ABSTRACT

MODE-METHOD INTERACTION: THE EFFECTS OF INQUIRY VS. EXPOSITORY AND BLENDED VS. FACE-TO-FACE INSTRUCTION ON 9TH GRADE STUDENTS' ACHIEVEMENT IN, SCIENCE PROCESS SKILLS IN AND ATTITUDES TOWARDS PHYSICS

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The purpose of this study is to find out the main effects of instructional modes (blended and face-to-face), teaching methods (inquiry and expository) and the interaction effects between them on 9th grade students' physics achievements, science process skills, and attitudes towards physics.

To achieve this purpose, 2x2 factorial design with four treatment groups were constructed, blended inquiry (W-INQU), blended expository(W-EXPO), face-to-face inquiry (INQU), and face-to-face expository (EXPO). Two web environments, Web Based Inquiry Learning Environment-WILE and Web Based Expository Learning Environment- WELE, were developed and used in blended mode with inquiry and expository teaching methods. Internet accesibilities and technological availabilities of the schools in Çankaya were used as two criteria of purposive sampling procedure, and then two private and two Anatolian High Schools in Çankaya were selected as a convenience sampling. The classes were randomly assigned to the treatment groups. 253 students' scores were used for inferential statistics.

The implementation of this study took six weeks in 2009-2010 academic year. Three instruments were used to gather data: electricity achievement test, science process skills test, and physics attitude scale. These instruments were administered both as pretests and as posttests. The data were analyzed by using Multivariate Analysis of Covariance (MANCOVA). The results revealed that: (1) blended instruction is more effective than face-to-face instruction in supporting students' conceptual understanding of electricity and their science process skills. (2) The inquiry teaching method is as effective as the expository teaching method when students' mean academic achievement, science process skills, and attitude scores are compared. (3) No interaction effect was found between teaching methods and instructional modes.

Keywords: blended instruction, inquiry teaching method, electricity, science process skills, attitudes towards physics, physics education

ÖZ

MOD - YÖNTEM ETKİLEŞİMİ: ARAŞTIRMACI-SORGULAYICIYA KARŞI AÇIKLAYICI VE HARMANLANMIŞA KARŞI YÜZ-YÜZE ÖĞRETİMLERİN 9. SINIF ÖĞRENCİLERİNİN FİZİKTEKİ BAŞARILARINA, BİLİMSEL SÜREÇ BECERİLERİNE VE TUTUMLARINA ETKİLERİ

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Çalışmanın amacı öğrenme ortamlarının (harmanlanmış ve yüz-yüze), öğretim metodlarının (araştırmacı-sorgulayıcı ve açıklayıcı) ve bunların etkileşimlerinin 9. sınıf öğrencilerinin elektrik konusundaki fizik başarılarına, bilimsel süreç becerilerine ve fiziğe karşı tutumlarına etkilerini ortaya çıkarmaktır.

Bu amaca ulaşmak için, 2x2 faktör dizaynı kullanılarak açıklayıcı ve araştırmacı-sorgulayıcı öğretim yöntemleri ile dört öğrenme grubu oluşturuldu. Bu gruplar: web ile harmanlanmış araştırmacı-sorgulayıcı (W-INQU), web ile harmanlanmış açıklayıcı (W-EXPO), yüz-yüze araştırmacı-sorgulayıcı (INQU) ve yüz-yüze açıklayıcı (EXPO). Bu çalışmada web tabanlı araştırmacı-sorgulayıcı ve açıklayıcı öğrenme ortamları (WILE and WELE) oluşturuldu ve bu öğrenme ortamları harmalanmış araştırmacı-sorgulayıcı ve açıklayıcı öğretim metodları ile kullanıldı. Örneklem seçimine amaçlı bir şekilde Ankara'nın Çankaya ilçesinde internet ve teknolojik altyapısı mevcut olan okulların seçimiyle başladı. Daha sonra uygunluk gözetilerek Çankaya ilçesindeki iki özel ve iki Anadolu Lisesi seçildi. Çalışmaya katılan sınıflar rasgele gruplara atandı. 253 öğrencinin sonuçları istatistiksel analizlerde kullanıldı.

Bu çalışma 2009–2010 eğitim-öğretim yılının ikinci döneminde altı hafta sürdü. 9. sınıf öğrencilerinden veri toplamak için üç ölçme aracı öntest ve sontest olarak kullanıldı: electrik başarı testi, bilimsel süreç becerileri testi ve fizik tutum ölçeği. Elde edilen veri MANCOVA kullanılarak analiz edildi. Sonuç olarak şu bulgulara ulaşıldı: (1) öğrencilerin elektrik konusundaki kavramsal anlamalarını ve bilimsel süreç becerilerini desteklemede harmanlanmış öğretim ortamı yüz-yüze ortamından daha etkiliydi, (2) araştırmacı-sorgulayıcı öğretim yöntemi açıklayıcı öğretim yöntemi kadar öğrencilerin akademik başarılarında, bilimsel süreç becerilerinde ve fiziğe karşı tutumlarında etkiliydi, (3) öğretim yöntemleri ile öğrenme ortamları arasında etkileşim bulunamadı.

Anahtar Kelimeler: harmanlanmış eğitim, sorgulayıcı öğretim metodu, elektrik, bilimsel süreç becerileri, fiziğe karşı tutum

To my family

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LIST OF ABBREVIATION

WEXPO: Blended Web with Expository Treatment Group
WINQU: Blended Web with Inquiry Treatment Group
EXPO : Face to Face Expository Treatment Group
INQU : Face to Face Inquiry Treatment Group
WELE : Web Based Expository Learning Environment
WILE : Web Based Inquiry Learning Environment
Mode : Instructional Mode
TM : Teaching Method
EAT : Electricity Achievement Test
SPST : Science Process Skills Test
PAS : Physics Attitudes Scale

CHAPTER 1

INTRODUCTION

The improvement in technology directly affects our life in a broad range of activities like shopping, transportation, communication, or education. One of the technological developments is of computers. With the development of nano-technological hardware, the size of computers decreased while the capacity of computers increased and became cheaper. Nearly 30 years ago, limited number of people could see the computers, but now they are a part of our lives in many areas like industry, hospitals, banks, supermarkets and schools (Akkoyunlu, 1995).

Internet seems to be the stimulator of technological developments in computers and provides very important opportunities for education (Karasar, 2004). The easiness on accessibility of the internet based sources can provide students' opportunities to restructure, rethink, categorize, and critique knowledge and visualize scientific ideas by using animations or simulations (Linn, Davis, & Bell, 2004). Students can also investigate dynamic events or situations that are difficult to observe in a classroom or laboratory environment.

Planning effective use of internet can have an impact on the students' ability to interpret information in and out of the classroom settings (Fisher, 2000). Internet is mainly composed of web based sources and web supplies a medium that students can easily reach knowledge (Yazıcı, 1999). Web based instruction needs a learning environment in online settings. A successful learning environment is a supportive learning environment. It should be not only appropriate for but also adaptive to the needs of individual learners. In other words, the content should cover examples related to their prior experiences and educational interests. It should also be written in a language appropriate for their comprehension level, complement with a variety of learning styles, and offer additional assistance at the times the learner needs it (Dupuis, 2003).

Web-based instruction became a unique instructional mode with the development and common use of web based tools for instructional purposes. Although web-based instructional mode is sometimes considered as an alternate to traditional face-to-face instructional mode, different instructional modes provide different learning opportunities for students. During face-to-face instruction, students learn by listening to lectures, contributing to discussions, and participating in the laboratory activities in classrooms; whereas, during web based instruction, students learn by reading texts, listening to audio, observing either still or animated images, watching videos, interacting with virtual environments, or communicating via electronic tools (Yelon, 2006). When a face-to-face instruction is blended with a web-based one, it provides the learners with explanations combining text, voice, video, graphics, and simulations. Furthermore, teachers may supply individual guidance and feedback and they may use the class time more efficiently (Dollar, Steif, & Strader, 2007). Blended instruction is the term referring to the combination of different instructional modes like face-to-face and web-based instructions. The definitions for blended learning in the literature are given as follows:

1. "Blended learning is defined as the mixture of various event-based activities, including face-to-face classrooms, live e-learning, and self paced learning" (Singh, 2003)

2. Kriger, Marsh and Smith (as cited in Duhaney, 2004) define blended learning as a combination of the use of electronic learning tools like software, email, World Wide Web and traditional face-to-face classroom teaching to ensure maximum effectiveness.

3. Singh and Chris (as cited in Oh, 2006) claimed that blended instruction is a combination of different instructional strategies in a course based on instructional needs. Different instructional attributes are associated with the instructional medium, allowing diverse learning activities and environments.

In this study, the blended instruction refers to the blend of web-based and face-to-face instructional modes. The definitions indicate that blended learning mainly aims to use the advantages of web based learning and those of face-to-face learning (Nickel, 2010). Olson and Wisher (2002) reviewed 47 studies related to use of web based instruction published between 1996 and 2002.

According to their meta-analyses, the mean effect size for the "blended" courses was 0.48, while that of the "all-online" courses was 0.08. Although this difference was not statistically significant, they claimed that web-based instruction might be more beneficial for students learning when it is used in conjunction with face-to-face classroom instruction. In other words, blended mode of instruction can be more effective than either face to face or web based modes of instructions alone.

Although the use of different instructional modes has potentials to contribute learning, at the same time, the instructional methods used in these modes can make a difference. Yelon (2006) states that:

> "Ineffective classroom training transformed to the internet is still ineffective training. To produce effective blended instruction, first and foremost, be sure to design instructional methods well" (p. 23).

1.1 Purpose of the Study

The main purpose of the study was to understand the interaction between teaching methods and instructional modes. In other words, the effects of instructional modes were analyzed for different teaching methods. While the instructional modes were set as blended and face to face instructions, teaching methods were set as expository and inquiry methods for this study. The possible effects were searched on 9th grade students' physics achievements, science process skills, and attitudes towards physics. A 2x2 factorial design, presented in Table 1.1 was used for the research.

Table 1.1

Constructed Treatment Groups in the Study

		Teaching Methods	
		Expository	Inquiry
Instructional Mode	Blended	W-EXPO	W-INQU
	Face to Face	EXPO	INQU

Expository and inquiry methods were selected for this study simply because they are easy to manipulate and compare. Inquiry and expository teaching methods are two of the mostly compared methods in the literature (Haury, 1993; Cobern, Schuster, Adams, Applegate, Skjold, Undreiu, Loving & Gobert, 2010; Yager & Akcay, 2010; Nwagbo, 2006; Lawson & Johson, 2002). While expository teaching is a teacher-dominated traditional method, inquiry is a student-centered method. According to inquiry oriented perspectives students should be not only physically but also cognitively engaged in science activities through inquiry (Macaroğlu, 2003). Inquiry involves active search of knowledge and understanding to create and satisfy curiosity. National Research Council (1996) states that inquiry involves activities like making observations, posing questions, planning investigations, using tools to gather analyze and interpret data, proposing answers, explanations and predictions, and communicating the results. However, there can be variations on the implementations of inquiry method (Cobern, Schuster, Adams, Applegate, Skjold, Undreiu, Loving & Gobert, 2010). Therefore, 5E learning cycle, a more specific and a well-defined inquiry method, was selected for the study.

On the other hand, expository teaching involves direct transmission of knowledge from one to another (Oliver & McLaughlin, 1996). It is defined as a teacher dominated teaching method through which teacher lecturers, provides notes, and solves sample problems (Martin, 2006). Expository texts are used as a material for expository teaching. According to Smith (2003) expository teaching and expository texts can provide deeper understanding if students are motivated to read variety of texts to find information and analyze different perspectives.

For the blended modes of instructions, two different web based environments were designed according to the basic characteristics of learning cycle and expository methods. Consequently, students were instructed in four different treatments during the study.

1) Blended mode of instruction with inquiry teaching method (W-INQU),
2) Blended mode of instruction with expository teaching method (W-EXPO),
3) Face-to-face mode of instruction with inquiry teaching method (INQU), and
4) Face-to-face mode of instruction with expository teaching method (EXPO).

The main effects of instructional mode and teaching methods on students' physics achievements, science process skills, and attitudes towards physics were investigated through this study. The interaction effects were also analyzed to understand how the teaching methods would contribute to the effectiveness of instructional modes.

1.2 Main Problem

The problem to be studied in this study is formulated as follows:

In what way the learning cycle and expository teaching methods contribute to the effects of blended instruction on 9th grade high schools students' physics achievements on electricity, science process skills, and attitudes towards physics?

1.2.1 Sub-Problems

The sub-problems are listed as follows:

1. What is the main effect of instructional modes (blended vs. face-to-face) on the population means of the combined dependent variables of 9th grade students' posttest achievement scores on "electricity", posttest science process skills, and posttest attitude scores towards physics when their pretest scores of achievements on "electricity", science process skills, and attitudes towards physics are controlled?
2. What is the main effect of teaching method (5E learning cycle vs expository) on the population means of the combined dependent variables the 9th grade students' posttest achievement scores on"electricity", posttest science process skills, and posttest attitude scores towards physics when their pretest scores of achievements on "electricity", science process skills, and attitudes towards physics are controlled?
3. What is the interaction effect between teaching method and instructional modes on the population means of the combined dependent variables of the 9th grade students' posttest achievement scores on "electricity", posttest science process skills, and posttest attitude scores towards physics when their pretest scores of achievements on "electricity", science process skills, and attitudes towards physics are controlled?

1.3 Null Hypotheses

The null hypotheses are listed as follows:

1. There is no statistically significant main effect of instructional modes (blended vs. face-to-face) on the population means of the combined dependent variables of 9th grade students' posttest achievement scores on "electricity", posttest science process skills, and posttest attitude scores towards physics when their pretest scores of achievements on "electricity", science process skills, and attitudes towards physics are controlled.

2. There is no statistically significant main effect of teaching method (5E learning cycle vs. expository) on the population means of the combined dependent variables of 9th grade students' posttest achievement scores on "electricity", posttest science process skills, and

posttest attitude scores towards physics when their pretest scores of achievements on "electricity", science process skills, and attitudes towards physics are controlled.

3. There is no statistically significant interaction effect between teaching method and instructional modes on the population means of the combined dependent variables of 9th grade students' posttest achievement scores on "electricity", posttest science process skills, and posttest attitude scores towards physics when their pretest scores of achievements on "electricity", science process skills, and attitudes towards physics are controlled.

1.4 Significance of the Study

Obviously, the developments in technology, computers, and the internet affect the Turkish education system. In the late 1980s, Turkish Ministry of Education started a campaign called "a million computers for schools" and aimed to supply at least one computer to each school. After that, new campaigns went on over time. In 2008, Ministry of Education supplied internet connections to each school. However, the internet was not effectively used in courses except for a few number of universities. The use of the internet by high school students was very limited. In 2011, Ministry of Education started a new and country-wide project to increase the use of technology and internet in high schools. The name of this project is FATİH (The Movement of Increasing Opportunities and Improving Technologies) and it aims to create e-contents to provide individuals opportunities for self-improvements by e-learning. Another purpose of the FATIH project is to help individuals to improve their technology usage and improve the practice of the internet in educational settings (National Ministry of Education, 2012). Some companies started to create e-content for FATİH project and presented them to Ministry of Education.

First of all, this study aims to help web developers built web based learning environments based upon specific teaching methods. The lesson plans and instructional materials such as web based learning environments developed for this study are also expected to be used by physics teachers during their instructional practices.

Secondly, this study will contribute to blended learning literature in terms of its effects on students' possible gains. Quite a number of studies conducted in different domains especially in biology revealed that blended instruction has positive effects on students' achievements, problem solving skills, and attitudes, and recommended that it should be used in other subject areas (Delialioğlu & Yıldırım, 2007; Nellman, 2008; Sanders & Shatler, 2001). However, there are only a limited number of studies conducted in the domain of physics which usually focused on the effectiveness of blended instruction. There is one meta-analysis in the literature about blended learning and it is released by US Department of Education (Means, Toyama, Murphy, Bakia & Jones, 2009). According to this meta-analysis, students who took all or part of their classes online performed better than those taking the same course through traditional face-to-face instruction. However, the researchers state that this result could not be generalized to K-12 students, because the studies included to the meta-analysis mainly are related to higher education or medical training. There is only a limited number of studies about K-12 level. The current study will contribute to the literature of blended learning by focusing on instruction of 9th grade physics curriculum.

Finally, apart from the arguments provided so far, the major significance of this study is to make contributions to the current literature by focusing on the possible interactions between instructional mode and instructional method. Blended, web based, or face-to-face instructional modes have different effects on students' achievements, science process skills and attitudes towards physics. As mentioned before, blended courses have higher effect sizes than the all-online courses (Olson & Wisher, 2002), or blended instruction have higher gain scores when compared to face-to-face instructional mode (Chandra & Watters, 2012). However, the methods used in these studies were not exactly defined or only one kind of teaching method was used. Inquiry and expository teaching methods are two distinct methods that can make a difference on students' combined dependent variables when used with blended or face-to-face instructional modes. The current study constructed two learning environments on the web and they were designed with inquiry and expository teaching methods in blended and face-to-face modes. The quantitative data of the study will be used to understand the possible interactions between instructional mode and method.

1.5 Definitions of the Terms

5E Learning Cycle: is a widely used inquiry based method for science instruction providing a structured way to implement inquiry in the classroom. (Marek, 2008). It includes five phases: engage, explore, explain, elaborate, and evaluate.

Blended Instruction: is the combination of web based and face-to-face instructions (Littlejohn & Pegler, 2007).

Expository Teaching: is a teacher dominated instructional method. The teacher is the controller and the imparter of knowledge. The teacher lectures, provides notes, explains charts, solve sample problems, read stories, and so on. All activities are designed and applied by the teacher. The teacher decides what is to be learned by the students. (Martin, 2006).

Internet: is a computer network that joins computers around the world together. It mainly consists of TCP/IP protocols, World Wide Web, file transfer, chat, conferencing and instant messaging (Seferoglu, 2006).

Instructional Mode: refers to the structural aspects of a course that have a major influence on the scheduling of classes: traditional, blended, and local online, or distance education (California State University - Policy Statement, 2003).

Inquiry: is a multifaceted activity that involves making observations, posing questions, examining books and other sources of information, planning investigations, reviewing what is already known, using tools to gather, analyze, and interpret data, proposing answers, explanations, or predictions, communicating the results. (National Research Council, 1996).

Teaching Method: is a way to shape information that supplants or compensates for cognitive processes necessary for achievement or motivation (Saloman, as cited in Clark, 1994).

Web Based Instruction: can be viewed as an innovative approach for delivering instruction to a remote audience, using web as a medium (Khan, 1997).

CHAPTER 2

REVIEW OF RELATED LITERATURE

Technological developments of computers (Akkoyunlu, 1995) especially the world wide use of the internet (Karasar, 2004) affect educational systems. World Wide Web is the mostly used internet environment (Yazıcı, 1999). This chapter starts with the first section of "web based instruction and physics". The literature review continues with "blended instruction", its definition, advantages and studies about it. Then the historical and popular debate between Richard Clark and Robert Kozma is presented in "medium-method conflict" section. This debate mainly focuses on the importance of teaching method used in an instructional medium. Then, inquiry teaching methods in web are reviewed and "5E learning cycle in web" is presented. One of the effects of learning cycle is related to "science process skills" of the students: therefore, particular attention was given to the science process skills. Inquiry teaching method is mainly compared with expository teaching method in the literature (Haury, 1993; Cobern, Schuster, Adams, Applegate, Skjold, Undreiu, Loving & Gobert, 2010; Yager & Akcay, 2010; Nwagbo, 2006; Lawson & Johson, 2002). The section of "Expository teaching method in web" is used for a comparison. Finally, electricity subject in physics is reviewed and "studies about electricity" are presented.

2.1 Web Based Instruction and Physics

Web-based instruction (WBI) uses the World Wide Web as the primary medium of course content delivery, class communication and class management. It has a growing preference of the internet bringing learning to students instead of bringing students to knowledge (Wang & Gearhart, 2006). In the literature, there are quite a number of studies about WBI in physics.

For example, Persin (2002) studied three four-year-periods in a South Florida high school between the years of 1991 and 2002. In these four-year-periods, he searched the effects of WBI on science students. First two of these periods did not include WBI and in the final one he used a web site to deliver weekly lecture notes, plans and assignments while also providing links to other sources of information in physics. He found that WBI enhance students' science achievements when their final scores are compared. The students receiving WBI got higher academic achievement than those receiving only traditional education with the mean effect size of 0.266, which suggested the typical students moved from 50th percentile to the 60.4th percentile when the web assisted instruction was combined with traditional methods.

Sun, Lin and Yu (2008) found similar results when they used web-based laboratory for science courses. They claimed that using technology is a new trend and can support learning in science courses. In addition, this web based laboratory can accommodate different learning styles. Quasi-experimental design is used for the study. 132 students were selected from four-fifth grade classes from two different elementary schools in Taiwan. F test is used for hypothesis testing ($F=1.532$, $p>0,5$). One of the results of this study was that the learning achieved in experimental group was more than that of the control group; most of the students (nearly three-fourths) were willing to use the laboratory. At the end of the study, they concluded that students get more interested in simulated experiments, science conceptions are built up more efficiently, and WBI achieved much better learning than traditional teaching.

Another study (Şengel, 2005) was conducted in Turkey with 51 private secondary school students. The aim of the study was to investigate the effects of WBI on students' achievements and attitudes toward science. A web-site related to science was developed by the researcher and used as a supplementary material to the course. The results of the study showed that students got higher mean values on post-test than pre-test scores in 6^{th} ($M_{post\text{-}test}=56.55$, $M_{pre\text{-}test}=42.85$), 7^{th} ($M_{post\text{-}test}=58.38$, $M_{pre\text{-}test}=46.81$), and 8^{th} ($M_{post\text{-}test}= 47.65$, $M_{pre\text{-}test} = 37.24$) graders.

Parallel with the research studies related to the effects of WBI, there is an increasing number of web sources on the internet directly related to physics. Some of these homepages and their properties are exemplified below;

1. The Baldufa Project; the project is prepared by Polytechnic University of Catalonia and url : http:///baldufa.upc.es is designed to help both teachers and students in teaching-learning activities in physics. "t" (theory documents), "p" (problems) and "q" (questions) are constructed by the authors. "Baldufa" pages include "find your teacher" and "the problem of the month" options. "Find your teacher" option consists of an index listing by name of all the teachers who are using "Baldufa" as a teaching and learning material. The names are active and lead to the teachers' homepages. "The problem of the month" option presents a problem. Users solve it themselves and send to the "Baldufa" server, then the best solution is published. The web-site is only used for helping to students or teachers; it is not used for an academic study. (Bohigas, Jaen, & Novell, 1998).

2. Motion Workshop; video-based system has several advantages such as; improved image size, higher quality, greater time resolution and ease of use. These advantages can be developed in World Wide Web (Chow, Carlton, Ekkekakis & Hay, 2000). "Motion Workshop" is prepared with these advantages by University of Melbourne. This applet allows students to track the motion of an object in a video clip, display resulting data in a spreadsheet and manipulate graphs representing the motion (Pearce & Livett, 2001). "Motion Workshop" supply students to make connections with real-world physics. Motion of three ball being juggled, motion of pool balls, collisions are some of the video-clip examples. Students can analyze these motions by pointing the objects in the clips. The positions of the objects are graphed by the program and analyzed by the students (Pearce & Livett, 1998). The important point of this project is graphical analyses of the motion, because students have difficulty in constructing motion graphs and this study helps them about drawing graphs.

3. xyZET and WebTOP; These are 3d simulation programs in the internet. "xyZet" (Hartel, 2000) is about mechanic subjects like collision processes, conservation of momentum, conservation of energy, planetary motion and pendulum motion. It is tested to understand for the effectiveness and robustness of the material in classroom environment. As a rule 30-50% of each lesson was teacher-oriented and this time is used to introduce the topic, explain important terms and definitions, and demonstrate the relevant experiments. Most students spent more than 50% of their time working on the assignments and sample problems in "xyZET" program. Finally, the material has proven to be robust and applicable. Classroom activities lead to a wide variation in the rate of student progress. Most students are very strongly oriented toward assignments. "WebTOP" (Mzoughi, Herring, Foley, Morris, & Gilbert, 2005) is a computer graphics software that helps instructors teaches and students learn about waves and optics. This software includes simulations and homework problems. First, it was used to simulate waves and optics in class. Second, the students were required to do two homework sets in which they needed to use "WebTOP". Finally, a questionnaire was prepared for the evaluation of the program and students find "WebTOP" demonstrations as "very useful" and "WebTOP" homework in between "very useful" and ""pretty useful".

4. PhET project: university of Colorado developed over 85 interactive simulations for science learning and teaching. The main characteristics of these simulations are emphasizing the connections between real life phenomena and the underlying science, making invisible visible (e.g. atoms, molecules, electrons, protons), including visual models that experts use to aid their thinking. In the lecture, these simulations can be used as an animated illustration or enabling classroom inquiry. (http://phet.colorado.edu/publications/classroom-use/PhETUseInLecture.pdf) Wieman, Adams, and Perkins (2009) claim that the PhET simulations allow students carry out exploration and learning that is cognitively similar to that of scientist, something they do not have the experience or motivation to do with most real equipment in physics. Wieman, Adams, Loeblein and Perkins (2010) also claim that PhET interactive simulations are widely

used in teaching physics and chemistry. And they say that these simulations can be used in similar ways of lectures, homework, in-class activities and laboratory.

These web-sites (The Baldufa, Motion WorkShop, xyZET, WebTOP and PhET) are designed for different purposes. However the selected strategies in them can be used to produce new web-sites for blended instruction. In this study, two web sites are prepared according to two teaching methods: expository and inquiry (5E learning cycle). In these web sites, theory based documents, problems and questions and their solutions are presented for the blended group of W-EXPO as in the Baldufa project. Similarly videos, simulations and physics applets are used for the blended group of W-INQU as in the Motion Workshop, xyZET, WebTOP. Some simulations of PhET are directly used in web based inquiry learning environment.

2.2 Blended Instruction

Blended learning, a combination of the use of electronic tools and traditional face-to-face classroom teaching strategies, is not a new concept and it has been growing in popularity, particularly in education (Duhaney, 2004). Dollar, Steif and Strader (2007) listed the opportunities and challenges of enhancing traditional classroom instruction with web based courses as follows:

Opportunities

a) Active Learning: carefully prepared and appropriately applied computer based materials can promote high levels of cognitive activity on the part of students. These materials should appropriately intersperse and sequence content, questioning, practice and assessment.
b) Explanations combining voice and evolving graphics: Combinations of voice and graphics have advantages of multiple pathways of information (aural and visual) and offer enormous benefits relative to textbooks.
c) Simulations: textbooks and instructors cannot offer dynamic simulations of relevant phenomena. Dynamic simulations are beneficial to explore an event.
d) Problem solving with individual instantaneous guidance and feedback: While solving homework problems students sometimes need few hints, but when they are unavailable (at 2 am), their time is wasted. The individual guidance and feedback for problem solving that students can get from online material are instantaneous and right on time.
e) Convenience of Review: Online materials can be engaged multiple times, giving students opportunities to review when convenient for them.
f) Feedback to instructors and more productive use of class time: data-mining technologies can be used to control students. Instruction time can be used more effectively.

Challenges

a) Design: It is important to signal users where they are and what is expected at each instant.
b) The challenges facing computer based materials: After completing the online materials, students should solve problems on paper with drawings, symbols and mathematics as is traditionally done. We could give them written homework on the side.

Delialioğlu and Yıldırım (2007) define the blended instruction in their study, "students' perceptions on effective dimensions of interactive learning in a blended learning environment". They say that instructors use simulations, online exercises and online feedback to create richer learning environments. The systematic and strategic integration of these tools to meet pedagogical goals introduce a new strategy that can be called blended learning, hybrid instruction, mediated learning, web enhanced instruction or web assisted instruction. The idea behind blended learning is to redesign the instruction to maximize the advantages of both face-to-face and online modes of instruction.

Gunter, Sanders and Morrison-Shetlar, and Yıldırım (as cited in Delialioğlu & Yıldırım, 2007) found that blended courses affect students' learning positively. Delialioğlu and Yıldırım (2007) designed a blended "Computer Networks and Communications" elective course at Middle East Technical University. 25 students enrolled the course and the study lasted 14 weeks, the students met once a week for an hour in class, but essential parts of the course were conducted online. At the end, the materials and the activities are found beneficial for learning by the students. They proposed several suggestions for the productive use of blended instruction. First of all, not only the technologies but also pedagogical philosophies, theories and instructional design methodologies should be blended.

Secondly, multimedia should be used in the web component to enhance learning. Thirdly, the communications between student-student and student-instructor should be encouraged and provided with facilities. Finally, online self-assessment tools should be provided to students. In addition to these, they claim that blended learning environments should be constructed for different students in different subject areas for the future studies.

Similar study conducted by Bernard and Cummings (2003) in the Caribbean. A web-based course was designed for "Information Technology" and implemented at some selected secondary schools. Before the study begins, an initial survey was conducted among the schools to determine the readiness for web based education as well to gain an understanding of the existing instructional characteristics. The course syllabus is revealed three types of units: concept based, skill based, and problem based learning. Concept based learning units contain descriptive instructional materials that require the students to understand the terms and concepts. The computer is used as tutor. Skill based learning units contain hands-on experience. After explaining the role of the tool, students completed some given tasks. Immediate feedbacks were given to the students. Computer is used as a tool. Problem based learning units contain analytical skills in problem solving. Students are responsible to apply and use the knowledge to solve problems and to perform critical thinking activities such as analyzing and evaluating. Computer is used as a trainee.

The teachers played the role of facilitator rather than a dispenser of instruction. At the end of the study, Bernard and Cummings (2003) claim that web based courses are effective for both slow learners and gifted students. Individual attention, teacher encouragement, repetition of explanations and assistance with practical exercises helped slow learners whereas the gifted students are encouraged by the teacher to become faster than the rest of the class.

Another study was conducted by Nellman (2008) for Biology courses in California, "a formative evaluation of high school blended learning biology course". The study aimed to answer the question "will participants increase their domain knowledge and problem solving skills after instruction in a high school level blended distance learning biology course?" Additionally, participant reactions to the blended instruction model were surveyed. The study consisted of pilot and main study groups and participants were students in an urban Southern California public high school biology course in genetics content. All students (N=144) were selected from biology classes and 115 of them participated to the study. 67 of them were randomly placed into the control group and the others placed into the treatment group. All students were issued a textbook and it's I-Text CD for home use. Three different instruments were used during the study. (1) Content Understanding Test includes 16 multiple choice test items to measure content understanding and 6 essay type questions to measure problem solving skills. (2) Students Attitude Questionnaire. (3) Technology Survey.
The hypothesis and related findings were as follows:

Hypothesis 1: Participants in a high school level blended biology course will increase their domain knowledge.

The results provided evidence that participants in the study significantly increased their domain knowledge (genetics content understanding). Mean improvement was 31% (t=21,97, df=66, p=.01).

Hypothesis 2: Participants in a high school level blended biology course will increase their problem solving skills.

The results provided evidence that participants in the study significantly increased their problem solving skills (Punnett squares). Mean improvement was 28% (t=11,67 , df=66, p=.01).

These three examples about blended instruction suggest that it should be studied in different fields. The first study was about a computer course and done in a university. It concludes that the blended instruction should have pedagogical philosophies. The second study was about Information Technology and gives information about the design of the course, the role of the teacher and the effects on slow and gifted learners. The third study was about biology and it concludes that blended instruction has the effect on students' knowledge positively. These results show that blended instruction can be used in physics and it can effect students' achievements.

Blended learning aims to combine the advantages of traditional courses and web based instruction together to enhance students learning and achievements (Nellman, 2008). Physics is one of the different subject areas for blended instruction and the current study aims to use it in a physics course. Because when ERIC is searched with the keywords "blended instruction" and "physics"

together, it finds only eleven documents. These documents are not directly related with each other and six of them were conducted after 2009.

2.3 Medium-Method Conflict

There is a popular debate related to medium and method distinction in education between Richard E. Clark and Robert B. Kozma in the literature. The opinions of Clark (1994) are summarized as bellows in this debate:

- Medium has economic benefits but no learning benefits.
- Learning is influenced more by the content and instructional method than type of medium
- Medium is not only failed to influence learning, but also directly responsible for motivating learning.
- Specialists generate about the "best" contents and methods for each medium. For example, videos for television, simulations for computers.
- In meta-analytic reviews, it seems that there is a positive effect of medium, but this effect may be caused by instructional methods that do not controlled during the studies.

On the other side of the debate, Kozma (1994) defends the following arduments:

- First of all, he asks the questions in the future form and uses "will" instead of "do". So he claims that in the future, the medium may affect the learning.
- He defines educational technology as "a design of science", not as "a natural science". He claims that we have not yet made one medium that affect the learning.
- If we consider the media as "mere vehicle" like Clark, we are likely never to understand the potential for such a relationship.
- Kozma mentioned about two significant studies, Thinker Tools and Jasper. The students who used them performed better than the students who did not use them.

Kozma (1991) defined medium with the relevant characteristics like their technologies, symbol systems and processing capabilities. Then he claimed that each medium (book, television, computer and multimedia) affects students learning and concludes that some students may learn a particular task regardless of delivery device but other may be able to take advantages of particular medium's characteristics to help construct knowledge.

Kozma (1991) replies Clark's argument that the reason of the difference on students understanding is the method, not the medium. He says that this argument creates a distinction between method and medium. They have a integral relationship and both are a part of a design.

Nancy and Monica (2005) claims that in 1983 when Clark published his first article about media-method conflict computers were communicated with each other only when they were connected each other physically in the same mainframe or server but now in 2005 computers can communicate each other even without cables with the development of internet and World Wide Web and Clark's delivery truck turned to supersonic jet. Finally, Nancy and Monica stated their beliefs as follows:

- Computers not all media are capable of supporting instructional method.
- The unique capabilities of computers affect learning.
- Computers supply the most cost efficient delivery method.

Consequently, the technological developments in time changed the nature of classrooms, students and teachers. Especially, the development in internet technology and web may shape future's classrooms as in the FATIH project in Turkey. The new findings discussed in web based instruction and physics, and blended instruction parts of this chapter show that the studies about media continued in time. So, the debate should not be elaborated further with the developing instructional media and methods.

2.4 Inquiry Learning

Inquiry is a multifaceted activity that involves making observations, posing questions, examining books and other sources of information, planning investigations, reviewing what is already known, using tools to gather, analyze, and interpret data, proposing answers, explanations, and predictions, communicating the results. (National Research Council, 1996). Inquiry method is mainly compared to traditional expository teaching method in the literature (Haury, 1993; Cobern, Schuster, Adams, Applegate, Skjold, Undreiu, Loving & Gobert, 2010; Yager & Akcay, 2010; Nwagbo, 2006; Lawson & Johson, 2002; Sokolowski & Rackley, 2011).

Nwagbo (2006) designed a study with 147 students from high schools in Nigeria. Students' achievements and attitudes to biology were tested. At the end he concludes that inquiry method significantly better than the expository method in enhancing cognitive achievement in Biology and students attitudes were changed positively with two teaching methods. Yager and Akcay (2010) designed a study with 12 teachers who agreed to participate in inquiry and traditional sections in their classes. 365 students for inquiry sections and 359 students for traditional sections were included into the study. Science process skills and understanding of science concepts were analyzed. The results showed that understanding of science concepts and science process skills of the students increased in inquiry sections and the difference is statistically significant. Similar to these studies, Lawson and Johson (2002) and Sokolowski and Rackley (2011) also found results that support inquiry learning about students understanding. However, these studies were not administered in a web based medium. Mioduser, Nacmias, Lahav and Oren (2000) reviewed 436 web sites, 146 (33,5 %) of them were related to physics, instructional model of these sites are classified as 330 (75,7 %) direct and 123 (28,2 %) inquiry based instruction. At the end of the study, their judgement about the web sites that one step ahead of the technology and two steps back for the pedagogy (p. 73). This study shows that web based learning environments mainly composed of direct instruction and the literature needs studies with web based inquiry.

The application of the inquiry instruction in web based learning environments should be supported by academic institutions, public organizations and private companies (Mioduser, Nacmias, Lahav & Oren, 2000). In the literature, there are some web based inquiry environments. These are listed below:

Web based inquiry science environment (WISE): It is constructed by Berkeley University in 1997 and supplies science inquiry activities for K-12 students. This environment gives some opportunities like reading and writing prompts, predict, observe, explain and reflect, critique and feedback, science narratives, challenge questions; argument organizers and explanation generation tools, idea manager, WISE draw and flipbook animator, MySystem; activity templates, inquiry and role-play, peer critique and feedback, debate, brainstorm, discussion; rich media and interactive simulations, virtual experiments, multimedia texts (http://wise.berkeley.edu/webapp/pages/features.html). Viola (2010) designed a doctoral study with WISE, he constructed two version: first, students make a claim and find an evidence for a subject in Biology and second, students do not make such a claim and evidence. He concluded that there is no significant difference between two versions of WISE, but there was a significant difference between the test scores of students who had different teachers.

Global Learning and Observations to Benefit the Environment (GLOBE): GLOBE involves students from 5000 schools in 60 countries. The students make environmental measurements and reports them using World Wide Web. Globe provides meaningful application for computer and communications technologies, increases students' performance in the job market every-where in the world, uses wide variety of operational capabilities of Web, provides data, visualizations and information (Finarelli, 1998). In 2012, the number of GLOBE schools is 25,257 and the number of teachers is 917 (http://www.globe.gov). Kids and Global Scientists (KGS) project is related to weather and it is designed for the needs of thousands of students and teachers in Detroit public schools (Songer, Lim & Kam).

GetSmart: website was developed for the purpose of investigating the impact of teacher produced online materials to improve students' performance and attitudes in physics classes at a high school in Australia. GetSmart includes web based lessons, texts, online chats and interactive activities. A study was constructed by Chandra and Watters (2012) to investigate the effects of GetSmart in a blended learning environment on year 12 students' achievement about "electronics" and "atomic physics unit". 48 students were assigned to treatment group and 32 students to control group. Two

experienced physics teacher (including the researcher) participated to the study. Knowledge, and science processes were tested. The main effects for knowledge was statistically significant in the favor of blended instruction, but there was no statistically significant main effect for science process skills. (http://www.copacabana-p.schools.nsw.edu.au/Get_Smart_Pages/Get_Smart.htm). GetSmart include both inquiry and expository materials designed by teachers.

As discussed above, there are a few number of projects related to web based inquiry environments. Additionally, these studies did not used for quantitative data analyzes. The literature about web based inquiry needs some projects to enrich the literature with quantitative data. This study aims to fill also this gap as discussed in chapter 1.

Bass, Contant and Carın (2009) stated that inquiry instruction had some special features that considerably fundamental to 5E learning cycle, these are;

- Learners are engaged by specific questions: Ideally, students would generate questions from their own experiences but many students need assistance in learning to form questions. In many cases the focus question or problem is formed by the teacher.
- Learners give priority to evidence as they plan and conduct investigations: Students devise ways to gather evidence to answer their questions. The degree of assistance is varying during the students collect data, decide the relevant data and organize the data. Students may use experimental investigations.
- Learners connect evidence and scientific knowledge in generating explanations: Students describe, classify and explain their observations and work by themselves and work with one another. Students learn from their explanations and ask "why something happens" or "what has happened".
- Learners apply their knowledge to new specific problems: To develop and extend their understanding students must apply their new knowledge to new circumstances.
- Learners engage in critical discourse with others about procedures, evidence and explanations: Children love to talk about their experiences and inquiry; science provides students to organize, record, report and reflect their knowledge.

These complex processes of inquiry instruction can be considerably simplified through the use of 5E learning cycle (Bass, Contant & Carın, 2009).

2.4.1 5E Learning Cycle

5E learning cycle supplies constructivism, conceptual change and inquiry learning in a classroom setting (Campbell, 2000). Bybee and Landes (1990) stated that the learning cycle is originally proposed by J. Myron Atkins and Robert Karplus in 1962 and then incorporated in the SCIS (Science Curriculum Improvement Study) program. This original model consisted of three phases: exploration, conceptual invention and application (Hammermand, 2006). The final version of the cycle was developed in the late 1980's as a component of Science for Life and Living curriculum created through the Biological Sciences Curriculum Study (BSCS) group (Bybee & Landes, 1990).

This group summarized these five phases as follows in their web-sites as a full report of 2006.

- Engage: this phase aims to promote curiosity and make connections between past and present knowledge of the students. Discrepant events can be used to supply curiosity.
- Explore: Conceptual change is facilitated. Students may complete lab activities, explore questions and possibilities, design and conduct preliminary investigations.
- Explain: Students' understanding of engage and explore phases is important and this phase provides opportunity to demonstrate their conceptual understanding, processes and skills. This phase also provides opportunities for teacher to directly introduce a concept and make explanations.
- Elaborate: Through new experiences, teachers challenge and extend students' conceptual understanding and skills. Students use their understanding for new additional activities.
- Evaluate: Students assess their understanding and teachers evaluate students progress toward achieving the educational objectives.

5E learning cycle format is a widely used inquiry based format for science instruction and it provides a structured way to implement inquiry in the classroom (Talley, & Cherry, 2009).

2.5 Science Process Skills and Related Studies

Science process skills can be defined as the skills that can facilitate learning, supply an active role to students during classrooms, develop students' responsibilities, increase learning and help students acquire research methods (Çepni, Ayas, Johnson & Turgut, 1997).

Science has three important dimensions: scientific knowledge, science processes, and scientific attitudes. The processes of doing science are the science process skills that scientists use. Science process skills and inquiry skills are necessary skills for creating scientific knowledge (Lanka, 2007). That means these skills can be accessed by applying them in the laboratory activities. Science process skills can be classified into two: basic science process skills and integrated science process skills.

Basic Science Process Skills:

- Observing - uses senses to gather information about an object or an event. It is a description of what was actually perceived. This information is considered qualitative data.
- Measuring - uses standard measures or estimations to describe specific dimensions of an object or an event. This information is considered quantitative data.
- Inferring - formulates assumptions or possible explanations based upon observations.
- Classifying - groups or orders objects or events into categories based upon characteristics or a defined criteria.
- Predicting - guesses the most likely outcome of a future event based upon a pattern of evidence.
- Communicating - uses words, symbols, or graphics to describe an object, action or an event.

Integrated Science Process Skills:

- Formulating Hypotheses - states the proposed solutions or expected outcomes for experiments. These proposed solutions to a problem must be testable.
- Identifying of Variables - states the changeable factors that can affect an experiment. It is important to change only the variable being tested and kept the rest constant. The one being manipulated is the independent variable; the one being measured to determine its response is the dependent variable; and all variables that do not change and may be potential independent variables are constants.
- Defining Variables Operationally - explains how to measure a variable in an experiment.
- Describing Relationships Between Variables - explains relationships between variables in an experiment such as between the independent and dependent variables plus the standard of comparison.
- Designing Investigations - designs an experiment by identifying materials and describes appropriate steps in a procedure to test a hypothesis.
- Experimenting - carries out an experiment by carefully following directions of the procedure so the results can be verified by repeating the procedure several times.
- Acquiring Data - collects qualitative and quantitative data as observations and measurements.
- Organizing Data in Tables and Graphs - makes data tables and graphs for data collected.
- Analyzing Investigations and Their Data - interprets data statistically, identifies human mistakes and experimental errors, evaluates the hypothesis, formulates conclusions, and recommends further testing where necessary.
- Understanding Cause and Effect Relationships - what caused what to happen and why.
- Formulating Models - recognizes patterns in data and makes comparisons to familiar objects or ideas.

When the science programs of different countries are searched, basic science process skills are important for elementary and early childhood students and integrated science process skills are important for secondary schools (Temiz, 2007).

These skills cannot be thought as steps of a procedure or independent segments. They are all related with each other. So the improvement of these skills can help meaningful learning and help individuals while solving problems in their daily life (Aktamış & Ergin, 2007).

A study was conducted with college biology and elementary majors to understand the attitudes of computer simulations on science process skills. Participants did use online resources and a computer simulation which is prepared with 5E method. A questionnaire was prepared to understand their attitudes toward science process skills. At the end of the study, 40% of biology majors and 85% of elementary education majors indicated that computer simulations helped them to improve their science process skills (Lee, Hairston, Thames, Lawrence, & Herron, 2002).

In another study (Lanka, 2007) a learning environment was created by using an inquiry skills to facilitate science process skills in teaching of physics teachers. In this learning environment, teachers get assessments to improve their science process skills in four dimensions.

• *Skill C1*: Using and organizing techniques, apparatus and materials;
• *Skill C2*: Observing, measuring and recording;
• *Skill C3*: Interpreting and evaluating experimental observations and data;
• *Skill C4*: Planning, carrying out and evaluating investigations.

After the study, teachers' perceptions were surveyed with a questionnaire which was prepared with a likert scale. The researcher found that with this questionnaire: 1) Fostering scientific attitudes (4,58 out of 5); 2) Encouraging learners to observe safety precautions at all times when conducting scientific investigations(4,67 out of 5); 3) Facilitating investigative/inquiry activities(3,87 out of 5).

In another study (Huppert, Lomask & Lazarowitz, 2002), a computer assisted learning environment was created with computer simulations. Treatment groups got computer simulations with classroom teaching. In computer laboratories treatment group students made 3 experiments by using the simulations and noted the data to the given worksheets. Then the students analyzed data. Control groups were instructed only traditional classroom teaching. An achievement test and a biology test of science processes were used. These tests were taken from the literature. The effects of this environment on students' achievements and scientific process skill were investigated. Treatment groups students got higher achievement scores and science process skills' scores than the control group students with the effect size of 2.66 and 3.02 respectively.

According to these studies, science process skills can be improved with the use of appropriate teaching method and material together. In this study, web based learning environments with 5E and expository teaching methods were developed. Both include the same subject matter and related examples and assessments. The effects of these blending methods on students' science process skills were investigated with a Science Process Skills Test which was taken from the literature.

2.6 Expository Teaching

Oliver and McLaughlin (1996) described five interactions between teacher and students; social, procedural, expository, explanatory and cognitive. According to their model, expository can be defined as the demonstrations of knowledge or skills in response to a direct request from one to another. Similarly, Martin (2006) defined expository teaching as a teacher centered teaching method. Martin also says that according to expository teaching, teacher lectures, provides notes, shows videos, explains charts, solves sample problems, and demonstrates laboratory exercises, reads stories and so on. All activities are teacher controlled. In addition to these, expository methodology has had its place in science education. Explanations of certain scientific concepts, such as nuclear energy, atomic theory, may be best handled in an expository mode with the whole class. However, Jerome Bruner argued that expository teaching has "two major weaknesses: (1) it makes the learner passive, and (2) the knowledge presented is inert" (Eggen & Kauchak , as cited in Martin, 2006).

On the other hand, expository texts mainly related to information and may use rhetorical structures such as cause and effect, analysis, compare and contrast, explanation, description, classification, illustration, argument and persuasion, and definition (VanderMey, Meyer, Van Rys, Kemper, & Sebranek, as cited in Jenkins, 2009). Due to Smith (2003), expository texts have three main advantages. First, if the information is presented to children in a fun and creative ways, children can develop more sophisticated skills in critical and analytical thinking. Second, students can synthesis material by reading from a variety of texts to find information on a topic, drawing out the main points and learn how to search for relationships among pieces of information. Third, teachers should provide different expository texts to students, so they have a chance to see different perspectives and finally this will supply the students' deeper understanding of the text.

In the literature, there are some studies that compare expository and inquiry teaching methods. For example; Anders, Berg, Christina, Bergendahl, Bruno and Lundberg (2003) designed a study to investigate students' attitudes towards learning after inquiry and expository versions of a chemistry laboratory. During the expository instruction, the experiment was described in detail. During the inquiry instruction, written information of the task was given to students to compare the two catalysts in any way they found relevant. The students had to use their existing knowledge to formulate a hypothesis, plan, perform and evaluate their experiment. 190 university students from different departments were the participants of the study. The attitudes of the students were analyzed by using a questionnaire and interview. At the end of the study, authors said that they had found true difference between the inquiry and expository instruction. They claimed that inquiry version was more beneficial than expository for the students.

As a second study that compares expository and inquiry, Nwagbo (2006) designed the study to compare guided inquiry and expository teaching methods in secondary schools biology course. A pre-test, post-test non equivalent control group design was adopted to the study and 147 students from four secondary schools participated in Nigeria. For data collection three instruments were used, scientific literacy test, biology achievement test and biology attitude test. Biology teachers were trained four weeks and the study lasted 6 weeks. The students' interactions were minimal. The lesson plans were given to the teachers. For the guided inquiry groups, drawing attention to the instructional materials (charts, real specimens, models etc.), probing questions, student questioning and drawing of conclusions and the teacher directing students' inconsistencies were used. Each activity was followed by a class discussion. The control group was taught the same biology concept, using expository method. Teacher delivered the pre-planned lesson to the students with little or no instructional materials. Student-teacher instruction was minimal. The students listened and assimilated principles and procedures for the correct solutions of problems. As a result of the study, the guided inquiry method was found significantly better than the expository method in enhancing cognitive achievement in biology. All the groups showed positive attitude to biology for the two teaching methods. There were no statistically significant interactions between teaching methods and scientific literacy on achievement and on attitudes to biology. As a final study about the comparison of inquiry and expository, Sweak, Jong and Joolingen (2004) tried to investigate the effects of discovery learning and expository instruction on definitional and intuitive learning. While discovery learning included hypothesis generation, experimental design and data interpretation and used simulation learning environment, expository instruction paid more attention to directly exposing definitions and equations and used hypertext learning environment. A pre-test, post-test design was adopted for the study and 112 students participated. The researchers expected for the discovery learning (simulation) group students do better in intuitive learning test and for the expository instruction (hypertext) group students do better in definitional learning test. However, it was found that expository instruction group performed better on the definitional knowledge test and intuitive knowledge test but not on the time needed to answer items. On the explanation test there was no difference between the two groups. The researchers claimed that in the simulation group many students followed the assignments given and did not engage in self guided discovery but in the hypertext group assignments were more directly presented. This implies that simulations are to be considered only when clear benefits of discovery are expected and only with sufficient learning time and freedom for the students to engage in discovery.

The findings in the literature can be summarized as following:

a) Expository teaching is a teacher centered and traditional teaching method. The students are passive and the teacher controls all activities in class.
b) Expository texts are mainly using for description, definition, explanation, cause and effect, analysis, compare and contrast etc. and they may supply deeper understanding of the concept.
c) Expository teaching is used for the comparison part in the studies. To investigate the effect of inquiry learning, expository teaching is used as the traditional instruction. However, in the studies there are no details of how they do expository teaching. In some studies, expository teaching supplies deeper understanding of knowledge, in some other studies inquiry supplies that. There is no strict beneficial literature between expository and inquiry.

2.7 Studies about Electricity

The literature was searched to review the studies about electricity subject. The methods used to teach electricity, the difficulties and misconceptions related to electricity are presented below.

Zavala (2008) performed a qualitative study to understand the teaching methods, misunderstandings and gaps of teachers while teaching electricity. He claimed that students started to learn electricity concepts at elementary level and apply their knowledge in daily life activities related to electricity. These activities were also the sources of their misunderstanding of electricity concepts. Additionally, teachers used different teaching methods according to their specific teaching goal. Four of six participant teachers of the study were willing to use laboratory activities, while two of them preferred lecture format for their primary method of instruction.

Different teaching methods can be preferred to teach a subject but electricity has many misconceptions and it is a part of real life. The electricity misconceptions were classified by different researchers in different formats. According to McDermott and Shaffer (1992) students did not understand how current flows in a wire and think a battery as a source of constant current instead of constant potential difference. And also Yalvaç (1998) classifies the misconceptions related to electricity in the literature as follows;

The sink model: a single wire is enough for the electric current.

The clashing current model: positive electricity moves from positive terminal and meet on the device with negative electricity coming from negative terminal.

The weakening current model: current gradually weakens while passing the electrical device.

The shared model: current is the same at all points in circuit regardless of the type, series or parallel.

Local reasoning: the change in one part of the circuit does not affect the other parts.

Empirical rule: the closest bulb to the battery lights brighter than the others.

Maloney, O'Kuma, Hieggelke, and Heuvelen (2001) tried to investigate the students' difficulties about electricity and magnetism and developed a survey "Conceptual Survey of Electricity and Magnetism (CSEM)". This survey was applied to more than 5000 physics students in four years. At the end of this survey study, they concluded that students had some difficulties about electricity and magnetism. The difficulties related to electricity were about the charge distribution in conductors and insulators, applications of Newton's third law (students seem to believe larger "objects" (in charge magnitude) exert large forces than smaller objects). Researchers of the study claimed that these difficulties could be eliminated with the newly developed and improved teaching way of electricity and magnetism.

The findings about electricity in the literature show that students hold misconceptions related to electricity and the subject should be taught with alternative teaching methods.

2.8 Summary of Related Literature

The literature review started with the web based instruction and physics. The effects of web based instruction on students' achievements and types of web based environments prepared for science and physics education were reviewed. First of all, web based instruction aims to bring learning to students by using internet (Wang & Gearhart, 2006). This aim changed students' learning. For example; Persin (2002), Sun, Lin and Yu (2008), and Şengel (2005) found similar results about web based instruction, increase on students' achievements. During these studies, web based environments were constructed and used for experimental groups. However, what kind of teaching methods were used while preparing these environments was not stated. Secondly, some web environments like the baldufa, motion workshop, xyZET and WebTOP, and Phet were reviewed. These web environments were developed with different designs. While one environment were designed for lecture notes, problems and questions, another environment designed for videos, 2d and 3d simulations. These differences of web environments can be used while preparing inquiry and expository teaching methods. For example; Baldufa contains lecture notes, solved problems and questions. It has similar activities of expository teaching methods. On the other hand, simulations in Phet can be used for explore and elaborate phases of 5E learning cycle.

Then, blended instruction was reviewed. Blended instruction aims to combine the advantages of face-to-face environment with web based instruction. These discussions about the opportunities and challenges of blended instruction were reviewed. The opportunities are: active learning, explanations combining voice and evolving graphics, simulations, problem solving with individual instantaneous guidance and feedback, convenience of review, and feedback to instructors. The challenges are mostly design and material based challenges. The studies propose arguments about the advantages of blended learning and how to design their studies with blended instruction. There were only two studies (Nellman, 2008; Chandra & Watters, 2012) try to investigate the effects of blended instruction on students achievements and science process skills. However, these studies did not mention which teaching methods were used in web based environments. So, new studies should give the detailed information about

Then, medium-method conflict was reviwed based upon the arguments of Richard E. Clark and Robert B. Kozma. While Clark (1994) defines medium as a mere vehicle and argues that it does not supply learning alone, Kozma (1994) states that technology will influence learning in the future and defining technology as a mere vehicle may result with never to understand the potential relationship. In the further studies, Nancy and Monica (2005) states that Clark's mere vehicle turned to supersonic jet with the development of internet and web based sources.

After the importance of method used in a technological medium, inquiry and expository teaching methods were reviewed. They are two distinct methods. While inquiry is a student-centered and it involves multifaceted activities like making observations, posing questions, planning investigations and using tools to gather, analyze, and interpret data (National Research Council, 1996), expository teaching method is a teacher-centered and involves activities like giving lectures and notes, solving sample problems and reading stories (Martin, 2006).

CHAPTER 3

METHOD

In this chapter, population, sample and sampling procedure, research design, variables, procedure, treatments, material development process, instruments, confirmatory factor analysis, teacher training, treatment fidelity and verification, statistical analysis, power analysis, unit of analysis, assumptions and limitations are discussed.

3.1 **Population**

The target population consists of all 9th grade students attending private and Anatolian high schools located in Çankaya district of Ankara in Turkey. The accessible population is also the 9th grade high school students enrolled in physics courses in these schools. Table 3.1 shows the number of private and Anatolian high schools and students in Ankara and Çankaya during 2009-2010 academic year.

Table 3.1

Number of Private and Anatolian High Schools and Number of 9th Grade Students in Çankaya and Ankara

School Type	Location	Number of Schools	Number of 9th Grade Students		
			Girls	Boys	TOTAL
Private High Schools	Çankaya	17	366	409	775
	Ankara	40	1,267	1,402	2,669
Anatolian High Schools	Çankaya	14	1,129	931	2,060
	Ankara	58	3,868	4,793	8,661

There are 17 private and 14 Anatolian high schools in Çankaya district. 2,669 private and 8,661 Anatolian high school students are in these schools. 775 of private and 2,060 of Anatolian high school students are in Çankaya district. The number of boys is larger than that of girls in these schools.

3.2 Sample and Sampling Procedure

The sample for the study was selected from the accessible population by purposive sampling. The internet accessibilities and technological availabilities were important criteria for the study. Students needed to access internet during their classroom hours and the computers should be available and ready to use softwares like JAVA and flash players. Two private and two Anatolian high schools in Çankaya complying these criteria were selected as a convenience to the researcher for the study. The teachers of the selected schools were informed about the nature of the study and they accepted to participate in the study.

Five classrooms from private high schools and eight classrooms from Anatolian high schools were participated to the study. Student distribution in these schools is shown in Table 3.2.

Table 3.4

Research Design of the Study

	O Pretests	X Treatment	O Posttest
EXPO	EAT – SPST PAS	Face-to-face Expository Instruction	EAT – SPST PAS
INQU	EAT – SPST PAS	Face-to-face Inquiry instruction	EAT – SPST PAS
W-EXPO	EAT – SPST PAS	Blended instruction with expository	EAT – SPST PAS
W-INQU	EAT – SPST PAS	Blended instruction with inquiry	EAT – SPST PAS

EXPO: Face to face expository group, INQU: Face to face inquiry group, W-EXPO: Expository blended with web, W-INQU: Inquiry blended with web, EAT: Electricity Achievement Test, SPST: Science Process Skills Test, PAS: Physics Attitudes Scale

According to 9th grade Turkish physics curriculum, there are four objectives as listed below:
Students should be able to:

1. Explain the role of potential difference in a simple electric circuit by remembering it as an indicator of energy difference that can create current between two edges of a conductor. (ELECTRIC CURRENT)
2. Explain the relationship between the current that passes through a conductor and the potential difference on it (OHM's LAW)
3. Explain the factors that affect the resistance of a conductor wire (RESISTANCE OF A WIRE).
4. Explain the relation among current, resistance and potential difference in serial and parallel circuits. (CONNECTIONS OF RESISTANCES)

These objectives are named as "electric current", "Ohm's law", "resistance of a wire", and "connections of resistances". The details of objectives are given in Appendix D-1. The treatments were designed according to the objectives. This study was planned for 8 hours with thinking two hours for each objective in each treatment. The details of treatments were presented in the following sections.

3.4 Variables

Four different instructional groups (W-INQU, W-EXPO, INQU and EXPO) were arranged in two private and two Anatolian high schools. Methods of teaching (MOT) and instructional modes (Mode) were defined as independent variables. The pretest scores of electricity achievement test (Pre-EAT), science process skills test (Pre-SPST), and physics attitude scale (Pre-PAS) were also defined as independent variables because they have potentials to be used as the covariates to ensure equality among the treatment groups. Posttest scores of the students were the dependent variables of the study. The posttests of the study electricity achievement test (Post-EAT), science process skills test (Post-SPST), and physics attitude scale (Post-PAS). Table 3.5 shows the variables of the study and some of their characteristics.

Table 3.5

Variables of the Study

Name of Variable	Dependent (DV)/ Independent (IV)	Categorical /Continuous	Scale
MOT	IV	Categorical	Nominal
Mode	IV	Categorical	Nominal
Pre-EAT	IV	Continuous	Interval
Pre-SPST	IV	Continuous	Interval
Pre-PAS	IV	Continuous	Interval
Post-EAT	DV	Continuous	Interval
Post-SPST	DV	Continuous	Interval
Post-PAS	DV	Continuous	Interval

MOT: Methods of Teaching, Mode: İnstructional mode, EAT: Electricity Achievement Test, SPST: Science Process Skills Test, PAS: Physics Attitudes Scale, Pre: Pretest, Post: Posttest

3.5 Procedure

This study was started with the observations of some students' interests to internet based educations while he was working as a teacher in a private school. Then, he focused on internet based learning and reached blended instruction.

The literature review was started with Middle East Technical University library portal with searching for relevant articles pertaining to blended instruction. The databases searched were Educational Resources Information Center (ERIC), ProQuest Dissertations and Abstracts and Social Science Citation Index (SSCI). The keywords such as "Blended Learning", "Blended Instruction", "Web-Based Instruction", "Online Learning", "Expository Instruction", "Inquiry based Instruction", "Learning Cycle", "Electricity" and combination of them were used to find related articles. In some cases, too many articles were provided as result of search. In these cases, "high school" or "physics" terms were used to filter the search results.

Based upon the review of the related literature, the necessary instructional materials materials were developed. Two web sites for conservation of energy were constructed by using 5E learning cycle and expository teaching methods. They were tested in the first semester of 2009-2010 education year. According to the test results, new web sites for electricity concept were developed for the main study in the second semester. Meanwhile, electricity achievement test, lesson plans, and study plans of treatments were developed. Permissions for the simulations used in the web environments were taken from the web developers of Phet and Walter Fendth. Also permission for science process skills test was taken from Burak Kağan Temiz.

Meetings were organized with administrations of private and Anatolian high schools and physics teachers in these schools. They accepted to participate in the study. Then, the permissions to implement the study were taken from Middle East Technical University Ethic Community and Ministry of Education. After all permissions were taken from Middle East Technical University and Ministry of Education, the main study started.

Before starting implementation, meetings were organized with each teacher and the details of lesson plans, study plans, and teaching methods were discussed. The treatments lasted six weeks. Before and after the treatment, the instruments (electricity achievement test, science process skills test and physics attitude scale) were used as pretest and posttest. All data collected from students were entered to electronic medium, cleaned, and analyzed by using SPSS Statistics 13.0.

Table 3.5

Variables of the Study

Name of Variable	Dependent (DV)/ Independent (IV)	Categorical /Continuous	Scale
MOT	IV	Categorical	Nominal
Mode	IV	Categorical	Nominal
Pre-EAT	IV	Continuous	Interval
Pre-SPST	IV	Continuous	Interval
Pre-PAS	IV	Continuous	Interval
Post-EAT	DV	Continuous	Interval
Post-SPST	DV	Continuous	Interval
Post-PAS	DV	Continuous	Interval

MOT: Methods of Teaching, Mode: İnstructional mode, EAT: Electricity Achievement Test, SPST: Science Process Skills Test, PAS: Physics Attitudes Scale, Pre: Pretest, Post: Posttest

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3.6 Treatments

As discussed above, four instructional groups were constructed for the study. These were face-to-face expository, face-to-face inquiry, blended expository and blended inquiry groups. In the following sections, the details of these groups will be explained.

3.6.1 Face-to-Face Expository Instruction

Expository teaching is a teacher dominated instruction. The teacher is the controller and the imparter of knowledge. The teacher lectures, provides notes, explains charts, solves sample problems, reads stories, and so on. All activities are designed and conducted by the teacher. The teacher decides what is to be learned and how is to be learned by the students (Martin, 2006).

Four sub-topics of electricity were designed according to expository learning. Each topic was planned for two classroom hours. The definition of the concepts, relations among them, related tables and figures, examples, possible questions and problems to be asked to students during classroom hours, their solutions, and homework problems were provided in the lesson plans of expository teaching. The lesson plans of expository treatment group were presented in Appendix A-1.

3.6.2 Face-to-Face Inquiry Instruction

Inquiry oriented instruction refers to student-centered activities through which students construct their own knowledge about scientific ideas, as well as develop necessary skills to conduct inquiries about the natural world. Inquiry involves the activities such as posing questions, reviewing what is already known, planning investigations, making observations, using tools to gather, analyze, and interpret data, proposing answers, explanations, and predictions, and communicating the results. (National Research Council, 1996).

"5E learning cycle" is a widely used inquiry based instructional method for science instruction providing a structured way to implement inquiry in the classroom. (Marek, 2008). It includes five phases, engage, explore, explain, elaborate and evaluate. The content of each phases are explained in the Table 3.6.

Table 3.6

The Content of 5E Phases in Inquiry Treatment Group

Engage	To supply the curiosity, videos, photos or interesting questions are used.
Explore	An experiment manual is prepared for each sub-topic. This manual directs the teacher during the experiment. It is not distributed to students.
Explain	At the end of the experiment, students are expected to explain an event with the questions written in the manual.
Elaborate	Students are expected to elaborate specific concepts or models with further simulations on the web or questions written on the manual.
Evaluate	The evaluation questions are distributed to students.

The role of the teacher during the implementation of learning cycle was to guide students, facilitate the experiments, and encourage students to reveal their opinions. Two hours were allocated for the each sub-topic of the unit. To help the teachers easily implement an inquiry oriented instruction, lesson plans were developed according to the phases of 5E learning cycle. The lesson plans were presented in Appendix A-2.

3.6.3 Blended Expository Instruction

There were two environments for blended expository instruction (WEXPO) group. One was the web based expository learning environment (WELE) and the second one was the face to face expository learning environment. Two hours lesson plans were prepared for each sub-topic of the related unit. The implementation of WEXPO started with WELE and continued in face to face classroom environment. The study and lesson plans about WEXPO were presented in Appendix A-3. In the following section, details of WELE and classroom activities are explained.

3.6.3.1 Web Based Expository Learning Environment

The web address of WELE is www.dersfizik.net/expo and it was prepared for WEXPO group students. This web site starts with data mining, introduction page and the objectives of the sub-topic. These properties are the same with web based inquiry learning environment. The common parts are explained in Section 3.6.5.

WELE was constructed by using expository teaching method. Four sub-topics, which were constructed with the objectives of Ministry of Education, were divided into sub-titles. These sub-titles are given in Table 3.7.

Table 3.7

Sub Topics and Sub Titles of WELE

	Sub Topics of WELE			
Sub-titles	Electricity Current	Resistance of a Wire	Ohm's Law	Connections of Resistances
	Formation of electric current	Resistance of a Wire	Ohm's Law	Series Connections
	Quantity of Electric Current	Evaluation Questions	Evaluation Questions	Parallel Connections
	Evaluation Questions			Mixed Connections
				Evaluation Questions

First sub-topic "electricity current" is explained here. In the first part of electricity current, the formation of electricity was described. The movements of electrons and electric field during the electric current were figured as in the textbooks. The role of the battery and the definition of electric current are directly explained. The historical development of electric current was also presented and at the end of this part, unit questions were asked and the answers were requested.

In the second part of electricity current, the quantity of electric current was described. The definition and the formula of electric current were directly given. At the end of this part, unit questions were asked and the answers were requested.

In the third part of electric current, two exercises were given. Then, the solutions of these exercises were shown in a new page. In the final part, the evaluation questions were given. The pages of WELE related to "electric current" are given in Appendixes B-1.

3.6.3.2 Classroom Activities of WEXPO

Students firstly used WELE in computer laboratory and then the same subject was reviewed in classroom environment. Expository teaching method was used in classroom environment and formation of electricity, the quantity of electric current were summarized and then the exercises and the evaluation questions were solved in classroom environment.

As a conclusion, the subject was taught with expository teaching method in web and classroom environment of WEXPO group. In the web environment, web site was directed students by explaining the concepts, giving examples, and solving sample problems. Teacher did not directly control the students during the web hours. In the classroom environment, teachers dominated and directed the lesson, asked some questions about web hour, explained the concepts, gave examples, and solved problems similar to web site.

3.6.4 Blended Inquiry Instruction

There were two environments for blended inquiry treatment (WINQU) group similar to WEXPO. One was the web based inquiry learning environment (WILE) and the second one was the face to face inquiry environment. Two hours lesson plans were prepared for each sub-topic again. The implementation of WINQU started with WILE and continued in face to face classroom environment. The study plan and lesson plan about WINQU are presented in Appendix A-4. In the following section, the details of WILE and classroom activities are explained.

3.6.4.1 Web Based Inquiry Learning Environment

The web address of WILE is ~~www.dersfizik.net/inqu~~ and it is prepared for WINQU group students. This web site starts with data mining, introduction page and the objectives of the sub-topic. These properties are the same with web based expository learning environment. The common parts are explained in Section 3.6.5.

WILE was constructed according to 5E learning cycle as discussed in literature review. For each phase of 5E cycle, a new page was prepared. Four sub-topics, which were developed according to the objectives of Ministry of Education, were divided into five sub-titles consistent with 5E phases. The name of each phase and sub topics are given in Table 3.8.

Table 3.8

Sub-topics of WILE constructed with 5E learning cycle

		Sub Topics of WILE			
		Electricity Current	Resistance of a Wire	Ohm's Law	Connections of Resistances
5E Learning Cycle	Engage	An electricity accident	Properties of a wire in the lamp	Electricity generation with lemons	Wheatstone Bridge
	Explore	Electricity Simulation	What affects resistance?	Volt – current experiment	Connections experiments
	Explain	Simulation Results	What affects resistance?	Volt-current experiment	Experiment Results
	Elaborate	What happens during the current?	Definition of resistance	What happens inside?	What happens inside?
	Evaluate	Evaluation questions	Evaluation questions	Evaluation questions	Evaluation questions

First sub-topic "electricity current" is explained here. Learning cycle started with engage phase. The researcher created students' interest in the related topic, and elicited students' prior knowledge with a video (Figure 3.1). This video was about an accident occurs in an electricity terminal, high voltage melted a wire between two lampposts. The reason of the accident and what is

happening in the video were asked to students. The students were answered the questions by using message boards.

Figure 3.1 Engagement Phase Video of Electricity Current

In the explore phase, applets and simulations were used. Applets can be defined as Java programs that run on a web page (Sun, 2012). Applets allow the users to make one or more manipulations and observe the results (Corder, 2005). They were taken from the internet by getting permissions. Three web site are used, two of them was a personal web sites (Mark Sullivan: http://mark.madscientist.ws/ and Walter Fendt: http://www.walter-fendt.de), the third web-site was a university web site of Colorado university, (http://phet.colorado.edu). The permissions were taken by e-mails. These e-mails are given in Appendix I. In the "electric current", an applet (Figure 3.2) which was taken from the Mark Sullivan's web site was used. The permission was taken for giving a link from our web-site. This applet supplies a circuit diagram. A user can construct her/his own circuit and test how it works. In WILE, students were asked to construct a simple circuit. Students selected appropriate wires and lamps among the provided equipments and connected them to the batteries, and finally they tested the constructed circuit.

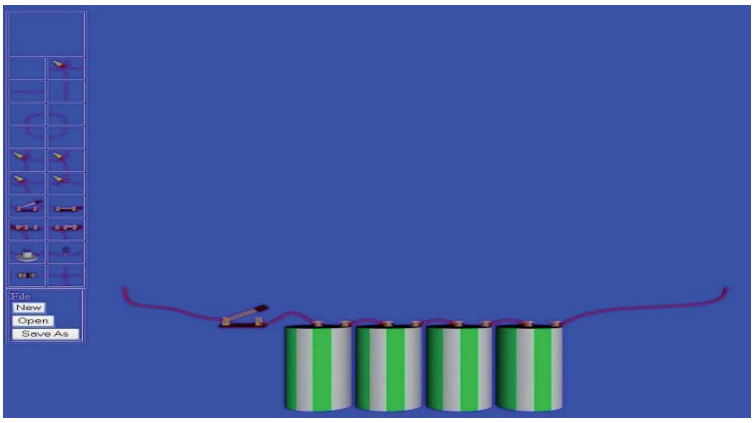


Figure 3.2 The Simulation Shape for Explore Phase of Electric Current

For the explain phase, a forum page was constructed. Discussion forum was independent from the message boards. Class discussions could be done by using these forums (Nellman, 2008). They stored each posting and the user could move backward and forward movement in the discussions. The questions related to explore phase were asked to students. Students and teachers shared their opinions in this forum. In "electric current", below questions were used;

- Did you achieve to light the lamp?
- What was needed to light the bulb?
- Do you think that only connection from minus terminal of battery to the lamp is enough for the light?
- Do you think that only connection from plus terminal of battery to the lamp is enough for the light?

In the elaborate phase, the details about the related concepts were given. Phet simulations were used for this purpose. The learners can change the independent variables, identify the dependent variables and set experimental conditions with simulations (Huppert et al., 2002). The simulations of elaborate phase also simulate the motion of electrons. Students were also requested to fill the tables given in the site by using the data taken from the simulations. The comments of the students were asked and they were requested to send their opinions by using message boards. In the electric current, students constructed the same circuit with the explore phase. However, in this case, the simulation (Figure 3.3) showed inside of the wires and the motion of the electrons. The direction of electrons in the circuit and the development of the current concept in the history of science were asked to students.

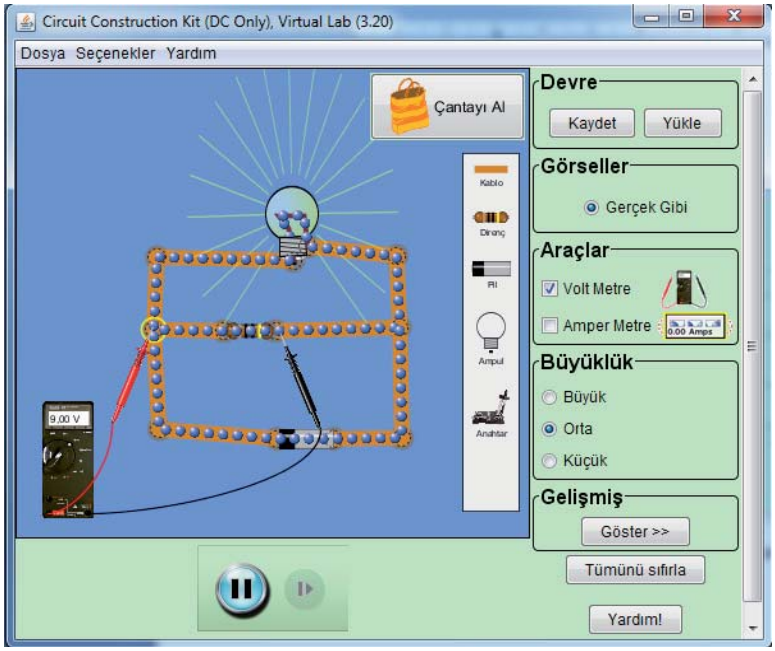


Figure 3.3 PHET Simulation Used in Elaborate Phase of Electric Current

In the evaluation phase, the evaluation questions were solved by the students. If the students did not complete them during the classroom hour, these questions were given as homework. In "electric current", nine questions were asked to students. The pages of WILE related to "electric current" were presented in Appendixes B-2.

3.6.4.2 Classroom Activities of WINQU

Students firstly used WILE in computer laboratory and then the same subject was discussed in classroom environment. Inquiry teaching method is used in classroom environment with 5E learning cycle. In the "electricity current" firstly the video of electricity accident were presented to students and asked what can be the reason of this accident again. Secondly, the properties of simple electric circuit as discussed in the explore phase were discussed with students. Thirdly, students explained the explore phase and then discussion went on with the motion of electric charges in the elaborate phase. Finally the questions in the evaluation part are solved in the classroom environment.

As a conclusion, the subject was taught according to 5E learning cycle in web and classroom environment to WINQU group. In the web environment, students continue the activities by answering questions, filling tables and conducted forums. Teachers are not directly control the students during the web hours, they just participated in the forum discussions to give direction to students' explanations. In the classroom environment, teachers encouraged students for explanations and questioning.

3.6.5 Common Parts of Web Based Learning Environments

Data mining, introduction page, message boards and homework pages are common for both web sites. Common parts are described below and given in Appendixes B-3.

1) Data mining: students were controlled by using data mining procedure. Students and teachers registered to the system by getting IDs and passwords before using the web-site. They had to join with this password to the site in each time. In addition, data mining is used to classify the student characteristics, categorize web-based educational resources, and develop a technique for discovering interesting associations between student quality, problem quality and solution strategies (Bidgoli, 2004). Data mining is used for two main purposes for this study:
a) Students in different groups should not be reach to the other groups' web sites. For example, a student from W-EXPO or INQU groups did not reach the WILE.
b) Students' posts to discussion forums and comments are named automatically.

2) Introduction page of web sites: Each web site includes same introduction page that informs the students about the aim and usage of the site. This page starts with the aim of the web site and the name of the study. Then, it informs the users about the usage and outline of the site. How a student can follow the steps and can reach the sub-titles and the sub-topics are described in this part.

3) Introduction page of each sub-topic. Objectives, content and procedures are given in this page. This page is the same for WILE and WELE. This means both web-site are constructed for the same purposes.

4) Message boards: Students send their comments and responses to the questions to the teachers and researcher by using these boards. Students' understandings and whether they completed the task given in the site are controlled with their messages.

3.7 Material Development Process

Two web-sites were constructed for the study. Web based Inquiry Learning Environment (WILE) was prepared for WINQU group students, and Web based Expository Learning Environment (WELE) was prepared for WEXPO group students. These learning environments were used for web instruction part of blended instruction. Both web sites have the same web design.

Before the main study starts, WILE and WELE were constructed for "conservation of energy" subject in the first semester and tested.

3.7.1 Testing WILE and WELE

3.7.1.1 Purpose

There are three main purposes of the testing:

- Understand whether the links in WILE/WELE works or not in the computer laboratory environment,
- Determine the possible challenges before the main study and overcome them,
- Get the students' general opinions about the usage of WILE/WELE.

3.7.1.2 Sample

Fifty six students (37 students for WILE and 19 students for WELE) from three classes of researcher's school are participated to the testing. These classes are randomly assigned to WILE and WELE. ,

3.7.1.3 Treatment

The testing is applied in the first semester of 2009-2010 academic year. The main study was going to be conducted in the second semester of the same school year. Therefore, "conservation of energy" subject from the first semester of 9^{th} grades was selected.

Two classes participated the testing of WILE and one class participated to WELE. They spend one hour classroom period in computer laboratories with WILE and WELE.

3.7.1.4. Web Based Inquiry Learning Environment (WILE) in Testing

5E learning cycle was used for constructing WILE. The explanations of each phase of learning cycle were presented in Appendix B-4.

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 (Figure 3.4) in the same page. After the video, several question were asked and the opinions of the students were sent by using message board.

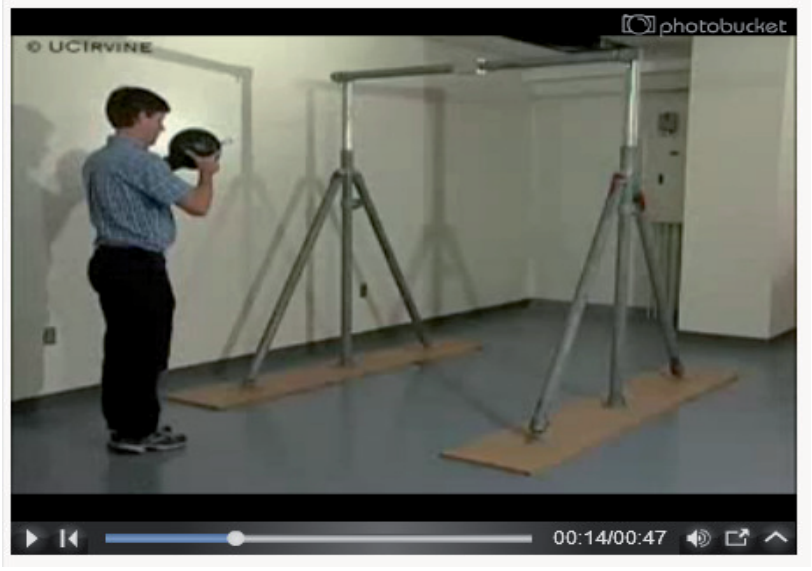


Figure 3.4 Video Used in Engage Phase of Testing

Explore phase: the simple pendulum applet which is designed by Walter Fendth was used in the explore phase of the testing. 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.
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 (figure 3.5) 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.

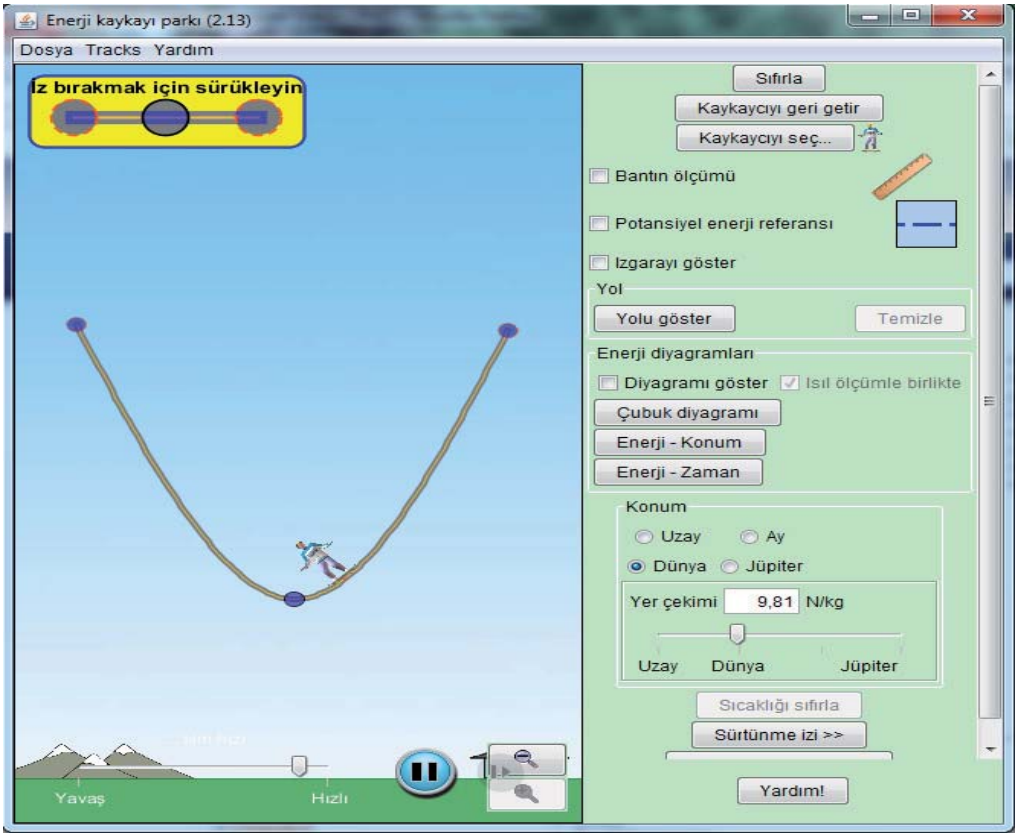


Figure 3.5 Energy Skate Park Simulation used in Elaborate Phase of WILE

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

3.7.1.5 Web Based Expository Learning Environment (WELE) in Testing

Expository teaching method was used to construct WELE (see Appendixes B-5). Explanation of the subject, “conservation of energy”, is divided into three parts

Conservation of energy 1: Definitions of potential and kinetic energy were provided by using the real life examples.

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.

Conservation of energy 3: Conservation of energy was applied on an example of a closed system.

Exercises: Four exercise problems were presented in an order. Students first saw the problem and then the solution.

Problems: Five problems are given to the students. But students only saw the problems, the solution of the problems were not presented.

3.7.1.6 Treatment Problems in Testing

Problems faced during the implementation of treatments are reported in this section. These problems are detected while observing and during the interviews with students.

An interview protocol was constructed to obtain students' general opinions. Four students from classes of WILE and two students from class of WELE were selected randomly. A hand-cam was used during the interviews. This interview protocol and its results are given in Appendix C. The problems observed during testing were listed below:

- Students started the web sites by taking accounts. They obtained their own ID and passwords. During this stage, web sites requested them to confirm their e-mails and then sent back the mail to their e-mail addresses. This took longer time then expected.
- In the engage phase of WILE, there was a video showing the simple pendulum motion. Students clicked at the same time to video so some computers did not open the video.
- In the engage phase of WILE, also some computers did not have appropriate media player program and so these students could not watch the video in their own computers. During the testing, these students watch the video from their friends' computers and then went on on their own computers.
- In the explore phase of WILE, there was a Java Applet which is prepared by Walter Fendth. There was no appropriate Java version in the computers so students had to download the Java first and then see the applet.
- In the explain phase of WILE, students shared their opinions in the forum. But some students could not send their opinions, because they had not used the forum page before.
- In the elaborate phase of WILE, a PHET simulation from Colorado University was used. Students firstly clicked on a link to open the university web site, then downloaded the simulation from this site, then open and used. This took again longer then expected
- In the evaluation phase of WILE, little number of students could complete this part. During the use of WELE, students got bored and did not send or do anything. Just read the subject and solved the exercises.
- Students forgot to write their names and the tables came to researchers' mail inbox without names.

3.7.1.7 Solutions of Treatment Problems

The solutions generated for the detected problems were as follows:

- Students selected only their user IDs and passwords to obtain an account. The confirmation with e-mails is deleted.
- A new link is constructed in each video and if the students did not open the video, they could download the video and open with media player.
- It is decided that download the latest version of media player and Java to each computer before the main study, and also software of videos, java applets and simulations were provided to the teachers.

- Students were informed about how to use forums before the main study.
- A new link was constructed that directly open PHET simulations.
- All questions were asked students in multiple choice formats in evaluation questions parts.
- Comments and message boards were added to WELE.
- To remind students to write their names while using the message boards, a reminder of "don't forget to write your name" written in red ink were inserted at the top of the message boards and also a new code was added.

3.8 Instruments

Three instruments were used for the study; 1) Electricity Achievement Test (EAT), 2) Science Process Skills Test (SPST), and 3) Physics Attitude Scale (PAS). Details about the instruments were provided in the following sections

3.8.1 Electricity Achievement Test

EAT were used to understand the effects of blended instructions on 9th grade students' achievements about electricity. The results of this test were used to measure students' achievements about electricity as mentioned in first and second research questions. The 9th grade physics curriculum includes the topics electric current, resistance of a wire, Ohm's law, and connections of resistances. A new test including these topics was prepared for the study and used as pretest and posttest.

Valid and reliable tests can be constructed with carefully planned tests. (Tekin, 1996). Gronlund (1998) states the preparation steps of an achievement test as follows: 1) Describe and define learning outputs of the test, 2) Construct table of specifications, 3) Construct suitable test items, 4) Check and control test items, 5) Order test items, and 6) Prepare the directives of the test. Similar to these steps, Spector (1992) states a circle while constructing a test. The steps of this circle as follows: 1) define constructs, 2) design test items, 3) pilot test, 4) application and item analysis, and 5) reliability and norm. The steps of the circle can be repeated during the procedure and the constructer can turn back in between steps.

Gronlund and Spector have similar steps in their test constructions but finally Crocker and Algina (1986) gives more detailed processes of test construction as follows and these processes are used to construct EAT.

The behavioral objectives of Ministry of Education were obtained from the 9th grade physics curriculum as given in Appendix D-1. Four main objectives were determined by the Ministry of Education. These four objectives are named as electric current (objective 1.1), resistance of a wire (objective 1.3), Ohm's Law (objective 1.2) and connections of resistances (objective 1.4). According to this classification, the objective list of EAT was prepared in more detail. Totally 26 behavioral objectives was prepared by using textbooks and other doctoral studies about electricity (Şen, 2010 ; Sancar, 2007). The objective list of EAT was given in Appendix D-2. The relation between objectives of EAT and objectives of electricity determined by Ministry of Education was given in Table 3.9.

Table 3.9

Objective number of EAT vs Objectives of Electricity Determined by Ministry of Education

	Objectives of Electricity Determined by Ministry of Education			
	Electric Current	Resistance of a Wire	Ohm's Law	Connections of Resistances
Objective number of EAT	1 - 2 - 3 - 4 5 - 6	10 - 11 - 12 13	7 - 8 - 9	14 - 15 - 16 - 17 18 - 19 - 20 -21 22 -23 - 24-25- 26

Table of test specifications of EAT was prepared with the use of Bloom's taxonomy and sub titles of electricity. While preparing this table is, the electricity concept was divided into 4 sub-titles as Ministry of Education did. According to the final version of the test, the specification table was reconstructed as given in Appendixes D-3.

The items related to electricity were taken from 9th grade Physics books, university entrance exam (ÖSS) questions, open high school 9th grade exam questions, and studies about electricity in the literature. Source of the items in the pool was presented in Table 3.10.

Table 3.10

Source of Items in the Pool

Source of Item	Number of Items taken from the source	Percentage of items in the pool
1- Physics Books	27	40%
2- University Entrance Exam	14	20%
3- Open High School Exam Question	10	14%
4- Studies about Electricity	18	26%

Physics Books: Three physics books were used as the source of items in the pool. One of them is a textbook that is used in private high schools and published by Oran Publishing. Fifteen objective type (true-false and fill in the blanks) items were added to item pool from this source. Second book is a textbook (Halliday, Resnick & Walker, 1993) that is used by university students in physics department at Middle East Technical University. Seven essay type items were taken for the pool and then they changed to multiple choice items with adding distracters. These books are originally in English and after the selection of the items they were translated into Turkish. The translations were also checked by a PhD student at Middle East technical university. The other physics book is an ancillary textbook for high school physics and published by Zambak Yayınları. Five essay type items were taken and distracters were added to these items.

University Entrance Exam: university entrance exam questions between 1992 and 2008 were searched. Fourteen questions were added to the pool.

Open High School Exam Questions: 2008-2009 academic year high school exam questions were reviewed and ten questions related to electricity were included into the pool.

Studies about Electricity: three studies from the literature were used. Nine questions from Şen (2010) and Sencar's (2007) doctoral thesis were selected for the pool. The third study about electricity was related to 8th grade students' understanding of fundamental electricity concepts (Akdeniz, Bektaş, Yiğit, 2000) and three questions were taken from the study for the pool.

Thirty two items were selected from the pool according to the table of test specifications and solved by the researcher. The answer key of the test was constructed. Some questions had four distracters or some had no distracters, new distracters were added to these items. The test was distributed to two research assistants at Middle East Technical University and the answer key was prepared by them. Research assistants also checked table of test specifications and Bloom's taxonomy. Assistants and researcher did a meeting and discussed the compatibility of test items with specifications table. Finally, it was agreed upon that there should be thirty questions in the test and 46% is on knowledge, 12% is on comprehension, 30% is on application and 12 % is on analysis levels acoording to Bloom's taxonomy. Source of items in the final version of the test is given in Table 3.11.

Table 3.11

Source of Items in the EAT

Source of Item	Number of Item Number in EAT
1- Physics Books	3*, 6*, 8*, 13**, 14*, 15*, 17***, 18***, 19***, 20***, 21***, 22***, 23***, 24***, 25***, 26***, 27***, 28***, 30***
2- University Entrance Exam	9[a] , 11[b], 16[c]
3- Open High School Exam Question	4, 5, 7,
4- Studies about Electricity	1[d], 2[e] , 10[e], 12[e], 29[f]

* Lise Fizik 2 Elektrik (2005), Zambak Yayınları, Çağlayan A.Ş. Basımevi, İzmir.
**Halliday, Resnick and Walker (1993)
***Physics 9 High School (2007.), Oran Yayınları, Feryal Matbaacılık, Ankara.
a: ÖSS-2004 b: ÖSS-2001 c:ÖSS-1992 d: Akdeniz, Bektaş and Yiğit (2000).
e: Şen (2010). f: Sencar (2007).

Thirty items in total were used in pilot test. It included sixteen multiple choice, ten fill in the blanks and four true/false type items. This test was distributed to thirty two private high school 10th grade students to understand the missing or misunderstandings of the test items. 45 minutes was given to the students to complete but most of them were completed nearly in 30 minutes. The final version of EAT is given in appendix D-4.

The responses of the students were analyzed by using ITEMAN program. The Cronbach's Alpha reliability coefficient of the responses was found to be 0.57. Item difficulty and item discrimination indices were in acceptable range. However, according to ITEMAN results, Items 2, 6 and 16 needed modifications. Then, SPSS analysis was conducted to determine the items that decrease the Cronbach Alpha reliability coefficient. Items 2, 6, 9 and 22 were the items that decrease the reliability coefficient. Item difficulty indexes of each item are evaluated by using ITEMAN results. The items between 0.20 and 0.80 are remarked as acceptable items (Measurement and Evaluation Center, 2003). Items 1, 19 and 27 are decided as easy questions and items 5, 6, 8, and 14 are difficult items. Then the discrimination indexes were calculated by using ITEMAN. Measurement and evaluation center (2003) reports about discrimination values as: 0.40 and higher values are very good items, between 0.30 and 0.39 are good items, between 0.20 and 0.29 are fairly good items, 0.19 or less are poor items. At the end of the item discrimination, items 1, 2, 5, 6, 7, 8, 10, 14, 16 and 29 are remarked as unacceptable items. Upon the review of the unacceptable items some of them required to be revised as in Table 3.12. The other items in EAT are decided as not required to revise.

Table 3.12

Revisions Made in EAT Items

Item Number	Revision Made in Item
Item 2	Battery, wire and lamp figure are added to the shape. The names of each are written.
Item 8	The question sentence is changed. The relation between resistance and length is given and the value of current is asked.
Item 9	To show the direction of current, the battery shape is added to figure.
Item 22	The question sample is changed as more simple.
Item 29	The question sample is changed as more simple.

Some statistics about the item analysis of the pilot study are given in Table 3.13.

Table 3.13

Pilot Study Statistics for EAT

Number of Items	30
Number of Examinees	32
Mean	14.000
Variance	13.125
Standard Deviation	3.623
Skewness	.745
Kurtosis	.004
Cronbach alpha	.567
Mean Item Difficulty	.467
Mean Item Discrimination	.365

As discussed above, the reliability constant of the test is calculated as .567 at the end of the pilot study and 5 items were revised. During the main study, pre-test and post-test reliabilities of the test were calculated as 0.776 and 0.886, respectively. These are acceptable Cronbach's Alpha values due to Maloney et, al. (2000). ITEMAN results for posttest of the study were presented in Appendix D-5.

A physics educator and three research assistants from Middle East Technical University and a high school physics teacher examined the final form of the test with respect to the appropriateness of the items for the content and grade level and face validity. Their recommendations were reflected in the test items.

EAT was scored with 1.0 for correct answers and 0.0 for wrong answers. The scores of the students were ranged between 0.0 and 30.0. Higher scores of the students indicated more and lower scores indicated less understanding of the electricity concept.

However, after implementing EAT in the main study, some items (14, 20, 21, 22, 27, 29, 30) were decided to make revision for further studies usage because there were some missing or misunderstanding points in these items. These items were also checked in ITEMAN results, and decided not to reduce from the study. The revised versions of these items were also presented in paranthesis in appendix D-4.

3.8.2 Science Process Skills Test

According to Temiz (2007), science process skills have started to investigate in1960s in the world and 1990s in Turkey. However, there is no test constructed for Turkish students except for Science Process Skills Measurement Test, the original name of this test is "Bilimsel Süreç Becerileri Ölçüm Testi (BSBÖT)" which was developed and validated by Temiz (2007). Until this test, Burns, Okey and Wise (1985) constructed a test to measure defining variables, designing investigations and experimenting, formulating hypothesis, organizing and drawing graphs. The original name of the test is "The Test of Integrated Science Process Skills-II (TIPS II)" and includes 36 items. The Cronbach's Alpha coefficient of the test was 0,86. This test was translated to Turkish by Özkan, Aşkar and Geban in 1991.

BSBÖT is selected for this study. Because it was a new test and originally prepared for Turkish students. It includes 6 modules:

Module 1: Identifying and Defining Variables and Formulating Hypothesis
Module 2: Describing Relationships between Variables, Designing Investigations and Experimenting
Module 3: Organizing Data in Tables

Module 4: Organizing Data in Graphs
Module 5: Analyzing Investigations and Their Data and Formulating Models
Module 6: Identifying and Defining Variables and Formulating Hypothesis

As described in literature review chapter, these modules are integrated science process skills. The names of module 1 and module 6 are the same. Module 1 contains multiple choice questions, while module 6 includes essay type questions.. According to Temiz, each module needs one classroom hour (40 minutes). This means to use BSBÖT at least 6 hours are needed which was not feasible for the current study. . Therefore, a new test, shorter version of the BSBÖT was used for the study.

New test was constructed according to the recommendations of Temiz (2007) and named as Science Process Skills Test (SPST). This test includes eight items from module 1, two items from module 2, two items from module 3, two items from module 4 and eight items from module 5, and two items from module 6. This first version was included 24 items.

During the content validity procedure of this version, the expert judgment is used. The test is given to two research assistants and an associated professor. The general opinion about the test was; it needs much time than a classroom hour (40 minutes). So it was decided that the number of essay type items should be decreased and one item from module 3 and module 4 and two items from module 6 were taken out. As a result, the final version of SPST was constructed with 20 items which includes two essay types and eighteen multiple choice type items. The final version of SPST was presented in Appendixes E-1.

Each module in SPST is scored with 8 points. Modules 1 and 5 had eight items, module 2 had two items, and modules 3 and 4 had one essay type items. Each item in modules 1 and 5 was scored 1.0 for correct answer, each item in module 2 was scored 4.0 for correct answers. Modules 3 and 4 were scored by rubrics with a maximum score of 8.0. The rubrics were adapted from Temiz (2007) and given in Appendixes E-2. The scores of the students were ranged between 0.0 and 40.0. Higher scores of the students indicated more and lower scores indicated less on the level of science process skills.

The reliability of the test scores (Cronbach's Alpha) according to pretest and posttest result were calculated 0.85 and 0.91 respectively.

Before using the items, Temiz was informed about the study and his permission to use the itemswas presented in Appendix E-3.

3.8.3 Physics Attitude Scale (PAS)

Students' level of attitudes towards physics was measured by physics attitude scale (PAS) presented in Appendixes F. This scale was originally developed by Taşlıdere and modified by Küçüker by adding 5 negative items. Five-point likert type scale was used in 24 items. So the students can get 24 and 120 as minimum and maximum scores. Taşlidere performed the factor analysis for the scale and found that the test measures physics attitudes in five factors; enjoyment, self efficacy, importance of physics, achievement-motivation and interest related behavior. So during the current study, it is decided that the factor analysis is not required to renew. However, confirmatory factor analysis is conducted to show whether our study confirms or not the factor of Taşlıdere's. Confirmatory factor analysis was presented in the following section.

The reliability coefficient of PAS was found 0.94 in Taşlıdere's study, 0.83 in Küçüker's study, 0.91 and 0.85 in the pretest and posttest of Serin's study. PAS is used as pretest and posttest in the current study. It was administered to 305 9^{th} grade students as a pretest and Cronbach's Alpha reliability coefficient is found 0.94. It was administered to 314 high school 9^{th} grade students as a posttest and Cronbach's Alpha reliability coefficient is found 0.93. The reliability coefficients were similar to each other, this shows the test scores seems reliable and consistent with Taşlıdere's, Serin's and Küçüker's results.

3.9 Confirmatory Factor Analysis

Confirmatory factor analysis was constructed for PAS in both pretest and posttest scores. According to the findings there are 5 factors in PAS. Before starting the factor analysis, descriptive statistics and assumptions are discussed in the following section.

3.9.1 Descriptive Statistics for Confirmatory Factor Analysis

The factors constructed by Taşlıdere were shown in Table 3.14. According to these factors, new variables were constructed in Statistical Package for Social Studies (SPSS) by averaging the items. Negative items were recoded with positive values. 1.0 was recoded with 5.0, 2.0 was recoded with 4.0, 4.0 was recoded with 2.0 and 5.0 was recoded with 1.0 in the 4, 8, 13, 17 and 24 items.

Table 3.14

Factor Analysis Results of PAT in Taşlıdere's Study

Factors	**Item Numbers**
Enjoyment	1, 2, 16, 17, 23
Self Efficacy	9, 10, 11, 18, 21
Importance of Physics	3, 4, 5, 13, 14
Achievement-Motivation	6, 7, 8, 12
Interest related Behavior	15, 19, 20, 22, 24

Descriptive statistics of the study was performed by means of Statistical Package for Social Studies (SPSS), version 13. Results of descriptive statistics for all factors in PAS are given in Table 3.15.

Table 3.15

Descriptive Statistics for Pretest Scores on the PAT and Related Reliability Coefficients

	N	Min	Max	Mean	SD	Skew.	Kurt.	Alpha
preenjoym	245	1.00	5.00	3.47	0.92	-0.58	0.07	0.87
preseffi	245	1.00	5.00	3.52	0.82	-0.37	0.36	0.88
preimphys	245	1.00	5.00	3.35	0.88	-0.47	0.03	0.84
preachmotv	245	1.00	5.00	4.02	0.72	-1.20	2.36	0.77
preintrelb	245	1.00	5.00	2.66	0.98	0.28	-0.77	0.83
postenjoym	245	1.00	5.00	3.53	0.91	-0.62	0.21	0.87
postseffi	245	1.00	5.00	3.55	0.82	-0.18	-0.19	0.87
postimphys	245	1.00	5.00	3.40	0.83	-0.23	0.02	0.79
postachmotv	245	1.00	5.00	4.00	0.72	-0.94	1.67	0.79
postintrelb	245	1.00	5.00	2.82	1.00	0.07	-0.72	0.83

Note. enjoym: enjoyment, seffi: self-efficacy, imphys: importance of physics, achmotv: achievement motivation, intrelb: interest related behavior

3.9.2 Assumptions of Confirmatory Factor Analysis

According to Tabachnick and Fidell (2007, pp. 733-734), there are five assumptions for confirmatory factor analysis. These are; sample size and missing data, normality, outliers, multicollinearity and singularity, and residuals.

The adequate sample size for confirmatory factor analysis is defined as minimum 16:1 ratio (sample size: observed variable) in Tabachnick and Fidell (2007, pp. 733-734). The current study has

the sample size of 253 and the dependent variables in PAS are enjoyment, self-efficacy, importance of physics, achievement motivation, and interest related behavior. So the ratio of sample size to observed variable is 50:1 (253:5). So the sample size is adequate for the study. The missing values were replaced with series mean as discussed in missing data analysis, so there were no missing values.

For multicollinearity, it is the simplest way to run correlations (Pallant, 2007 , p. 225). If the correlations are above 0.80, it will be considered removing the cases. Correlations among factors before and after treatment are given in Table 3.16. All correlations are significant and below 0.80.

Table 3.16

Correlations among Factors Before and After Treatments

Variables	preenjoym	Preseffi	preimphys	preachmotv
preenjoym				
preseffi	.724*			
preimphys	.599*	.527*		
preachmotv	.554*	.653*	.553*	
preintrelb	.683*	.594*	.531*	.449*
	postenjoym	postseffi	postimphys	postachmotv
postenjoym				
postseffi	.677*			
postimphys	.713*	.563*		
postachmotv	.575*	.632*	.512*	
postintrelb	.684*	.557*	.625*	.377*

Note. enjoym: enjoyment, seffi: self-efficacy, imphys: importance of physics, achmotv: achievement motivation, intrelb: interest related behavior

* Correlation is significant at the .01 level (2-tailed).

For normality assumption, skewness and kurtosis values were checked in Table 3.15. Only one value of kurtosis exceeds +2. The other values are between -2 and +2, so it was concluded that normality assumption was met.

Univariate outliers were checked by using boxplots as described in Pallant (2007, pp. 59-61). There were eight outliers. They were excluded from the study. Additionally multivariate outliers were checked by using Mahalanobis distances again as explained in Pallant (2007, pp220-223). No case was evaluated as multivariate outlier. Outliers were discussed during missing data analysis in Chapter 4.1.

Residuals were checked in the LISREL output. As a result, the assumptions of confirmatory factor analysis were not violated.

3.9.3 Results of the Confirmatory Factor Analysis

In the model, physics attitudes of the students were constructed by five factors; enjoyment, self efficacy, achievement motivation, importance of physics, and interest related behavior.

The model was repeated three times with lisrel statistical program until pretest scores reached the good fit. Firstly, there was no good fit between the model and observed data. ($\chi^2 = 31.31$, $p = 0.00$, GFI=0.95; AGFI= 0.85; RMSEA= 0.10; SRMR=0.039). A detailed output of lisrel was given in Appendix I-1. Secondly the model was repeated with adding a covariance between self-efficacy and achievement-motivation. ($\chi^2 = 17{,}41$, $p = 0.00$, GFI= 0.97; AGFI= 0.90; RMSEA= 0.064; SRMR= 0.033). Finally, a covariance was added between students' achievement-motivation and importance of

physics. Figure 3.7 shows the final model resulted with a god fit between the model and the observed data (χ^2 =1,25, p = 0.74, GFI= 1.00; AGFI=0.99; RMSEA= 0.00; SRMR= 0.008).

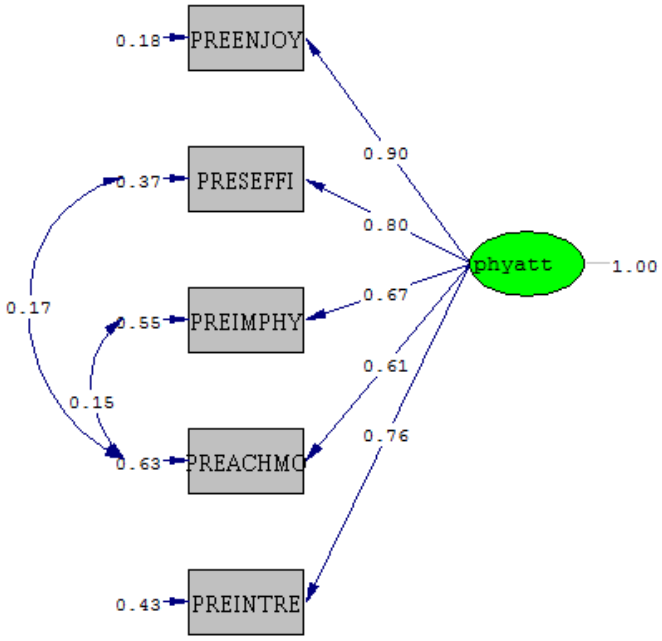
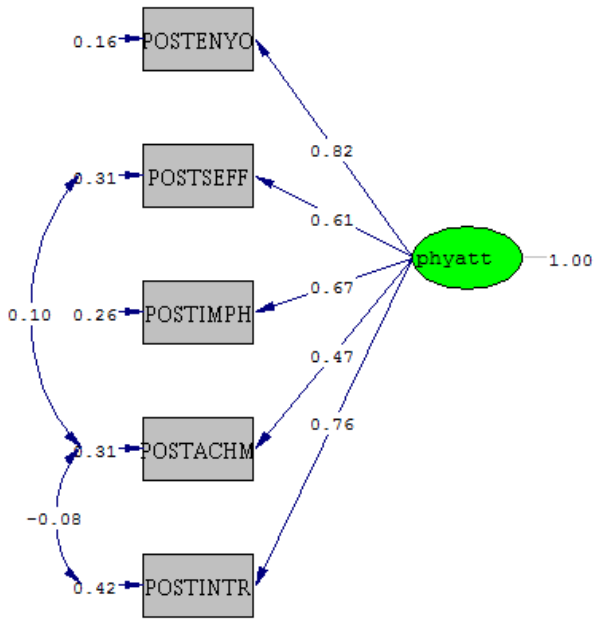


Figure 3.6 The Model Showed a Good Fit With the Pretest Data With the Standardized Regression Coefficients

The same procedure was used for the posttest results of the PAS. Again the model was repeated three times to reach a good fit. Firstly, there was no good fit between the model and observed data (χ^2 = 35.46, p = 0.00, GFI= 0.95; AGFI=0.84; RMSEA= 0.11; SRMR= 0.047). A detailed output of lisrel was given in Appendix I-2. Secondly the model was repeated with adding a covariance between self-efficacy and achievement-motivation (χ^2 = 10.60, p = 0.03, GFI= 0.98; AGFI= 0.94; RMSEA= 0.022; SRMR= 0.025). Finally, a covariance was added between students' achievement-motivation and interest related behavior. Figure 3.7 shows the final model resulted with a god fit between the model and the observed data (χ^2 = 1.94, p = 0.58, GFI= 1.00; AGFI= 0.98; RMSEA= 0.000; SRMR= 0.008).



Chi-Square=1.94, df=3, P-value=0.58390, RMSEA=0.000

Figure 3.7 The Model Showed a Good Fit With the Posttest Data With the Standardized Regression Coefficients

As a result, confirmatory factor analysis was performed to confirm the five factors of PAT. However, two modifications were done to reach a good fit. This means that there are correlations between factors.

3.10 Teacher Training

Before the study begins, it is planned to make a meeting with all teachers at the same time. But, the schools in the study were far away from each other and the teachers did not teach the same groups. Table 3.17 shows the groups and teachers distributions to groups.

Table 3.17

Teachers Distributions to The Treatment Groups

		Treatments in the study			
		EXPO	INQU	W-EXPO	W-INQU
SCHOOLS	AX	Teacher A	Teacher A	Teacher A	Teacher A
	AY	Teacher B	Teacher C	Teacher B	Teacher C
	PX		Teacher R		Teacher R
	PY		Teacher D		Teacher D

So, special meetings were planned with each teacher. There were four teachers in the study as seen in Table 3.18. The researcher (R) was the teacher of PX school.

PX teacher was the researcher (teacher R) of the study and 5 years teaching experience. PY school teacher (teacher D) was a male and had 5 year teaching experience. He participated to the study with two classes. The classes in the private schools assigned for inquiry and blended web with inquiry groups. So, the teacher in PY was trained for inquiry instruction. First of all, the importance of the study and the groups in the study were explained to him. Inquiry and 5E learning cycle was introduced. By using the timeline of the study for each group, the expectations from the teacher was explained. During the timeline of the study, he said that he couldn't perform these experiments before, so the experiments were performed with the researcher before the study. During the laboratory experiments, it was observed that some of the equipments for the experiments were not enough for the whole class. These equipments were supplied by the researcher. Then, the instruments were given to the teacher and explained how they should be administered. Also daily lesson plans and laboratory sheets were povided.

In AX school, one physics teacher was participated to the study with four classes. Teacher C was a male and 21 year experienced. A meeting was planned with him and first of all, the importance of the study and the groups in the study are explained. Inquiry, expository and 5E learning cycle was introduced briefly. By using the timeline of the study for each group, the expectations from the teachers were explained. How he should use the web sites was explained. Teacher C said that he performed the experiments in the study in laboratory each year. So, the experiments were not introduced. Then the instruments were given to him and explained how they should be administered. Also, daily lesson plans and laboratory sheets were provided to the teacher.

In AY school, two physics teachers were participated to the study with two classes of each. One of them was female (teacher A) and 18 years of experience and the other one was male (teacher B) and 21 years of experience. Teacher A applied expository teaching method in her classes and teacher B applied inquiry teaching method. A meeting was planned with two teacher at the same time and first of all, the importance of the study and the groups in the study were explained to them. Inquiry and 5E learning cycle were introduced briefly. By using the timeline of the study for each group, the expectations from the teachers were explained. How they should use the web sites were introduced. Teacher B informed the researcher that he performed the experiments in the study in laboratory each year. So the experiments were not introduced them. Then the instruments were provided and explained how they should be administered. Also daily lesson plans and laboratory sheets were provided.

3.11 Treatment Fidelity and Verification

Two web based learning environments WILE and WELE were constructed by the researcher and used during the study. Thesis monitoring committee checked all the instructional materials developed for the study and made some recommendations like constructing an introduction page for each learning environment and for each sub-topic.. With the light of their advices, the web sites were continuously revised. In addition to them, the supervisor of the study always checked and controlled the steps in the treatments.

Expert judgment form was used for treatment fidelity, and classroom observation checklist was used for treatment verification.

3.11.1 Expert Judgment Form

Expert judgment form (EJF) was prepared to get the opinions of experts related to the web sites. WELE and WILE were prepared for the study. One is related to expository teaching and one is inquiry teaching. Both web sites divided electricity into four parts similar to the curriculum. One EJF (Appendixes H) was prepared for the first parts of the web sites and then it was adopted to the other parts.

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. EJFs were distributed to teachers, PhD students, and academicians. One academician from Middle East Technical University and one physics teacher from private school replied EJFs. Descriptive statistics of EJF for WILE is presented in Table 3.18.

Table 3.18

Descriptive Statistics of EJF for WILE

	Mean	S.D.
Chapter 1: Electric Current		
Technical and Visual Evaluation	4.10	0.78
1.1 An electricity accident	4.00	0.00
1.2 Electricity Simulation*	0.00	0.00
1.3 Simulation Results	4.33	0.57
1.4 What happens during the current?	4.75	0.50
1.5 Evaluation questions	4.75	0.50
Chapter 2: Resistance of a Wire		
Technical and Visual Evaluation	4.30	0.48
2.1 Properties of a wire in the lamp	5.00	0.00
2.2 What affects resistance?	4.67	0.57
2.3 What affects resistance?	4.67	0.57
2.4 Definition of resistance	4.50	0.57
2.5 Evaluation questions	4.75	0.50
Chapter 3: Ohm's Law		
Technical and Visual Evaluation	4.10	0.57
3.1 Electricity generation with lemons	4.00	0.00
3.2 Volt – current experiment	4.67	0.57
3.3 Volt-current experiment	4.67	0.57
3.4 What happens inside?	4.25	50
3.5 Evaluation questions	3.00	0.81
Chapter 4: Connections of Resistances		
Technical and Visual Evaluation	4.00	0.00
4.1 WheatstoneBridge*	0.00	0.00
4.2 Connections experiments	5.00	0.00
4.3 Experiment Results	4.00	0.00
4.4 What happens inside?	4.00	0.00
4.5 Evaluation questions	3.75	0.50

*Simulation and videos in these sections could not opened by experts, so these sections were coded as 0.00.

According to Table 3.18, in general, expert opinions about WILE seems positive. However, in Chapter 1.2, the expert could not open the simulation to evaluate, similarly in Chapter 4.1, expert could not open the video. They were the technical problems and solved by a computer engineer. The issues raised by the expert in evaluation questions of Chapter 3.5 were overcomed by adding different kinds of questions.

Additionally, experts' responses to essay type items and general opinions about the materials were evaluated and necessary revisions were made. Similarly, descriptive analysis for WELE are presented in Table 3.19.

Table 3.19

Descriptive Statistics of EJF for WELE

	Mean	S.D.
Chapter 1: Electric Current		
Technical and Visual Evaluation	4.56	0.53
1.1 Formation of electric current	4.20	0.48
1.2 Quantity of Electric Current	4.40	0.55
1.3 Solved Exercises	4.50	0.57
1.4 Evaluation questions	3.75	0.95
Chapter 2: Resistance of a Wire		
Technical and Visual Evaluation	4.11	0.60
2.1 Resistance of a Wire	4.20	0.45
2.2 Solved Exercises	4.50	0.57
2.3 Evaluation questions	4.00	0.82
Chapter 3: Ohm's Law		
Technical and Visual Evaluation	4.11	0.33
3.1 Ohm's Law	3.60	0.89
3.2 Solved Exercises	3.75	0.95
3.3 Evaluation questions	3.75	0.95
Chapter 4: Connections of Resistances		
Technical and Visual Evaluation	4.00	0.00
4.1 Series Connections	3.60	0.55
4.2 Solved Exercises	3.75	0.50
4.3 Parallel Connections	4.00	0.00
4.4 Solved Exercises	4.00	0.00
4.5 Mixed Connections	3.60	0.55
4.6 Solved Exercises	3.75	0.50
4.7 Evaluation questions	3.75	0.50

According to Table 3.19, expert opinion about "evaluation questions" were between medium to good. To increase the quality of evaluation parts the quality of the questions were reviewed and the number of solved questions in each chapter were increased.

3.11.2. Classroom Observation Checklist

Classroom Observation Checklist was used for treatment verification (Appendix I). The aim of the checklist was to veryfiy that the instructions in treatment groups were consistent with the the preestablished instructional plans. The checklist includes four parts. Each part corresponds to one treatment type in the study. The main characteristics of each treatment were reflected in the checklist. EXPO group classroom observation checklist (COC) includes 11 items, W-EXPO group COC includes 17 items, INQU group COC includes 17 items, and finally W-INQU group COC includes 24 items. For the blended groups, COC was devided into two parts as classroom activities and web activities.

The study was conducted for four weeks in 13 classes. The researcher was also a teacher of 3 classes, so the researchers' classes observed with another observer who was a research assistant in the

department of secondary science and mathematics education at METU. This observer made two observation in the researchers classes and four observations in the other teachers' classes with the researcher. The researcher also observed 16 classes. Totally, 22 hours were observed by the researcher and the other observer. That means 21% of 104 classroom hours were observed in the study. The number of observations and the treatment groups were presented in Table 3.20.

Table 3.20

The Number of Observed Classroom Hours in Schools

		Treatments in the study				Total
		EXPO	INQU	W-EXPO	W-INQU	
SCHOOLS	AX	2			6	8
	AY		2	2+2*	2+2*	10
	PX				2*	2
	PY		2			2
Total		2	4	4	12	22

*These observations were done with an observer who is a research assistant at Middle East Technical University.

In each observation, a COC is filled. Each item in the checklists have three alternatives "Yes" (meaning that the instruction is consistent with the preestablished standards of instruction), "Partial" (partial consistencey), and "No" (not consistent). "Yes" is coded as "2", "partial" is coded as "1", and "no" is coded as "0". Then, the mean values and standard deviations of each observation were presented in Table 3.21.

According to this table, overall treatment means seem to above 1.50 and this can be concluded 75% of the desired lesson plans was administered in the classes. In the observation 4 of face-to face inquiry treatment group, the experiment was not administered by teacher so the mean value seems low.

Table 3.21

Descriptive Statistics of Classroom Observation Checklists

	Mean	S.D.
Face-to-Facce Expository Treatment		
Observation 1	1.45	1.07
Observation 2	1.63	0.82
Overall	1.55	0.95
Face-to-Face Inquiry Treatments		
Observation 1*	1.84	0.40
Observation 2**	1.81	0.47
Observation 3	1.61	0.62
Observation 4	0.75	1.40
Overall	1.50	1.04
Blended Expository Treatment		
Observation 1*	1.78	0.50
Observation 2*	1.91	0.35
Observation 3**	1.78	0.50
Observation 4**	1.83	0.46
Overall	1.83	0.41
Blended Inquiry Treatment		
Observation 1	1.79	0.48
Observation 2	1.87	0.40
Observation 3	1.67	0.52
Observation 4	1.93	0.30
Observation 5	1.85	0.43
Observation 6	2.00	0.00
Observation 7***	1.74	0.65
Observation 8***	2.00	0.00
Observation 9	1.84	0.43
Observation 10	1.93	0.30
Observation 11	1.84	0.43
Observation 12	1.87	0.40
Overall	1.87	0.40

* These observations were done by an observer who is a research assistant at Middle East Technical University with researcher.
**Researcher's observation made with the other observer.
***These observations were done in researchers classes by an observer who is a research assistant at Middle East Technical University.

In order to obtain reliable results with COC, some observations were done by another observer. Mean scores of these observations are seen in Table 3.21. Therefore, these three observations had two scores. The correlation coefficients between these scores were presented in Table 3.22 .

Table 3.22

Correlation Coefficients Of Two Observers

Obserations	Correlation Coefficient
Observation 1 (INQU)	0.86
Observation 2 (W-EXPO)	0.74
Observation 3 (W-EXPO)	0.76

As a conclusion, the researcher and the other observer were almost in agreement that the implementations were mostly consistent with the lesson plans.

3.12 Statistical Analysis

First of all, two independent variables were identified during the study; methods of teaching and instructional mode. Secondly, to control students' prior knowledge, three pretest scores were used as covariates; electricity achievement (preEAT), science process skills (preSPST), and physics attitudes (prePAS). There were three dependent variables which were measured by using posttest scores. These are; electricity achievement (postEAT), science process skills (postSPST), physics attitude (postPAS).

Descriptive statistics were performed for each group in the design of the study with using the independent and dependent variables described above. Then Multivariate Analysis of Covariance (MANCOVA) was performed for the inferential statistics. Finally follow-up ANCOVAs were performed in order to evaluate effects of independent variables on the dependent variables separately.

3.13 Power Analysis

This study looks for small or medium effect sizes as similar to the studies in literature review. The selected α value (the probability of rejecting a true null hypothesis) is .05 and β value (the probability of failing to reject a false null hypothesis) is .20 for the study. The power analysis was performed by using the explanations given in Cohen (1977). There are two cases for factorial design in this book. The first one is including equal number of sample sizes in each group. The alpha value is defined as .05, the effect size is medium and f=.25, the degrees of freedom for four teaching methods is u=3 and finally the desired power is .80. According to these values, sample size tables of Cohen (1977, p: 384) shows that this study needs 45 participant for each group. The study contains four groups so it needs at least 45*4=180 participants.

The second case includes unequal number of sample sizes in groups. For this case, the number of average sample size is calculated by

$$n = \frac{N}{k}$$

n: number of average sample size in groups

N: total number of participants in study

k: number of groups in the study

314 students participated to this study and there were 4 teaching groups. So the average sample size is

$$n = \frac{314}{4} = 78$$

Alpha= .05, u=3, f=.25, and n=78. According to these values, power tables of Cohen (1977, p: 316) show that the power of the study is .97.

However, after the missing data analysis, 245 students participated to all posttests and the average sample size of the groups are calculated again,

$$n = \frac{253}{4} = 63$$

Alpha= .05, u=3, f=0.25, and n=63. According to these values, power tables of Cohen (1977, p: 316) show that the power of the study is 0.91.

3.14 Unit of Analysis

For the independence of observations to be met, the experimental unit and the unit of analysis should be the same. However, in this study similar to other doctoral studies (Peşman, 2012; Serin, 2009), it was not possible to make experimental unit and the unit of analysis the same. The experimental unit of this study is each intact group, and the unit of analysis is each participant.

3.15 Assumptions and Limitations

Assumptions of the study are listed below:

1. Students answered the tests seriously, consciously and truthfully.
2. The treatments were implemented as in lesson plans.
3. The independence of observation was satisfied.

Limitations of the study are listed below:

1. The results of the study are limited to 9th grade students who were in private and Anatolian high schools in Çankaya.
2. The results are limited to "electricity" concept.
3. The results of the study are limited to inquiry and expository teaching methods and their integration to blended and face-to-face instructional modes.
4. In private high schools, the number of intact classes was not enough to construct all groups. It is preferred that only inquiry groups were constructed in these schools. So expository treatments were not administered in private schools.

CHAPTER 4

RESULTS

This chapter includes missing data analysis, descriptive statistics, and inferential statistics with MANCOVA analysis. At the end, the results of the study are summarized.

4.1. Missing Data Analysis

Four instruments were used for the study. 314 students participated in the posttests and 305 students participated in the pretests. So, nine students were missing at the beginning of the study. Numbers of present and missing values associated with the variables are shown in Table 4.1. A class in school PY was excluded from the study because students' post SPST scores were very low when compared with preSPST scores. There were sixteen students in this class. Therefore, the sample decreased to 298.

Table 4.1

Missing values prior to the analysis

Variable	Present (N)	Missing (N)	Missing (%)
PreEAT Scores	290	8	3
PreSPST Scores	285	13	4
PrePAS Scores	290	8	3
PostEAT Scores	279	19	6
PostSPST Scores	276	22	7
PostPAS Scores	272	26	9
Gender	298	0	0

During the missing data analysis, first of all, the students that did not have one of the posttest scores were excluded from the study. The number of students in the study decreased to 261. Secondly, the missing values of pretest scores were identified. Eleven scores from preEAT, seven scores from preSPST and seven scores from prePAS were missing. Their percentage was less than 5 percent and thus there seems to be no inconvenience for replacing the missing values with the series mean value (Tabachnick & Fidell, 2007, p.63). These missing values were replaced with series mean value. Finally, univariate and multivariate outliers were checked. While deciding univariate outliers, normality plots and z-scores of the cases were used. The cases that exceeded ±3 were determined as an outlier (Tabachnick & Fidell, 2007, p.73). Table 4.2 shows the scores of outliers, Cases 1 to 7 were recognized as an univariate outlier. However, during descriptive statistics, the kurtosis value of the postSPST score was -9.964 and then Case 8 was identified to be an outlier in the W-EXPO group. These cases were excluded from the study. Then, Mahalanobis distances were calculated to define multivariate outliers. However, no multivariate outliers were found in the data, all probability of Mahalanobis distances exceeded 0.001(Tabachnick & Fidell, 2007, p.74).

As a result, 253 students' scores were accepted to be used in descriptive and inferential statistics.

Table 4.2

The Pretests and Posttests Scores of Outliers

Cases	Treatment Group	Post EAT	Post SPST	Post PAS	Pre EAT	Pre SPST	Pre PAS	Zpost EAT	Zpost SPST	Zpost PAS
Case1	EXPO	2.00	38.00	76.00	12.00	36.50	81.00	-3.32	0.67	0.36
Case2	WINQU	5.00	2.00	92.00	3.00	27.00	116.00	-2.68	-3.69	0.57
Case3	WINQU	7.00	3.00	73.16	4.00	15.50	64.00	-2.25	-3.57	0.53
Case4	WINQU	9.00	5.00	87.81	7.00	1.00	70.26	-1.83	-3.34	0.32
Case5	INQU	12.00	2.00	78.00	2.00	4.00	87.00	-1.20	-3.70	-0.25
Case6	INQU	14.00	6.00	59.00	9.00	2.00	84.00	-0.77	-3.21	-1.35
Case7	EXPO	15.00	27.00	24.00	13.00	28.00	24.00	-0.55	-0.66	-3.39
Case8	WEXPO	19.00	21.50	102	12.68	30.50	80.44	-0.22	-4.18	1.29

EXPO: Face-to-Face Expository Treatment Group; W-INQU: Blended Inquiry Treatment Group;INQU: Face-to-Face Inquiry Treatment Group; post: Posttest; pre:Pretest; EAT:Electricity Achievement Test; SPST: Science Process Skills Test; PAS: Physics Attitudes Scale

4.2 Descriptive Statistics

The gender distribution of 253 students included in the analyses was homogeneous. 130 students were female and 123 students were male. Number of male and female students, mean values, standard deviations, skewness and kurtosis values, maximum and minimum scores of each group are given for the pretest and posttest scores of EAT, SPST and PAS, respectively.

4.2.1 Descriptive Statistics for PreEAT and PostEAT

Descriptive statistics of students' preEAT and postEAT scores are given in Tables 4.3 and 4.4, respectively. EAT was constructed by the researcher for this study and it includes 30 items. The correct answer was coded as 1 and the wrong answer as 0. So the minimum score is zero and maximum score is thirty for the test.

In the face-to-face groups, male and female students' pretest scores were nearly the same means (12.39, 12.55) in EXPO group but those of the INQU group were slightly different (12.36, 14.45). INQU group (13.45) students seemed more successful than EXPO group (12.46). In the blended groups, male students of WINQU groups (11.03) seemed less successful and female students of WINQU groups (13.46) seemed the most succesful. In addition, WINQU group (12.26) seemed less successful than WEXPO group (13.08).

Table 4.3

Descriptive Statistics for the PreEAT

Method	Gender	N	Mean	SD	Skewness	Kurtosis	Min	Max
EXPO	Male	23	12.39	4.80	-0.208	-0.901	4.00	20.00
	Female	18	12.55	3.83	-0.691	0.536	5.00	18.00
	Total	41	12.46	4.35	-0.348	-0.675	4.00	20.00
INQU	Male	38	12.36	4.58	-0.349	-1.010	3.00	20.00
	Female	41	14.45	3.14	0.412	-0.350	8.00	21.00
	Total	79	13.45	4.01	-0.414	-0.142	3.00	21.00
WEXPO	Male	21	13.01	4.54	-0.043	0.965	2.00	22.00
	Female	29	13.13	2.94	0.313	-1.008	8.00	19.00
	Total	50	13.08	3.66	0.037	0.960	2.00	22.00
WINQU	Male	41	11.03	4.24	-0.606	-0.040	1.00	18.00
	Female	42	13.46	4.34	-0.874	0.507	2.00	20.00
	Total	83	12.26	4.44	-0.635	-0.022	1.00	20.00

The mean scores of the groups are high in preEAT. The reason for this can be that the elementary school curriculum includes similar objectives with that of 9th grades related to electricity. When the objectives of elementary and secondary school curriculums are compared, "resistance of the wire" is taught at 6th grade level, "Ohm's law", "electric current" and "connections of resistances" are taught at 7th grade level (National Ministry of Education, 2012).

At the end of the posttest of EAT, all groups increased their own means, and this was an obvious expectation at the beginning. In the face-to-face groups, INQU students (17.19) seemed a bit more successful than EXPO ones (16.63). Female students of these groups seemed more successful than male students.

In the blended groups, WEXPO showed the best performance and got the highest mean score (19.60). Female and male students of this group had similar means (19.33 and 19.79). The overall mean of WINQU group was 18.05, female and male students' means were 18.76 and 17.31 respectively.

Table 4.4

Descriptive Statistics for the PostEAT

Method	Gender	N	Mean	SD	Skewness	Kurtosis	Min	Max
EXPO	Male	23	15.95	4.71	-1.290	1.431	4.00	21.00
	Female	18	17.50	4.47	-1.479	1.814	7.00	22.00
	Total	41	16.63	4.62	-1.286	1.208	4.00	22.00
INQU	Male	38	16.44	3.94	-0.565	-0.332	6.00	22.00
	Female	41	17.87	4.31	-1.075	1.396	4.00	24.00
	Total	79	17.19	4.18	-0.767	0.348	4.00	24.00
WEXPO	Male	21	19.33	3.75	0.056	-1.110	14.00	25.00
	Female	29	19.79	3.59	-0.929	0.630	10.00	25.00
	Total	50	19.60	3.63	-0.481	-0.366	10.00	25.00
WINQU	Male	41	17.31	4.41	-0.934	1.908	4.00	25.00
	Female	42	18.76	5.34	-0.703	0.100	6.00	27.00
	Total	83	18.05	5.33	-0.673	0.587	4.00	27.00

The gained scores and effect sizes of each treatment group were computed and shown in Table 4.5. WEXPO got the highest improvement with an effect size of 1.79.

Table 4.5

Gain Scores and Effect Sizes of Each Group for EAT

Method	Gender	N	Gain Scores	Cohen's d
EXPO	Male	23	3.56	0.75
	Female	18	4.95	1.19
	Total	41	4.17	0.93
INQU	Male	38	4.08	0.96
	Female	41	3.42	0.91
	Total	79	3.74	0.91
WEXPO	Male	21	6.32	1.52
	Female	29	6.66	2.03
	Total	50	6.52	1.79
WINQU	Male	41	6.28	1.45
	Female	42	5.30	1.09
	Total	83	5.79	1.18

Because some hypotheses of the study were related to comparison of the effects of methods of teaching and instructional modes, EAT scores of face-to-face groups (EXPO and INQU), blended groups (WEXPO and WINQU), expository instruction groups (EXPO and WEXPO) and inquiry instructions groups (INQU and WINQU) were computed as in Table 4.6. According to the table, there is an obvious difference between blended groups and face to face groups, and also between expository and inquiry groups. Whether these differences are significant or not will be discussed after MANCOVA analysis.

Table 4.6

Gain Scores and Effect Sizes of EAT with respect to Hypothesized Groups

Method	Gender	N	Gain Scores	Cohen's d
Expository	Male	44	4,88	1,09
EXPO+WEXPO	Female	47	6,01	1,66
	Total	91	5,46	1,36
Inquiry	Male	79	5,22	1,22
INQU+WINQU	Female	83	4,37	1,01
	Total	162	4,79	1,06
Face to face	Male	61	3,88	,87
EXPO+INQU	Female	59	3,89	1,00
	Total	120	3,89	,92
Blended	Male	62	6,29	1,48
WEXPO+WINQU	Female	71	5,86	1,39
	Total	133	6,06	1,37

4.2.2 Descriptive Statistics for PreSPST and PostSPST

The descriptive statistics of science process skills test (SPST) were presented in Table 4.7 and Table 4.8. There were totally 20 items, 18 of which were multiple choice and 2 of which were essay type items. There were five modules in SPST with each have eight points. The maximum score was 40 and the minimum was zero. The missing values of preSPST and postSPST were replaced with zero.

Table 4.7

Descriptive Statistics for the PreSPST

		N	Mean	SD	Skewness	Kurtosis	Min	Max
EXPO	Male	23	36.50	2.65	-1.446	3.721	28.00	40.00
	Female	18	35.44	3.77	-1.116	0.590	27.00	40.00
	Total	41	36.03	3.19	-1.344	1.779	27.00	40.00
INQU	Male	38	27.09	12.01	-0.650	-1.108	4.00	40.00
	Female	41	32.47	6.53	-1.207	1.040	13.50	40.00
	Total	79	29.88	9.88	-1.143	0.232	4.00	40.00
WEXPO	Male	21	32.02	6.10	-0.397	-0.774	19.00	40.00
	Female	29	35.31	4.21	-0.855	0.103	24.50	40.00
	Total	50	33.93	5.29	-0.799	-0.071	19.00	40.00
WINQU	Male	41	31.21	8.30	-1.157	0.188	11.00	40.00
	Female	42	31.22	8.71	-1.566	1.967	5.00	40.00
	Total	83	31.22	8.45	-1.354	1.040	5.00	40.00

In the expository teaching groups, EXPO and WEXPO, overall mean scores (36.03 and 33.93) are higher than the mean scores (29.88 and 31.22) in inquiry teaching groups, INQU and WINQU. In the INQU groups it is clear that females (32.47) were more successful than males (27.09).

At the end of the posttest scores of SPST, all groups increased their own means except for EXPO group whose scores decreased a little. Male students in this group decreased their means, while female groups were nearly the same. However, still EXPO and WEXPO groups (34.59 and 36.23) had higher means than INQU and WINQU groups (30.81 and 32.63).

Table 4.8

Descriptive Statistics for the PostSPST

		N	Mean	SD	Skewness	Kurtosis	Min	Max
EXPO	Male	23	34.00	5.11	-1.290	1.431	25.00	40.00
	Female	18	35.36	5.27	-1.560	1.960	21.00	40.00
	Total	41	34.59	5.16	-0.968	-0.230	21.00	40.00
INQU	Male	38	28.50	8.87	-0.482	-0.839	8.00	40.00
	Female	41	32.96	7.61	-1.611	2.111	9.50	40.00
	Total	79	30.81	8.49	-0.950	-0.117	8.00	40.00
WEXPO	Male	21	34.69	4.83	-0.749	-0.933	25.50	40.00
	Female	29	37.35	2.28	-0.349	-1.392	33.00	40.00
	Total	50	36.23	3.77	-1.319	1.207	25.50	40.00
WINQU	Male	41	31.59	7.79	-1.175	0.304	13.00	40.00
	Female	42	33.67	7.45	-1.517	1.294	13.50	40.00
	Total	83	32.63	7.64	-1.295	0.582	13.00	40.00

The gain scores and effect sizes of each group were computed and presented in Table 4.9. WEXPO got the highest improvement; EXPO group got negative effect sizes; INQU and EXPO groups got small effect sizes. Whether these improvements significant or not will be discussed after MANCOVA analysis.

Table 4.9

Gain Scores and Effect Sizes of Each Group for SPST

Method	Gender	N	Gain Scores	Cohen's d
EXPO	Male	21	-2.50	-0.61
	Female	20	-0.08	-0.02
	Total	41	-1.44	-0.34
INQU	Male	39	1.41	0.13
	Female	35	0.49	0.07
	Total	74	0.93	0.10
WEXPO	Male	21	2.67	0.49
	Female	28	2.04	0.60
	Total	49	2.30	0.50
WINQU	Male	41	.38	0.05
	Female	40	2.45	0.30
	Total	81	1.41	0.18

Gain scores of face-to-face groups (EXPO and INQU), blended groups (WEXPO and WINQU), expository instruction groups (EXPO and WEXPO) and inquiry instruction groups (INQU and WINQU) were computed as in table 4.10. According to this table, there is an obvious difference between groups. According to methods of treatments, inquiry groups got higher improvement scores than expository groups. In addition, for instructional mode, blended learning groups got higher improvement than face to face learning group. However these differences are small, there may not be significant. Whether these differences are significant or not will be discussed after MANCOVA analysis.

Table 4.10

Gain Scores of SPST with respect to Hypothesized Groups

Method	Gender	N	Gain Scores	Cohen d
EXPO+WEXPO	Male	44	-0.03	-0.01
	Female	47	1.23	0.33
	Total	91	0.61	0.14
INQU+WINQU	Male	79	0.88	0.09
	Female	83	1.48	0.20
	Total	162	1.18	0.14
Face to face	Male	61	-0.06	-0.01
	Female	59	0.32	0.05
	Total	120	0.12	0.02
Blended	Male	62	1.16	0.16
	Female	71	2.28	0.37
	Total	133	1.74	0.26

4.2.3 Descriptive Statistics for PrePAS and PostPAS

The scores of physics attitude scale (PAS) were evaluated by SPSS 13.0. Table 4.11 and table 4.12 presents the descriptive statistics of the prePAS and postPAS, respectively.

PAS was taken directly from the literature. There were 24 items with Likert scale. So each item was coded from 1 to 5 and the score range become 24 and 120. The missing values were replaced with smean score.

Table 4.11

Descriptive Statistics for the PrePAS

		N	Mean	SD	Skewness	Kurtosis	Min	Max
EXPO	Male	23	87.39	17.15	0.116	-0.672	59.00	120.00
	Female	18	71.24	22.05	0.140	-0.865	36.00	111.00
	Total	41	80.30	20.84	0.168	0.544	36.00	120.00
INQU	Male	38	85.53	15.46	0.528	-0.178	57.00	119.00
	Female	41	76.62	11.54	0.080	-0.878	53.00	96.00
	Total	79	80.91	14.21	0.544	0.310	53.00	119.00
WEXPO	Male	21	92.43	13.99	-0.648	-0.231	62.72	113.00
	Female	29	81.78	15.56	-1.527	2.314	36.00	102.00
	Total	50	86.25	15.70	-1.089	1.747	36.00	113.00
WINQU	Male	41	81.25	17.25	-1.514	2.854	28.00	108.00
	Female	42	76.23	16.52	-0.026	0.292	40.00	119.00
	Total	83	78.71	16.98	-0.749	0.967	28.00	119.00

In the blended expository teaching group, WEXPO, overall mean score (86.25) is higher than the other groups. In all groups, it seems that male student have positive attitudes than female students.

At the end of the posttest scores of PAS, only WINQU groups increased its own mean from 78.71 to 83.31.

Table 4.12

Descriptive Statistics for the PostPAS

		N	Mean	SD	Skewness	Kurtosis	Min	Max
EXPO	Male	23	85.35	21.13	-0.242	-0.099	38.00	120.00
	Female	18	76.08	20.80	0.205	-0.653	47.16	119.00
	Total	41	81.28	21.24	-0.038	-0.573	38.00	120.00
INQU	Male	38	87.47	12.82	0.430	0.020	63.00	120.00
	Female	41	74.87	16.19	0.325	0.108	40.00	114.00
	Total	79	80.91	15.88	0.047	-0.023	40.00	120.00
WEXPO	Male	21	91.21	14.91	-0.464	-0.361	62.00	114.00
	Female	29	80.14	16.11	0.308	0.240	52.00	120.00
	Total	50	84.79	16.41	-0.035	-0.487	52.00	120.00
WINQU	Male	41	87.07	17.76	-0.796	0.601	40.00	120.00
	Female	42	79.64	13.03	-0.446	-0.214	50.00	102.00
	Total	83	83.31	15.90	-0.442	0.153	40.00	120.00

The gain scores and effect sizes of each group were computed and presented in Table 4.13. WINQU got the highest improvement; WEXPO and EXPO got similar improvements; INQU group effect size is zero; whether these values are significant or not will be discussed after MANCOVA analysis.

Table 4.13

Gain Scores and Effect Sizes of Each Group for PAS

Method	Gender	N	Gain Scores	Cohen's d
EXPO	Male	21	-2.04	-0.11
	Female	20	4.84	0.23
	Total	41	.98	0.05
INQU	Male	39	1.94	0.14
	Female	35	-1.75	-0.12
	Total	74	0.00	0.00
WEXPO	Male	21	-1.22	-0.08
	Female	28	-1.64	-0.10
	Total	49	-1.46	-0.09
WINQU	Male	41	5.82	0.33
	Female	40	3.41	0.23
	Total	81	4.60	0.28

The interesting point in Table 4.13 is that male students in EXPO group decreased their means while female students increased. The reason of this result is the students' pretest results. Female students got low while male students got high scores in the pretest.

The mean scores of face-to-face groups (EXPO and INQU), blended groups (WEXPO and WINQU), expository instruction groups (EXPO and WEXPO) and inquiry instructions groups (INQU and WINQU) were computed as in Table 4.14.

Table 4.14

Gain Scores of PAS with respect to Hypothesized Groups

Method	Gender	N	Gain Scores	Cohen d
EXPO+WEXPO	Male	44	-1,65	-,10
	Female	47	,84	,05
	Total	91	-,36	-,02
INQU+WINQU	Male	79	3,95	,25
	Female	83	,86	,06
	Total	162	2,36	,15
Face to face	Male	61	,44	,03
	Female	59	,26	,02
	Total	120	,33	,02
Blended	Male	62	3,44	,21
	Female	71	1,35	,09
	Total	133	2,32	,14

According to this table, inquiry groups' physics attitudes got higher than expository groups. Similarly blended groups got higher attitudes than face-to-face groups. However, these differences are small and this may not be significant. Whether these differences are significant or not will be discussed after MANCOVA analysis.

4.3 Inferential Statistics

In this part, inferential statistics were constructed by using MANCOVA model. Three steps were applied. First of all, covariates are determined, secondly assumptions of MANCOVA are checked and finally MANCOVA results are discussed.

4.3.1 Determination of Covariates

The statistical creterian to identify a covariate is that there should be uncorrelation among covariates and correlation between covariate and dependent variables (Tabachnick & Fidell, 2007, pp. 211-212). The relation between covariates needs to be smaller than .80 (Stevens, 2009, p.292). The correlation table between the variables was constructed by using SPSS as shown in Table 4.15.

Table 4.15

Correlation Among Possible Covariates and the Dependent Variables

Variables	preEAT	preSPST	prePAS	postEAT	postSPST
preSPST	**.402**				
prePAS	.118	.125			
postEAT	**.438**	**.304**	.095		
postSPST	**.456**	**.746**	.084	**.468**	
postPAS	.091	.102	**.650**	**.142**	.072

Pretest scores can be treated as a covariate to control pre-existing differences between groups and additionally the covariate should be a continous variable, measured reliable and correlate with dependent variable (Pallant, 2007, pp. 233-234). As seen in Table 4.15, the correlations between pretests' scores are smaller than .80 and there seems correlation between pretests and posttests. As a result, pretests of EAT, SPST and PAS will be used as the covariates of this study.

4.3.2 Assumptions of MANCOVA

Five assumptions of MANCOVA were checked; independence of observations, normality, multicollinearity, homogeneity of variances and homogeneity of regression.

Independence of observations, data collectors (teachers participated to the study) verified that the students completed tests on their own. To understand whether there was any violation in the scores, their scores were controlled for the anomalies by the researcher before the analyses starts.

Normality, skewness and kurtosis values are given in the descriptive statistics. The values between -2 and +2 can be accepted as normal distribution. (George & Mallery, 2003, pp. 98-99). Only the Kurtosis values of preSPST for male EXPO group and prePAS for female WEXPO group exceeded ±2. This is not a serious violation, because all other values were in acceptable range. Then, to test multivariate normality, Mahalanobis distances were calculated by using SPSS (Pallant, 2007, pp 220-223). Univariate and multivariate outliers were excluded from the study during missing data analysis. As a result, normality assumption was decided to be established.

Multicollinearity refers to high correlation among a set of independent variables. (Pallant, 2007, p 225). Correlations about potential covariates are represented in table 4.15. The correlation among the variables is less than .80. So multicollinearity assumption was satisfied.

Homogeneity of variances can be tested by using Levene's test in SPSS. This test is more robust against nonnormality (Stevens, 2009, pp 227-228). Table 4.16 shows the Levene's test results and it was seen that p values for postEAT and postPAS were higher than 0.05. Therefore, homogeneity of variances was for these dependent variables. However, p value for the postSPST scores was not higher than 0.05. So homogeneity of variances assumption is not met for postSPST.

Table 4.16

Levene's test of equality of error variances

	F	df1	df2	Sig.
postEAT	0.582	3	249	0.627
postSPST	5.724	3	249	0.001
postPAS	0.965	3	249	0.410

Box's test of equality of covariance matrices was used for homogeneity of covariances. This assumption is related to sample sizes of groups. There were larger than 20 cases in each group. The ratio of largest group/ smallest group should be less than 1.5 to verify this assumption. However, this ratio was not met and there was no significant value in Box's M test. Tabachnick and Fidell (2007, p. 252) states that if the sample size are unequal and Box'M test is not significant then robustness is not guaranteed. In this case, the sample sizes and the sizes of variances and covariances can be controlled. If the larger samples produce larger variances, the alpha level is conservative so that the null hypothesis can be rejected with confidence. Table 4.17 shows the variances and sample sizes of each treatment group for each dependent variable.

Table 4.17

Variances of Treatment Groups

	EXPO n = 41	W-EXPO n = 50	INQU n = 79	W-INQU n = 83
postEAT	21,338	13,184	17,438	24,290
postSPST	26,678	14,247	72,142	58,435
postPAS	451,404	269,525	252,487	252,864

According to the Table 4.17, when the variances of treatment groups and the samples sizes in each cell are controlled, there is no direct proportion between sample size of each group and variances. Fortunately, F test is robust against this assumption (Stevens, 2009, p.227). It is assumed that the homogeneity of variances was met but homogeneity of variances/covariances matrices was not met.

Homogeneity of regression assumes that slope of the regression between dependent variable and covariates are the same with the population slope of regression coefficient for each cell (Tabachnick and Fidell, 2007 pp. 202-203). This assumption can be tested by using syntax in SPSS. A syntax is formed by using the explanations in Stevens (2009, pp.300-308) and in Tabachnick and Fidell (2007, pp 281-284). The syntax is shown in Figure 4.1.

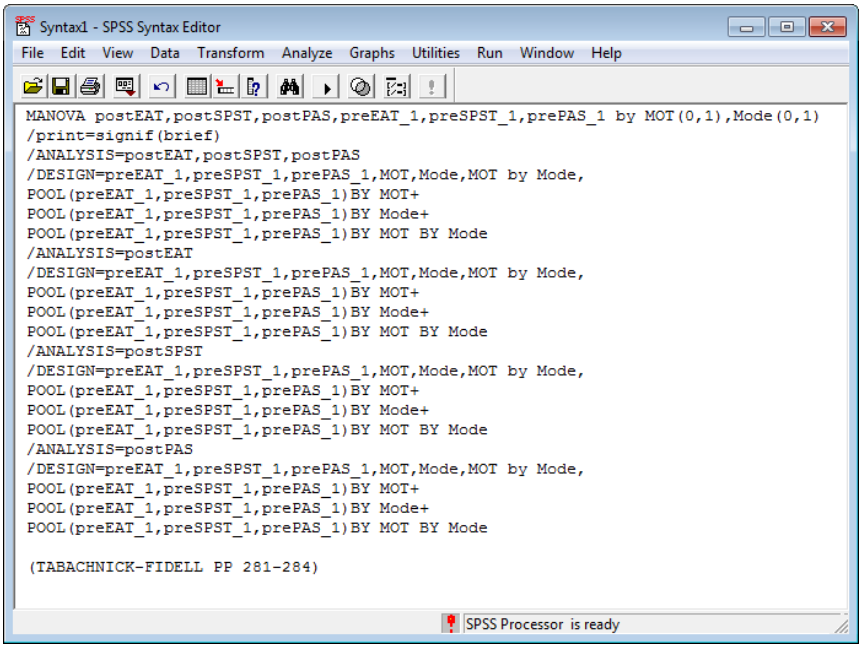


Figure 4. 1 SPSS Syntax For Homogeneity of Regression Assumption

While writing the syntax, the posttest scores of EAT, SPST, and PAS were used as dependent variables, pretest scores of EAT, SPST, and PAS were used as covariates and method of treatments (MOT) and instructional mode (Mode) were used as independent variables. After defining the variables, follow-up ANCOVA analyses were constructed for each dependent variable. As stated in Tabachnick and Fidell (2007, pp.281) homogenity of regression is established alpha value is set as 0.01 level for siginificance. After running the syntax on SPSS, to perform the MANCOVA: F=1.43 , p=.073 , Wilk's Lambda = .852, and to perform the follow up ANCOVA's F =0.81 , p=0.604 for postEAT , F =2.11 , p=0.030 for postSPST, F =1.65 , p=0.103 for postPAS. As a result of these, all values to perform MANCOVA and follow-up ANCOVAs exceed F value in the given alpha set in Tabachnick and Fidell. Homogenity of regression assumption is established. The SPSS output for homogeneity of regression is given in appendix K.

4.3.3 MANCOVA RESULTS

The dependent variables of the study were the posttest scores on electricity achievement test (postEAT), science process skills test (postSPST), and physics attitude scale (postPAS). The independent variables are methods of teaching (MOT) and instructional modes (Mode). The covariates were the pretest scores on electricity achievement test (preEAT), science process skills test (preSPST), and physics attitude scale (prePAS).

The first hypothesis was;

"There is no statistically significant main effect of instructional modes (blended vs face-to-face) on the population means of the combined dependent variables of the 9th grade students' posttest achievement scores on the subject of "electricity", posttest science process skills, and posttest attitude scores towards physics when their pretest scores of achievements in "electricity", science process skills, and attitudes towards physics are controlled."

Table 4.18 shows the MANCOVA results of the study. According to this table, when the main effect of instructional mode is checked, there is evidence that instructional mode makes a significant difference on the dependent variables (postEAT, postSPST, and postPAS). In other words, the effect of instructional mode is statistically significant (F(3,244)=6.697, p=0.000, Wilk's Lambda=0.924, partial eta squared = 0.076 and observed power=0.974) when students' pretest scores were controlled. Therefore, p =0.000 and α =.05 ($p < \alpha$), null hypothesis is rejected.

Table 4.18

MANCOVA Results

	Wilks' Lambda	F	Hypothesis df	Error df	Sig.	Partial Eta-squared	Observed Power
Intercept	0.712	32.91	3	244	0.000	0.288	1.000
PreEAT	0.863	12.91	3	244	0.000	0.137	1.000
PreSPST	0.681	38.05	3	244	0.000	0.319	1.000
PrePAS	0.590	56.56	3	244	0.000	0.410	1.000
MOT	0.981	1.613	3	244	0.187	0.019	0.421
Mode	0.924	6.697	3	244	0.000	0.076	0.974
MOT By IM	0.984	1.314	3	244	0.270	0.016	0.349

The second hypothesis was;

"There is no statistically significant main effect of teaching method (5E learning cycle vs expository) on the population means of the combined dependent variables of the 9th grade students' posttest achievement scores on the subject of "electricity", posttest science process

skills, and posttest attitude scores towards physics when their pretest scores of achievements in "electricity", science process skills, and attitudes towards physics are controlled."

When the main effects of the method of teaching is checked, there is no evidence that the method of teaching make a significant difference on the dependent variables (postEAT, postSPST, and postPAS). In other words, the effect of methods of teaching is not statistically significant ($F(3,244)=1.613$, $p=0.187$, Wilk's Lambda=0.924, partial eta squared = 0.019 and observed power=0.421) when students' pretest scores were controlled. Therefore, $p=0.187$ and $\alpha=.05$ ($p > \alpha$), null hypothesis is failed to reject.

The third hypothesis was;

"There is no statistically significant interaction effect between teaching method and instructional media on the population means of the combined dependent variables of the 9th grade students' posttest achievement scores on the subject of "electricity", posttest science process skills, and posttest attitude scores towards physics when their pretest scores of achievements in "electricity", science process skills, and attitudes towards physics are controlled."

When the interaction effect is checked, there is no evidence that there is an interaction between method of teaching (MOT) and instructional mode (Mode). The interaction is not statistically significant ($F(3,244)=1.314$, $p=0.270$, Wilk's Lambda=0.984, partial eta squared = 0.016 and observed power=0.349). In other words, there is no interaction between MOT and Mode, when the students' pretest scores were controlled. Therefore, $p=0.270$ and $\alpha=.05$ ($p > \alpha$), null hypothesis is failed to reject.

As a result, one hypothesis was rejected while two hypothesis were failed to reject. For the rejected hypothesis, follow-up ANCOVA was constructed to understand significant difference on which dependent variable exist.

4.3.4 Follow-up ANCOVA Results

In order to see the main effects are in favor of which groups. Univariate ANCOVAs for each dependent variable are necessary. Table 4.19 shows the univariate ANCOVA results.

The alpha value (0.05) is divided to 3, which is the number of dependent variables in the study, to obtain new alpha as described in Tabachnick and Fidell (2007, p. 270). Because a Bonferroni type adjustment is required for the inflated type I error in case of separate univariate tests instead of multivariate test. The new alpha is set at 0,017 levels.

Table 4.19

Univariate ANCOVA Results

Source	Dependent Variable	df	F	Sig.	Partial Eta Squared	Observed Power
Intercept	PostEAT	1	44.901	0.000	0.154	1.000
	PostSPST	1	42.999	0.000	0.149	1.000
	PostPAS	1	28.895	0.000	0.105	1.000
MOT	PostEAT	1	0.228	0.633	0.001	0.076
	PostSPST	1	4.288	0.039	0.017	0.541
	PostPAS	1	0.717	0.398	0.003	0.135
Mode	PostEAT	1	14.902	**0.000**	0.057	0.970
	PostSPST	1	8.440	**0.004**	0.033	0.825
	PostPAS	1	0.993	0.320	0.004	0.168
MOT by Mode	PostEAT	1	2.148	0.144	0.009	0.309
	PostSPST	1	0.558	0.456	0.002	0.115
	PostPAS	1	1.331	0.250	0.005	0.210

According to the Table 4.18, the main effect of instructional mode is on the dependent variables of achievement (postEAT) and science process skills (postSPST). In other words, blended instruction and face to face instruction significantly differ on the achievement with a medium effect size (F(1,246)=14.902 , p=0,000 ; partial eta squared =0.057 , observed power=0.970). The postEAT mean scores for blended and face-to-face groups are 18.63 and 17.00 respectively. The postEAT mean scores of the blended groups are higher than the face-to-face groups. As a result, the significant difference between blended and face-to-face groups in achievement (postEAT) scores is in favor of the blended groups. According to the other dependent variable postSPST, blended instruction and face-to-face instruction significantly differ on the science process skills with a small to medium effect size (F(1,246)=8.440 , p=0,004 ; partial eta squared =0.033 , observed power=0.825).
The postSPST mean scores for blended and face-to-face groups are 33.98 and 32.10 respectively. The postSPST mean scores of the blended groups are higher than the face-to-face groups. As a result, the significant difference between blended and face-to-face groups in the postSPST scores is in favor of the blended groups.

4.4 Summing up the Results

1. There is a statistically significant difference with a medium effect size between mean combined scores of electricity achievement, science process skills and attitudes towards physics in blended and face-to-face instructional groups. According to follow-up ANCOVAs for each dependent variable, blended and face-to-face groups significantly differ in the achievement and science process skills scores with a medium effect size. This significant difference seems to be in the favor of blended instruction. There is no statistically significant difference in students' attitudes towards physics.
2. There is no statistically significant difference between inquiry (5E learning cycle) and expository teaching methods on the combined dependent variables of the 9^{th} grade students' posttest achievement scores on the subject of "electricity", posttest science process skills and posttest attitude scores towards physics when their pretest scores of achievements in "electricity", science process skills and attitudes towards physics are controlled.
3. There is no statistically significant interaction effect between teaching method and instructional mode on the combined dependent variables of the 9^{th} grade students' posttest achievement scores on the subject of "electricity", posttest science process skills and posttest attitude scores towards physics when their pretest scores of achievements in "electricity," science process skills and attitudes towards physics are controlled.

CHAPTER 5

DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

In this chapter, discussions about the results, possible threats to internal and external validity, conclusions, implications, and recommendations for further studies are presented.

5.1 Discussion

The purpose of the study was to investigate the main effects of instructional modes (blended and face-o-face), teaching methods (inquiry and expository) and the interaction effects between them on 9th grade students' achievements on electricity, science process skills, and attitudes towards physics. In this 2x2 factorial design, a statistically significant effect was observed solely for instructional mode. The students who were instructed in blended mode got higher scores than the students who were instructed in face-to-face mode on electricity achievement and science process skills tests.

Blended learning is designed to integrate the strengths of face-to-face learning experiences with the strengths of web based learning experiences (Garrison & Kanuka, 2004; Vaughan & Garrison,2005; Vignare, 2007, as cited in Nickel, 2010). Several studies reported that blended learning affects students' learning positively (Chandra & Watters, 2012; Delialioğlu & Yıldırım, 2007; Nellman, 2008). Based upon the review of empirical studies Larsen (2012) also concluded that blended learning improves achievement. The idea that blended learning enhances students understanding was supported with the results of the current study. This study also revealed that blended instructional mode affect students' science process skills as well as achievements. Nevertheless, this study did not detect any evidence that instructional modes can make a difference on students' attitudes towards physics. This result is similar with that of Bilal and Erol (2009) but contradicts with others' (Chandra & Watters, 2012; Sun, Lin and Yu, 2008; Şengel, 2005). A positive effect of blended mode of instruction on students' achievement and science process skills observed probably because students instructed in blended mode can access the course content and have a chance to review it, practice and actively involve the activities, solve extra problems, and share their opinions and questions with their teachers any time they needed.

Two teaching methods, inquiry and expository, were selected to test the possible effects of teaching methods. The analysis of data could not detect a significant difference between the effects of teaching methods on students' possible gains. Actually, there is no conclusive evidence in the literature about the superiority of a specific instructional method on students' achievements. While some studies (Nwagbo, 2006; Yager & Akcay, 2010; Lawson & Johson, 2002; Sokolowski & Rackley, 2011) conclude that inquiry learning provides better understanding when it is compared to expository learning, some others (Sweak, Jong and Joolingen, 2004) present contradictory evidence that expository teaching provides better understanding. This is probably because achievement is a multifaceted construct and the effect of a specific instruction depends on what sort of achievement is intended. In this study, the achievement test included different types of items formats but the problem situations were limited to well-defined problems. Although the result that inquiry did not make a difference on students' achievements can be understandable from this perspective, the result that inquiry did not make a difference on students' science process skills is a little odd. The rationale of inquiry based teaching is to stimulate science process skills. Students need to actively use and consequently improve science process skills during an inquiry based instruction. Quite a number of studies have also showed that inquiry based teaching methods improve students' science process skills (Ergül, Şimşekli, Çalış, Özdilek, Gökmençelebi, & Şanlı, 2011; Şimşek & Kabapınar, 2010; Campbell, Zharg & Neilson, 2011). In this study, when the students' science process skill scores are checked, gain score of inquiry groups (0.93) is higher than those of expository groups (-1.44).

However, this difference is not statistically significant. This is probably because improving students' science process skills needs much more time than the time spent in this study.

The research design of the study had an advantage of seeing the effects of each instructional mode for two different teaching methods and each teaching method in two different instructional modes; consequently, the interaction between teaching method and instructional mode was tested. However, no evidence was detected about the interactions. It is worth to notice that the methods of this study are limited to expository and inquiry and it is still possible to detect an interaction effect between instructional method and mode when some other methods like modelling, problem based or project based learning are implemented. In the same way, type of modes can also create an interaction. Blended and face-to-face modes were used in the current study. Only web based learning mode or different percentages of web and face-to-face in blended learning mode can still make a difference in terms of interactions between instructional methods and modes.

5.2 Implications

This study found that blended learning environment creates some advantages to increase students' understandings and science process skills. The current physics curricula are developing with the technological developments in FATIH project and this project should be supported by public and government. Teachers can integrate some technological issues to their classrooms in an appropriate way. They can use blended learning and technological tools while developing their instructions to improve students' achievement levels. Additionally, textbook writers or publication companies can invest on developing web based learning environments.

Furthermore, while using technology in classrooms, teachers should be careful because technology may not be as beneficial as expected, if technology and teaching method are not blended successfully because an ineffective classroom environment transformed to blended learning will still be ineffective (Yelon, 2006). In the current study, there is no difference between the expository and inquiry learning methods in blended mode. The new technological tools can include inquiry teaching methods as well as expository teaching method.

5.3 Recommendations for Further Studies

In the current study, there were two independent variables, instructional modes and methods of teaching, and three dependent variables: achievement, science process skills and attitudes. However, some other independent variables (gender, school, school type) can also be used during the analysis.

Firstly, gender, instructional mode, and teaching method were used as independent variables in the collected data, MANCOVA analysis was repeated and the results were the same with the current study. There was only statistically significant difference in instructional mode in favor of blended mode of instruction. Addition of gender to the study did not make a difference.

Secondly, instructional mode and gender were used as fixed factors; without methods of teaching. In this case, gender was found significant for PAS scores. That is, there is a statistically significant difference between male and female students' PAS scores. It seems that the attitudes of females towards physics changed positively with blended instruction more than those of males and it is statistically significant. Similarly, Sanders & Morrison-Shatler (2001) reported that females had significantly more positive attitudes than males to blended learning and females used the web more often than males. This study can be repeated by including gender differences in the future studies.

Thirdly, the schools and instructional mode were used as fixed factors. In this case, there was a statistically significant difference between schools on students SPST scores. When the descriptive statistics for schools were examined with instructional mode, it can be concluded that the mean scores of SPST in AX were higher than those in AY. PX mean scores were the smallest when compared with AX and AY. Furthermore, there was an interaction between schools and instructional mode for EAT and SPST scores. This interaction showed that in school AX, blended learning did not excessively change students' achievements on the subject of electricity, and science process skills. In AY, blended learning increases students' science process skills, and achievements on the subject of electricity. In PX blended learning decreases achievements and skills. These interactions are shown in figure 5.1.

This result shows that the future studies related to blended learning should be designed in only one school and one teacher. This may eliminate the limitations in this study.

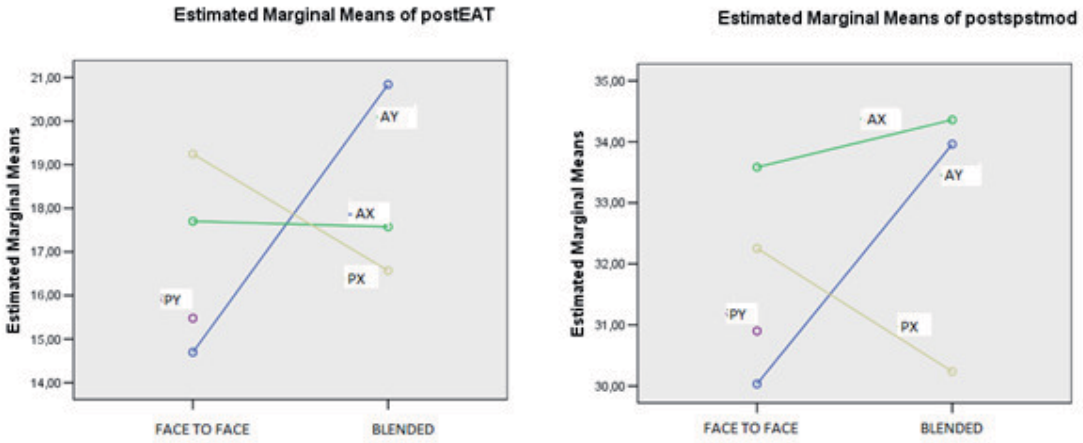


Figure 5.1 Interaction Plots For postEAT and postSPST Due to Schools

Finally, when the school types and instructional mode were used as fixed factors, there were two types of schools in the study, Anatolian and private. There appears an interaction between the independent variables on students' achievement scores; the achievement of students in Anatolian high schools was increasing with blended learning while it was decreasing in private high schools. This interaction can also be predicted with figure 5.1. For the future studies, the school type seems to be an important variable that may affect the results.

In addition to these extra analyses with the data, future studies can also consider some other variables than the current study did not mention. Some other dependent variables like problem solving skills and attitudes towards internet or computers should be searched. Also blended learning with some other teaching methods or strategies like problem or project based learning or modeling instructioncan be used in the future studies. This study was conducted in a district whose socioeconomic status is high in Turkey; therefore, this might affect the results of the study. Similar studies can be designed in some other districts. Studies that measure the students' usage of web based environments out of their classrooms should be checked to understand how long students use web based learning environments and its possible effects on the dependent variables.

In the current study the levels of instructional mode were limited to face to face and blended instructions only. In the future studies, if the conditions can be arranged a third level of instructional mode, web only, should be integrated to the research design to elaborate the effects of instructional mode.

5.4 Internal Validity

Internal validity is related to the threats or factors other than the independent variable that affect the dependent variable. In other words, it focuses on threats or rival explanations that influence the outcomes of an experimental study but are not part of the independent variable (Gay & Airasian, 2000, p.372). Fraenkel and Wallen (1996, p.241) defines internal validity similarly. The relevant threats to the current research are maturation, testing, instrumentation, statistical regression, differential selection of participants, mortality, subject characteristics, location, attitudinal effects (Hawthorne, John Henry and Demoralization effects), and implementation.

Maturation
The study lasted for only 6 weeks with the applications of instruments. Participants' ages varied between 15 and 16. Therefore, "maturation" threat was not a problem for this study.

Testing
Taking a pretest may improve performance on a posttest. The effect of pretest is assumed to be minimized because all groups took the pretest before the study.

Instrumentation
Three instruments were used as pretest and posttest during the study. These tests were the same. Thus, instrumentation decay is assumed to have been controlled. In the instructions of the test, it was written that the scores of the study would be used in a research study and would not be shared anyone else. All tests were administered by the teachers of the treatment groups and teachers were informed before the administrators about the instructions. Therefore, data collector bias is assumed to have been controlled.

Statistical Regression
Statistical regression occurs when participants are selected on the basis of their extremely high or extremely low scores. Students preEAT, prePAS and preSPST scores were used for the equality of the treatment groups. So, statistical regression is assumed to be controlled. However, students' pretest mean scores for achievement were range from 11.86 to 13.23 out of 30. It seems high. The reason of that is students' elementary science curriculum had similar objectives of 9^{th} grade physics courses.

Differential Selection of Participants
The study was administered to 13 intact classes and the classes were not changed or revised for the study. According to the teachers of the selected schools, these classes were constructed by the school administrations randomly at the beginning of the school year. There were no statistically significant differences among them. So, differential selection of participants' threat is assumed to be controlled.

Mortality
314 students participated to study at the beginning, but 6 tests were administered to the students. 245 students took all of the posttests. For each test, the missing data is less than 12 percent, except for postSPST. In a private school class, it was not administered well or the students of this class did not pay attention to this test. Therefore, this class was excluded from the study. Following the missing data analysis, mortality is assumed to be minimized.

Subject Characteristics
The treatments were randomly assigned to the intact classes. MANCOVA was used to analyze the data of posttest scores. Pretest scores were used as the covariates for the equality of the participants. Therefore, subject characteristics threat is assumed to be minimized.

Location
Two Anatolian and two private schools were included in the study. In Anatolian high schools, treatments were assigned for each class; that is, each treatment was implemented in one class. However, in private high schools, there were not enough number of classes for each treatment, so inquiry teaching method was selected for these schools and two treatments were implemented there. The classes in the schools were in similar conditions. Hence, the location threat is assumed to be minimized.

Attitudinal Effects
The students from different classes may contact with each other about the treatments of the study or computer and laboratory activities in their classrooms. In order to avoid such attitudinal effects, some parts of the treatments were given as a worksheet to the expository groups. All the other groups had new activities in their classrooms.

Implementation

Teacher training were administered with the teachers. Each teacher was informed about the importance of the study. The lesson plans and study plans were prepared and submitted to the teachers. How they should use these plans was explained. Schools were visited during the implementation and classroom observation checklists were used. The implementation threat is thus assumed to be controlled.

5.5 External Validity

External validity concerns whether the study results conducted with a sample group can be generalized to the population or not (Gay & Airasian,2000). In the current study, two different school types were used: Anatolian and private high schools. There were 2,669 private, 8,661 Anatolian high school students in Ankara. The accessible population includes 775 of private and 2,060 of Anatolian in 14 Anatolian and 17 private high schools in Çankaya district. In the sample of the study, there were 89 private high school students, it corresponds to 11.5 % of all private high schools students, and 225 Anatolian high school students, it corresponds to 10.9 % of all Anatolian high schools students. Therefore, the number of students (n=314) participated in the study exceeds 10% of the accessible population; the results of this study can be generalized to this accessible population. In Çankaya district, the students are expected to have medium or high socioeconomic status. Participated Anatolian high schools also select the students with the high school entrance exam and the scores of the students must be high. The students in these schools were mostly medium or high achievers. In conclusion, the results can be generalized to similar other settings.

5.6 Conclusions

According to the results of the current study blended instruction is more effective than face-to face instruction on 9^{th} grades students' achievements in electricity subject and science process skills.

With respect to the effect of inquiry teaching method, it was not different from the effects of expository teaching method on students' achievement, science process skills and attitudes towards physics. There seems to be no interaction between instructional modes and teaching methods either. However, it has to be noted that while the teaching methods were limited to expository teaching and learning cycle, instructional modes were limited to face to face and blended instruction for this conclusion. Therefore, further studies are needed with different teaching methods and instructional modes to elaborate the instructional mode and method interactions.

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APPENDIX A-1

LESSON PLAN FOR EXPOSITORY TREATMENT

FİZİK DERS PLANI-1

BÖLÜM 1

SINIF : Lise 1.
ŞUBELER : Anlatım (Expository) yöntemi kullanılacak olan sınıflar
ÜNİTE NO : 5
ÜNİTE ADI : MADDE VE ELEKTRİK,
KONU : Elektrik Akımı
BAŞLAMA : 01.Mart.2010.
BİTİŞ : 07.Mart.2010.
SÜRE : 2 Ders Saati,

BÖLÜM 2

AMAÇLAR :

1. Potansiyel farkını, bir iletkenin iki ucu arasında akım oluşmasına neden olabilecek enerji farkının bir göstergesi olarak ifade edildiğini hatırlayarak basit bir elektrik devresindeki rolünü açıklar.

HEDEF VE DAVRANIŞLAR :
Bu bölümün sonunda öğrenciler:

- Elektrik akımının yönünü anlar.
- Elektrik akımı sırasında elektronların hareket yönünü açıklar.
- Elektrik akımını elektron sayısını ve zamanı kullanarak tanımlar.
- Elektrik akımının birimini söyler.
- Konu ile ilgili problemleri çözer.

ÜNİTE KAVRAMLARI :
Potansiyel fark, Pil, Elektron, İletken, Elektrik Akımı, Elektron Akımı, Akım Şiddeti, Yük Miktarı,

ÖĞRENME – ÖĞRETME – YÖNTEM VE TEKNİKLERİ :

1. Anlatım (Expository)

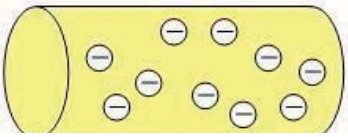
KULLANILACAK EĞİTİM TEKNOLOJİLERİ, ARAÇ – GEREÇLER KAYNAKÇA :

1. Ders Kitabı
2. Ödev Kağıtları

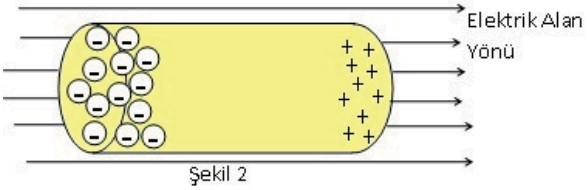
ÖZET :

1-Elektrik Akımı

İletkenler içerisinde bulunan elektronlar, Şekil 1 de gösterildiği gibi dağınık halde bulunurlar ve serbestçe hareket edebilirler.



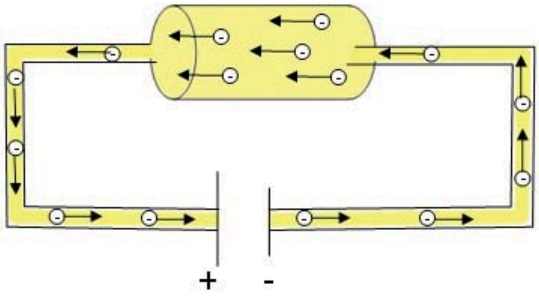
Eğer bu iletken Şekil 2 deki gibi bir elektrik alan içerisine konulursa , elektronlar elektriksel kuvvetlerin etkisi ile elektrik alan yönünün tersi yönde hareket ederler.



Şekil 2

Elektronlar iletkenin uçlarında toplanarak potansiyel fark oluşturur.

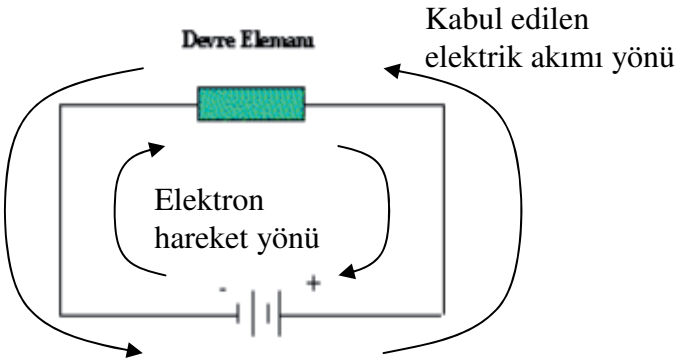
Bir iletken, bir elektrik alanın içersine konulmak yerine, uçlarına bir pil bağlandığında da uçlarında potansiyel fark ve içerisinde elektrik alan oluşur. Bu durumda iletken içindeki elektronlar elektriksel kuvvet nedeniyle hareket ederler. Bu şekilde oluşan elektron hareketine elektrik akımı denir.



Şekil 3

Sonuç olarak, bir pilin uçları iletken tel kullanılarak birbirlerine bağlanırsa, elektronların hareket etmesi sağlanmış olur, yani elektrik akımı oluşur.

Tarihi akış içerisinde akım bilgisi, yük taşıyan parçacıklar bilgisinden eski olduğu için akımın yönü "+" yüklerin hareket yönü olarak tanımlanmıştır. Ancak daha sonraki bulgular bunun yanlış olduğunu ortaya koymakla beraber, akımın yönünün "+" dan "-" ye doğru almanın sonuçları etkilemediği görüldüğünden gelenek devam ettirilmiştir.

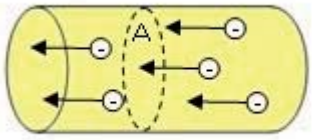


Bu bölümde elektrik akımının elektron akımına ters yönde olduğu ve bunun tarihsel gelişimlerinden kaynaklandığı vurgulanmıştır.

Bölüm soruları:
1. Elektrik devrelerinde pillerin kullanılmasının sebebi nedir?
2. Elektronlar pilin hangi ucundan diğerine doğru hareket ederler?
3. Bir lamba bir pile bağlanarak yakılmak istendiğinde, lamba üzerinde ne şekilde bir bağlantı yapılmalıdır?
4. Tarihsel gelişim içerisinde önce elektronların hareket ettiğimi yoksa elektrik akımının varlığımı bulunmuştur?

2- Akım Şiddeti

Bir iletkenin "A" kesitinden birim zamanda geçen net yük miktarına elektrik akım şiddeti denir.



Akım şiddeti *"i"* , iletkenin herhangi bir kesitinden *"t"* sürede geçen toplam yük miktarı "q" ile gösterilirse akımın değeri;

$$i = \frac{q}{t}$$

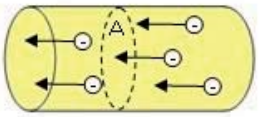
Simgesi	ismi	birimi	Birim sembolü
i	Akım Şiddeti	Amper	A
q	Yük miktarı	Coulomb	c
t	Zaman	saniye	s

Bu bölümde akım değerinin iletkenin kesitinden birim zamanda geçen yük miktar olduğu vurgulanmıştır.

Bölüm Soruları:
1. İletkenden geçen akım miktarı sabit kalmak koşulu ile, daha fazla süre akım geçmesi sağlanırsa, iletkenden geçen yük miktarı sayısı nasıl değişir?
2. Bir iletkenden aynı sürede daha fazla yük geçişi akımın ne şekilde değiştiğini gösterir?

3- Çözümlü Örnekler

Çözümlü Örnek-1



Bir iletkenin herhangi bir kesitinden 0,3 saniyede 6.10^{18} tane elektron geçtiğine göre, bu iletkenden geçen elektrik akımı kaç Amper'dir? (1 elektronun yükü $1,6.10^{-19}$ coulomb' dur.)

$i = \frac{q}{t}$ denklemine göre;

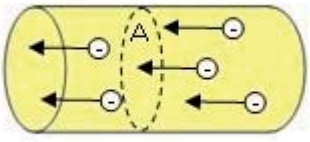
$$\begin{array}{ll} 1\,e & 1,6.10^{-19}\ ederse \\ 6.10^{18}\,e & q \end{array}$$

$$q = 9,6.10^{-1}\ c$$

$$i = \frac{9,6.10^{-1}}{0,3}$$

$$i = 0,32\ A$$

Çözümlü Örnek -2



Bir devredeki iletken telden 0,16 Amper'li akım 4 saniye geçirildiğinde iletkenin herhangi bir kesitinden bu zaman içerisinde geçen elektron sayısını bulunuz? (1 elektronun yükü $1,6.10^{-19}$ coulomb' dur.)

$i = \frac{q}{t}$ denklemine göre;

$$0,16 = \frac{q}{4}$$

$$q = 0,64\ c$$

$$\begin{array}{ll} 1,6.10^{-19} c & 1e\ ederse \\ 0,64\ c & n \end{array}$$

$$n = \frac{0,64}{1,6.10^{-19}}$$

$$n = 4.10^{18}\ \text{tan}\ e \quad elektron$$

BÖLÜM 3
ÖLÇME - DEĞERLENDİRME :

Öğrencilere Ödev-1 soruları dağıtılacak ve diğer dersin ilk bölümünde yapılamayan sorular kontrol edilecektir. Öğretmen tarafından bireysel ve grup halinde öğrenciler değerlendirilecektir.

BÖLÜM 4
UYGULAMAYA İLİŞKİN AÇIKLAMALAR :

Elektrik Akımı ve Akım Şiddeti:

Süre : 90 dakika, Anlatılacak, gösterilecek, şekilleri çizilecek, çizdirilecek, örnekler verilecek, Farklı maddelerden örnek ölçümler yapılacak, tartışılacak. 2 soru çözülecek. 9 soru ödev verilecek. Konu anlatımı sırasında bölüm soruları öğrencilere sorulacak ve verilen cevaplara göre konunun açıklamalarına devam edilecektir.

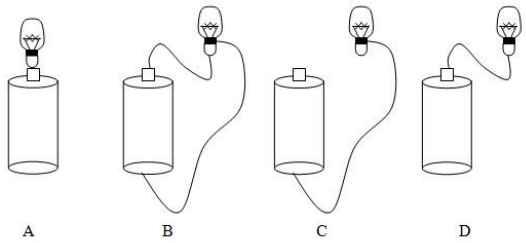
KAYNAKÇA :

- M.E.Bk. Ders Programları, Fizik Ders Programı,
- Sürat Yayınları – Fizik 1 Ders Kitabı, 154 – 177. sayfa, Fizik Deney Kitabı,
- 11.Eylül 2007 tarihli ünitelendirilmiş yıllık ders planı,

Ödev-1

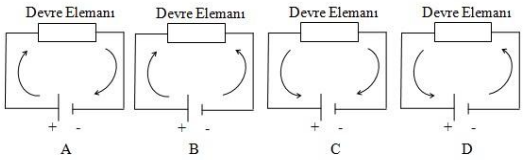
Adı Soyadı:
Okulu:
Sınıfı:
Numarası:

1.



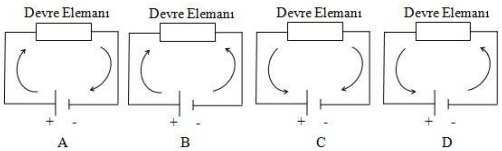
Yukarıdaki elektrik devrelerinin hangisinde ışık yanar?

2.



Yukarıdaki elektrik devrelerinin hangisinde gösterilen elektrik akım yönü doğru gösterilmiştir?

3.



Yukarıdaki elektrik devrelerinin hangisinde gösterilen elektron akım yönü doğru gösterilmiştir?

Aşağıdaki cümleleri **doğru/yanlış** şeklinde sınıflandırın.

4. ____ Pil elektrik devrelerinde potansiyel fark sağlayan devre elemanıdır.

5. ____ İletken içerisinden geçen yük miktarına akım denir.

6. ____ Elektron akımı pilin + ucundan - ucuna doğrudur?

7. ____ Elektrik akımının birimi Amperdir.

8. Bir elektrik devresinden 3 dakika boyunca 6 Amperlik akım geçtiğine göre; bu elektrik devresinden geçen yük miktarı kaç coulomb dur?

A) 2 coulomb
B) 6 coulomb
C)18 coulomb
D) 360 coulomb
E) 1080 coulomb

9. Bir iletkenin herhangi bir kesitinden 0,2 saniyede 3.10^{18} tane elektron geçtiğine göre, bu iletkenden geçen elektrik akımı kaç Amper'dir? (1 elektronun yükü $1{,}6.10^{-19}$ coulomb' dur.)

A) 1,0 Amper
B) 1,2 Amper
C) 1,8 Amper
D) 2,4 Amper
E) 3,0 Amper

1. Grup: Açıklayıcı Öğretim (Expository Teaching)

Ders 1: Giriş -Öntestler • Çalışma ile ilgili genel bilgi. • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 2: Giriş -Öntestler • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)	Ders 3: Elektrik Akımı • Elektrik-elektron akımı • Akım Şiddeti (sınıf)	Ders 4: Elektrik Akımı • Çözümlü Örnekler • Değerlendirme sorularının çözülmesi (sınıf)	Ders 5: Bir İletkenin Direnci • Direncin bağlı olduğu değişkenler (sınıf)
Ders 6: Bir İletkenin Direnci • Çözümlü Örnekler • Değerlendirme sorularının çözülmesi (sınıf)	Ders 7: OHM Kanunu • Ohm Kanunu • Ampermetre ve Voltmetre (sınıf)	Ders 8: OHM Kanunu • Çözümlü Örnekler • Değerlendirme sorularının çözülmesi (sınıf)	Ders 9: Dirençlerin Bağlanması • Dirençlerin Seri bağlanması • Dirençlerin Paralel Bağlanması • Dirençlerin karışık bağlanması (sınıf)	Ders 10: Dirençlerin Bağlanması • Çözümlü Örnekler • Değerlendirme sorularının çözülmesi (sınıf)
Ders 11: Bitiş -Sontestler • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 12: Bitiş • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)			

APPENDIX A-2

LESSON PLANS FOR INQUIRY TREATMENT

FİZİK DERS PLANI-1

BÖLÜM 1

SINIF : Lise 1
ŞUBELER : Araştırmacı ve Sorgulayıcı (Inquiry) kullanılacak olan sınıflar
ÜNİTE NO : 5
ÜNİTE ADI : MADDE VE ELEKTRİK,
KONU : Elektrik Akımı
BAŞLAMA : 01.Mart.2010.
BİTİŞ : 07.Mart.2010.
SÜRE : 2 Ders Saati,

BÖLÜM 2

AMAÇLAR :

1. Potansiyel farkını, bir iletkenin iki ucu arasında akım oluşmasına neden olabilecek enerji farkının bir göstergesi olarak ifade edildiğini hatırlayarak basit bir elektrik devresindeki rolünü açıklar

HEDEF VE DAVRANIŞLAR :
Bu bölümün sonunda öğrenciler:

- elektrik akımının yönünü anlar.
- elektrik akımı sırasında elektronların hareket yönünü açıklar.
- elektrik akımını elektron sayısını ve zamanı kullanarak tanımlar.
- elektrik akımının birimini söyler.
- Konu ile ilgili problemleri çözer.

ÜNİTE KAVRAMLARI :
Potansiyel fark, Pil, Elektron, İletken, Elektrik Akımı, Elektron Akımı, Akım Şiddeti, Yük Miktarı,
ÖĞRENME – ÖĞRETME – YÖNTEM VE TEKNİKLERİ :

1. Araştırmacı ve Sorgulayıcı (Inquiry- 5E)

KULLANILACAK EĞİTİM TEKNOLOJİLERİ, ARAÇ – GEREÇLER KAYNAKÇA :

1. Ders Kitabı,
2. Ödev Kağıtları
3. Deney Malzemeleri
4. Bilgisayar ve Televizyon
5. Tepegöz

ÖZET :	**1-İlgi Çekme:** Televizyon ve bilgisayar kullanılarak "elektrik kazası" isimli video öğrencilere izletilecek ve buradaki kazanın sebebi tartışılacaktır. *Televizyon veya bilgisayarın kullanılamadığı laboratuar ortamları var ise: öğrencilere hiç elektrik kazası görüp görmedikleri sorulacak ve bu kazalardaki olayların nasıl olduğu tartışılacaktır. **2- Keşfetme:** "Basit bir elektrik devresi" başlıklı deneyin öğrenciler tarafından yapılması sağlanacaktır. **3- Açıklama:** Deneyin sonucundaki sorular sorularak öğrencilere açıklamalar yaptırılacaktır. **4-Detaylandırma:** öğrencilere yaptıkları deney sırasında hangi yüklerin hareket ettiği sorulacak ve bu noktadan hareketle elektrik akımı ve elektron akımının yönlerini anlamaları sağlanacaktır. Akımın devre elemanlarının üstünden geçişleri sırasında azalmadığına dikkat çekilecektir. Deney sonundaki **teorik bilgi** öğrencilere açıklanacaktır. Açıklama sırasında öncelikle akım şiddetinin ne demek olduğu tartışılacak ve akım şiddetinin iletkenden geçen yük miktarı ile orantısı konuşulacaktır. **5-Değerlendirme:** Öğrencilere ödev-1 soruları dağıtılacaktır. Öğrenciler sınıf içerisindeki performanslarına göre değerlendirileceklerdir.

BÖLÜM 3
ÖLÇME - DEĞERLENDİRME :

Öğrencilere Ödev-1 soruları dağıtılacak ve diğer dersin ilk bölümünde yapılamayan sorular kontrol edilecektir. Öğretmen tarafından bireysel ve grup halinde öğrenciler değerlendirilecektir.

BÖLÜM 4
UYGULAMAYA İLİŞKİN AÇIKLAMALAR :

Elektrik Akımı ve Akım Şiddeti:

Süre : 90 dakika,

Konuya ilgi çekilecek, deney yaptırılacak, konu ile ilgili teorik açıklamalar yapılacak, konu detaylandırılacak ve son olarak değerlendirilecektir. Bir çok bilimsel kavramı öğrencilerin keşfetmesi hedeflenmiştir. Bu nedenle öğretmen sadece bir yol gösterici veya bazı noktalarda yardım edici olarak görev yapacaktır.

Konu hem sınıfta hem de fen laboratuarında işlenecektir. Konuya fen laboratuarında ilgi çekme ile başlanacak, deney yaptırılacak ve konu ile ilgili açıklamalar yapılacaktır. Bundan sonra konu detaylandırılacak ve değerlendirilecektir. Bu aşamaların hepsi öğrenci tarafından gerçekleştirilecektir.

Sınıf dersi sırasında laboratuarda yapılan olay sınıf içerisinde tekrarlanacaktır. Öğretmen fen labı sırasında videonun nasıl olduğunu öğrencileri etkileyip etkilemediği üzerine sorular soracaktır. Bundan sonra deneyle ve forum bölümü ile ilgili sorularla devam edecektir. 4. bölümün sonundaki yük hareketini tartışacaktır. Son olarak öğrencilerin ödev sorularından yapamadıkları ile ders sonlandırılacaktır.

KAYNAKÇA :

- M.E.B. Ders Programları, Fizik Ders Programı,
- Sürat Yayınları – Fizik 1 Ders Kitabı, 154 – 177. sayfa, Fizik Deney Kitabı,
- 11.Eylül 2007 tarihli ünitelendirilmiş yıllık ders planı,

Deney-1
BASİT BİR ELEKTRİK DEVRESİ

DENEYİN AMACI: Anahtar, üreteç ve duy kullanarak, devre yapmak ve bir elektrik devresinde bulunması gereken üç elemanı tanımak. Anahtar durumuna göre açık devre ve kapalı devre yapmak.

HAZIRLIK SORULARI: Deneyin başlangıcında aşağıdaki sorular öğrencilerle tartışılacaktır.

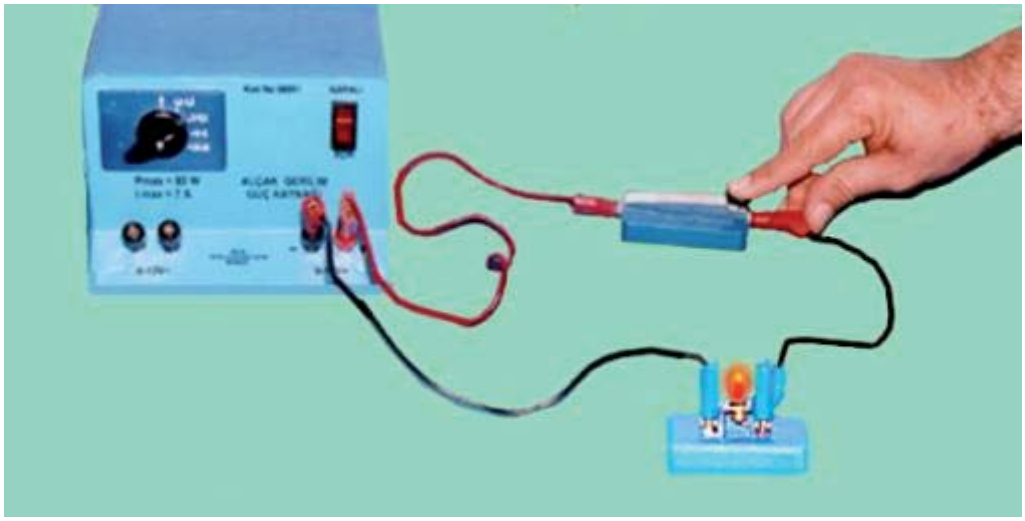
1-Basit bir elektrik devresini nasıl oluşturabiliriz? Bir elektrik devresinde hangi elemanlar bulunur? Tartışınız.

2-Açık devre ve kapalı devre deyince ne anlıyorsunuz? Tartışınız.

KULLANILAN ARAÇ VE GEREÇLER:

1.güç kaynağı 2.duy (lambasıyla birlikte)
3.anahtar 4.bağlantı kablosu

DENEY DÜZENEĞİ: Bu düzenek sadece öğrencilerden istenen kısım olarak çizilmiştir. Öğrencilere verilmeyecek veya istenen kısmınlar söylenmeyecektir.



DENEYİN YAPILIŞI:

Deneydeki devre elemanları öğrencilere verilecek ve bu devre elemanlarını kullanarak kapalı devre oluşturmaları istenecektir. Öğrencilere deney kağıtları dağıtılmayacak, deney düzeneğini ne şekilde kuracakları hakkında açık bilgi verilmeyecektir. Öğrencilere devreyi tamamlamaları için 10 dakika süre verilecektir.

1-Güç kaynağının (+) ve (-) kutbuna birer bağlantı kablosu takınız.
2-Bağlantı kablosunun bir ucunu anahtara, diğer ucunu ampule bağlayınız.
3-Anahtar açık konumdayken güç kaynağını 3-4,5 volta getirerek açınız.
4-Anahtar açık konumdayken ampulün yanmadığını gözleyiniz.
5-Bu defa anahtarı kapatıp, devreyi tamamlayınız ve ampulün yandığını gözleyiniz.

DENEYİN SONUCU:

Deneyin sonunda öğrencilere aşağıdaki sorular sırası ile sorulacaktır. Bu sorulardan alınan cevaplara göre bir sonraki aşamaya geçilecektir.

Lambayı yakabildiniz mi?
Lambanın yanması için neler gereklidir?
Lambanın yanması için üretecin sadece – kutbu kullanılabilir mi?
Lambanın yanması için üretecin sadece + kutbu kullanılabilir mi?
Kapalı devreyi ve açık devreyi tanımlayınız?

DETAYLANDIRMA: Sorular tamamlandıktan sonra devre içerisinde yüklerin nasıl hareket ettiği ve akım şiddetinin büyüklüğünün hesaplanması ile konu detaylandırılacaktır.

Üretecin bir ucundan diğer ucuna elektrik yüklerinin hareketini sağlayan kesintisiz iletken yola "elektrik devresi" denir. Elektrik devresinde elektronlar üretecin – kutbundan çıkarak + kutba doğru hareket ederler. Bu olaya elektrik akımı denir. Elektrik akımı ile elektron akımı ters yönlüdür. Elektrik devresinde akımın yönü (+) kutuptan, (-) kutba doğru kabul edilmiştir.

Elektrik akımının şiddeti; devreden birim zamanda geçen yük miktarı olarak tanımlanır.
Akım şiddeti *"i"* , iletkenin herhangi bir kesitinden *"t"* sürede geçen toplam yük miktarı "q" ile gösterilirse akımın değeri;

$$i = \frac{q}{t}$$

Simgesi	ismi	birimi	Birim sembolü
i	Akım Şiddeti	Amper	A
q	Yük miktarı	Coulomb	c
t	Zaman	saniye	s

2. Grup: Araştırmacı ve Sorgulayıcı Öğretim (Inquiry Teaching)

Ders 1: Giriş -Öntestler • Çalışma ile ilgili genel bilgi. • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 2: Giriş -Öntestler • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)	Ders 3: Elektrik Akımı • Elektrik-elektron akımı • Akım Şiddeti • Deney-1 (Fizik Lab)	Ders 4: Elektrik Akımı • Konu Tekrarı • Ödev-1 sorularının çözülmesi (sınıf)	Ders 5: Bir İletkenin Direnci • Direncin bağlı olduğu değişkenler • Deney-2 (Fizik Lab)
Ders 6: Bir İletkenin Direnci • Konu Tekrarı • Ödev-2 sorularının çözülmesi (sınıf)	Ders 7: OHM Kanunu • Ohm Kanunu • Deney-3 (Fizik Lab)	Lesson 8: OHM Kanunu • Konu Tekrarı • Ödev-3 sorularının çözülmesi (sınıf)	Ders 9: Dirençlerin Bağlanması • Dirençlerin Seri bağlanması • Dirençlerin Paralel Bağlanması • Dirençlerin karışık bağlanması • Deney-4 (Fizik Lab)	Ders 10: Dirençlerin Bağlanması • Konu Tekrarı • Ödev-4 sorularının çözülmesi (sınıf)
Ders 11: Bitiş -Sontestler • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 12: Bitiş • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)			

APPENDIX A-3

LESSON PLANS FOR BLENDED WEB WITH EXPOSITORY TREATMENT

FİZİK DERS PLANI-1
BÖLÜM 1

SINIF : Lise 1.
ŞUBELER : Web ile harmanlanmış anlatım (Blended web with expository) yöntemi kullanılacak sınıflar
ÜNİTE NO : 5
ÜNİTE ADI : MADDE VE ELEKTRİK,
KONU : Elektrik Akımı
BAŞLAMA : 01.Mart.2010.
BİTİŞ : 07.Mart.2010.
SÜRE : 2 Ders Saati

BÖLÜM 2

AMAÇLAR :

1. Potansiyel farkını, bir iletkenin iki ucu arasında akım oluşmasına neden olabilecek enerji farkının bir göstergesi olarak ifade edildiğini hatırlayarak basit bir elektrik devresindeki rolünü açıklar

HEDEF VE DAVRANIŞLAR :

Bu bölümün sonunda öğrenciler:

- elektrik akımının yönünü anlar.
- elektrik akımı sırasında elektronların hareket yönünü açıklar.
- elektrik akımını elektron sayısını ve zamanı kullanarak tanımlar.
- elektrik akımının birimini söyler.
- Konu ile ilgili problemleri çözer.

ÜNİTE KAVRAMLARI :

Potansiyel fark, Pil, Elektron, İletken, Elektrik Akımı, Elektron Akımı, Akım Şiddeti, Yük Miktarı,

ÖĞRENME – ÖĞRETME – YÖNTEM VE TEKNİKLERİ :

1. Web ile harmanlanmış anlatım (Blended web with expository)

KULLANILACAK EĞİTİM TEKNOLOJİLERİ, ARAÇ – GEREÇLER KAYNAKÇA :

1. Ders Kitabı,
2. Bilgisayar- İnternet

ÖZET :	www.dersfizik.net/expo isimli web adresinin 1. bölümündeki elektrik akımı başlıklı konu öğrenciler tarafından işlenecektir. Dersin sonunda öğrencilere "değerlendirme soruları" kısmının tamamlanması gerektiği hatırlatılacaktır. Bu bölüme gelemeyen öğrenciler var ise bir sonraki derse kadar tamamlamaları istenecektir. Sınıf dersi sırasında öğrencilere konu tekrar edilecektir. Öğrencilerin değerlendirme sorularında yapılamayan örnekler var ise bunlar sınıfta çözülecektir.

BÖLÜM 3
ÖLÇME - DEĞERLENDİRME :

Öğrencilerin "Değerlendirme Soruları" bölümünü tamamlamaları sağlanacaktır Öğretmen tarafından bireysel ve grup halinde öğrenciler değerlendirilecektir.

BÖLÜM 4
UYGULAMAYA İLİŞKİN AÇIKLAMALAR :

Elektrik Akımı ve Akım Şiddeti:

Süre : 90 dakika, Anlatılacak, gösterilecek, şekilleri çizilecek, çizdirilecek, örnekler verilecek, Farklı maddelerden örnek ölçümler yapılacak, tartışılacak. 2 soru çözülecek. 9 soru ödev verilecek. Konu anlatımı sırasında bölüm soruları öğrencilere sorulacak ve verilen cevaplara göre konunun açıklamalarına devam edilecektir. Öğretmen öğrencilerin verdikleri cevapları aynı web adresinden kontrol ederek, sınıf dersini şekillendirebilir.

KAYNAKÇA :

- M.E.Bk. Ders Programları, Fizik Ders Programı,
- Sürat Yayınları – Fizik 1 Ders Kitabı, 154 – 177. sayfa, Fizik Deney Kitabı,
- 11.Eylül 2007 tarihli ünitelendirilmiş yıllık ders planı,

3. Grup Web ile Harmanlanmış Açıklayıcı Öğretim (Blended Web with Expository)

Ders 1: Giriş -Öntestler • Çalışma ile ilgili genel bilgi. • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 2: Giriş -Öntestler • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)	Ders 3: Elektrik Akımı • www.dersfizik.net/expo 1- Elektrik Akımı (Bilgisayar Lab)	Ders 4: Elektrik Akımı • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)	Ders 5: Bir İletkenin Direnci • www.dersfizik.net/expo 2- Bir İletkenin Direnci (Bilgisayar Lab)
Ders 6: Bir İletkenin Direnci • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)	Ders 7: OHM Kanunu • www.dersfizik.net/expo 3- OHM Kanunu • Ampermetre ve voltmetre okunması (Bilgisayar Lab)	Ders 8: OHM Kanunu • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)	Ders 9: Dirençlerin Bağlanması • www.dersfizik.net/expo 4- Dirençlerin Bağlanması (Bilgisayar Lab)	Ders 10: Dirençlerin Bağlanması • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)
Ders 11: Bitiş -Sontestler • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 12: Bitiş • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)			

APPENDIX A- 4

LESSON PLANS FOR BLENDED WEB WITH INQUIRY TREATMENT

FİZİK DERS PLANI-1
BÖLÜM 1

SINIF : Lise 1.
ŞUBELER : Web ile harmanlanmış sorgulayıcı (Blended web with inquiry) öğretim yöntemi kullanılacak sınıflar
ÜNİTE NO : 5
ÜNİTE ADI : MADDE VE ELEKTRİK,
KONU : Elektrik Akımı
BAŞLAMA : 01.Mart.2010.
BİTİŞ : 07.Mart.2010.
SÜRE : 2 Ders Saati,

BÖLÜM 2

AMAÇLAR :

1. Potansiyel farkını, bir iletkenin iki ucu arasında akım oluşmasına neden olabilecek enerji farkının bir göstergesi olarak ifade edildiğini hatırlayarak basit bir elektrik devresindeki rolünü açıklar

HEDEF VE DAVRANIŞLAR :
Bu bölümün sonunda öğrenciler:

- elektrik akımının yönünü anlar.
- elektrik akımı sırasında elektronların hareket yönünü açıklar.
- elektrik akımını elektron sayısını ve zamanı kullanarak tanımlar.
- elektrik akımının birimini söyler.
- Konu ile ilgili problemleri çözer.

ÜNİTE KAVRAMLARI :
Potansiyel fark, Pil, Elektron, İletken, Elektrik Akımı, Elektron Akımı, Akım Şiddeti, Yük Miktarı,

ÖĞRENME – ÖĞRETME – YÖNTEM VE TEKNİKLERİ :

1. Web ile harmanlanmış sorgulayıcı (Blended web with inquiry)

KULLANILACAK EĞİTİM TEKNOLOJİLERİ, ARAÇ – GEREÇLER KAYNAKÇA :

1. Ders Kitabı,
2. Bilgisayar

ÖZET :	www.dersfizik.net/inqu isimli web adresinin 1. bölümündeki elektrik akımı başlıklı konu öğrenciler tarafından işlenecektir. Dersin sonunda öğrencilere "değerlendirme soruları" kısmının tamamlanması gerektiği hatırlatılacaktır. Bu bölüme gelemeyen öğrenciler var ise bir sonraki derse kadar tamamlamaları istenecektir. Sınıf dersi sırasında öğrencilere konu tekrar edilecektir. Öğrencilerin değerlendirme sorularında yapılamayan örnekler var ise bunlar sınıfta çözülecektir.

BÖLÜM 3

ÖLÇME - DEĞERLENDİRME :Öğrencilerin "Değerlendirme Soruları" bölümünü tamamlamaları sağlanacaktır Öğretmen tarafından bireysel ve grup halinde öğrenciler değerlendirilecektir.

BÖLÜM 4

UYGULAMAYA İLİŞKİN AÇIKLAMALAR :

Elektrik Akımı ve Akım Şiddeti:

Konuya ilgi çekilecek, deneyi yaptırılacak, konu ile ilgili teorik açıklamalar yapılacak, konu detaylandırılacak ve son olarak değerlendirilecektir. Bir çok bilimsel kavramı öğrencilerin keşfetmesi hedeflenmiştir. Bu nedenle öğretmen sadece bir yol gösterici veya bazı noktalarda yardım edici olarak görev yapacaktır.

Konu hem sınıfta hem de bilgisayar laboratuarında işlenecektir. Konuya internette ilgi çekme ile başlanacak, deneyleri yaptırılacak ve konu ile ilgili açıklamalar yapılacaktır. Bundan sonra konu detaylandırılacak ve değerlendirilecektir. Bu aşamaların hepsi öğrenci tarafından gerçekleştirilecektir.

Sınıf dersi sırasında laboratuarda yapılan olay sınıf içerisinde tekrarlanacaktır. Öğretmen fen labı sırasında videonun nasıl olduğunu öğrencileri etkileyip etkilemediği üzerine sorular soracaktır. Bundan sonra deneyle ve forum bölümü ile ilgili sorularla devam edecektir. 4. bölümün sonundaki yük hareketini tartışacaktır. Son olarak öğrencilerin değerlendirme sorularından yapamadıkları ile ders sonlandırılacaktır.

KAYNAKÇA :

- M.E.Bk. Ders Programları, Fizik Ders Programı,
- Sürat Yayınları – Fizik 1 Ders Kitabı, 154 – 177. sayfa, Fizik Deney Kitabı,
- 11.Eylül 2007 tarihli ünitelendirilmiş yıllık ders planı,

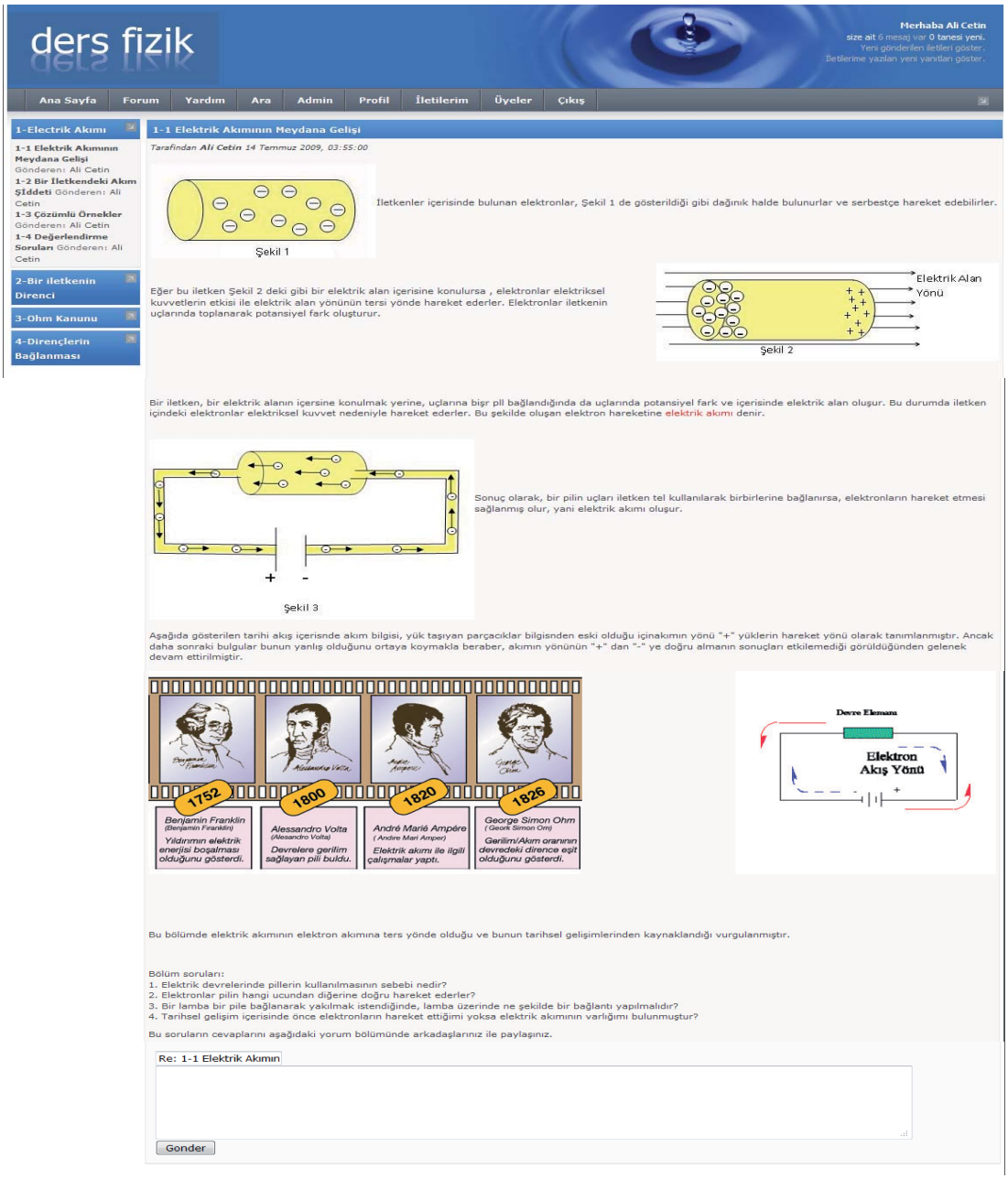
4. Grup Web ile Harmanlanmış Sorgulayıcı Öğretim (Blended web with Inquiry)

Ders 1: Giriş -Öntestler • Çalışma ile ilgili genel bilgi. • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 2: Giriş -Öntestler • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)	Ders 3: Elektrik Akımı • www.dersfizik.net/inqu 1- Elektrik Akımı (Bilgisayar Lab)	Ders 4: Elektrik Akımı • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)	Ders 5: Bir İletkenin Direnci • www.dersfizik.net/inqu 2- Bir İletkenin Direnci (Bilgisayar Lab)
Ders 6: Bir İletkenin Direnci • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)	Ders 7: OHM Kanunu • www.dersfizik.net/inqu 3- OHM Kanunu • Ampermetre ve voltmetre okunması (Bilgisayar Lab)	Ders 8: OHM Kanunu • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)	Ders 9: Dirençlerin Bağlanması • www.dersfizik.net/inqu 4- Dirençlerin Bağlanması (Bilgisayar Lab)	Ders 10: Dirençlerin Bağlanması • Konu Tekrarı • Değerlendirme sorularının çözülmesi (sınıf)
Ders 11: Bitiş -Sontestler • Internet tutum ölçeği (IAT) • Bilimsel süreç beceri testi (SPST) (sınıf)	Ders 12: Bitiş • Fizik tutum ölçeği (PAT) • Elektrik başarı testi (EAT) (sınıf)			

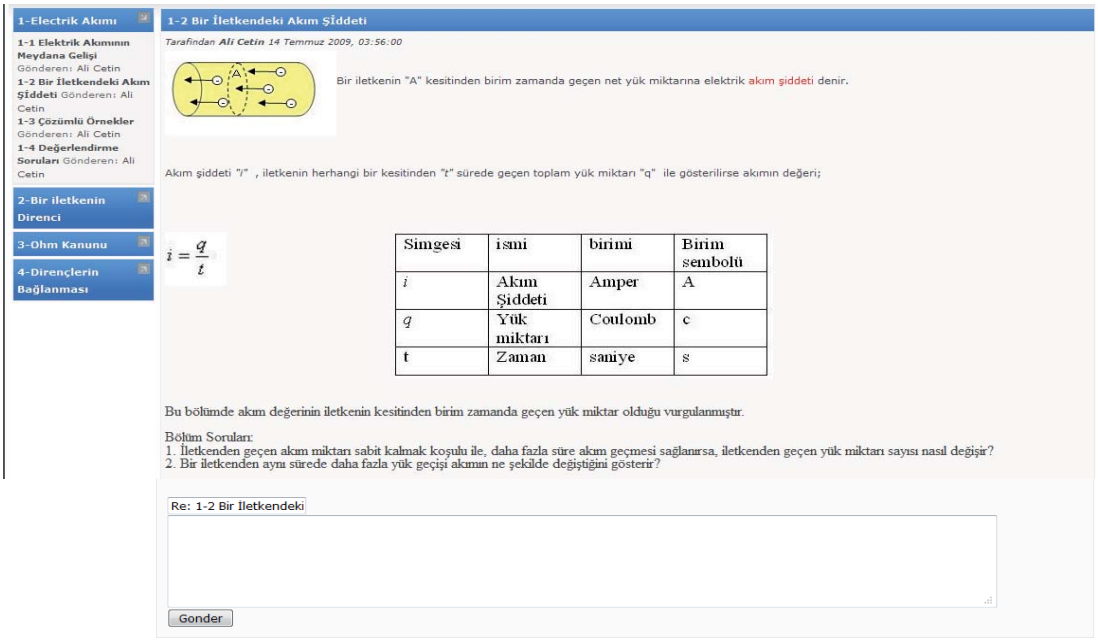
APPENDIX B-1

PAGES OF WEB BASED EXPOSITORY LEARNING ENVIRONMENT (WELE)

1-1 Formation of Electric Current



1.2 The Quantity of Electric Current



1-Electrik Akımı
1-1 Elektrik Akımının Meydana Gelişi Gönderen: Ali Cetin
1-2 Bir İletkendeki Akım Şİddeti Gönderen: Ali Cetin
1-3 Çözümlü Örnekler Gönderen: Ali Cetin
1-4 Değerlendirme Soruları Gönderen: Ali Cetin
2-Bir iletkenin Direnci
3-Ohm Kanunu
4-Dirençlerin Bağlanması

1-2 Bir İletkendeki Akım Şİddeti

Tarafından Ali Cetin 14 Temmuz 2009, 03:56:00

Bir iletkenin "A" kesitinden birim zamanda geçen net yük miktarına elektrik akım şiddeti denir.

Akım şiddeti "i" , iletkenin herhangi bir kesitinden "t" sürede geçen toplam yük miktarı "q" ile gösterilirse akımın değeri;

$$i = \frac{q}{t}$$

Simgesi	ismi	birimi	Birim sembolü
i	Akım Şiddeti	Amper	A
q	Yük miktarı	Coulomb	c
t	Zaman	saniye	s

Bu bölümde akım değerinin iletkenin kesitinden birim zamanda geçen yük miktar olduğu vurgulanmıştır.

Bölüm Soruları:
1. İletkenden geçen akım miktarı sabit kalmak koşulu ile, daha fazla süre akım geçmesi sağlanırsa, iletkenden geçen yük miktarı sayısı nasıl değişir?
2. Bir iletkenden aynı sürede daha fazla yük geçişi akımın ne şekilde değiştiğini gösterir?

Re: 1-2 Bir İletkendeki

Gonder

1.3 Exercises

1-Electrik Akımı
1-1 Elektrik Akımının Meydana Gelişi Gönderen: Ali Cetin
1-2 Bir İletkendeki Akım Şİddeti Gönderen: Ali Cetin
1-3 Çözümlü Örnekler Gönderen: Ali Cetin
1-4 Değerlendirme Soruları Gönderen: Ali Cetin
2-Bir iletkenin Direnci
3-Ohm Kanunu
4-Dirençlerin Bağlanması

1-3 Çözümlü Örnekler

Tarafından Ali Cetin 14 Temmuz 2009, 04:11:00

Çözümlü örnek-1

Bir iletkenin herhangi bir kesitinden 0,3 saniyede 6.10^{18} tane elektron geçtiğine göre, bu iletkenden geçen elektrik akımı kaç Amper'dir? (1 elektronun yükü $1,6.10^{-19}$ coulomb' dur.)

Çözümlü örnek -2

Bir devredeki iletken telden 0,16 Amper'li akım 4 saniye geçirildiğinde iletkenin herhangi bir kesitinden bu zaman içerisinde geçen elektron sayısını bulunuz? (1 elektronun yükü $1,6.10^{-19}$ coulomb' dur.)

Çözümler için tıklayınız

1.3 Solutions of Exercises

1-Electrik Akımı

1-1 Elektrik Akımının Meydana Gelişi Gönderen: Ali Cetin
1-2 Bir İletkendeki Akım Şiddeti Gönderen: Ali Cetin
1-3 Çözümlü Örnekler Gönderen: Ali Cetin
1-4 Değerlendirme Soruları Gönderen: Ali Cetin

2-Bir iletkenin Direnci

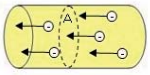
3-Ohm Kanunu

4-Dirençlerin Bağlanması

Çözümlü Örnekler

*Tarafından **Ali Cetin** 01 Mart 2009, 03:29:00*

Çözümlü örnek-1



Bir iletkenin herhangi bir kesitinden 0,3 saniyede 6.10^{18} tane elektron geçtiğine göre, bu iletkenden geçen elektrik akımı kaç Amper'dir? (1 elektronun yükü $1,6.10^{-19}$ coulomb' dur.)

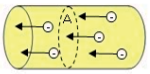
$$\begin{array}{ll} 1\,e & 1,6.10^{-19}\ ederse \\ 6.10^{18}\ e & q \end{array}$$

$$q = 9,6.10^{-1}\ c$$

$$i = \frac{9,6.10^{-1}}{0,3}$$

$$i = 0,32\ A$$

Çözümlü örnek -2



Bir devredeki iletken telden 0,16 Amper'li akım 4 saniye geçirildiğinde iletkenin herhangi bir kesitinden bu zaman içerisinde geçen elektron sayısını bulunuz? (1 elektronun yükü $1,6.10^{-19}$ coulomb' dur.)

$$0,16 = \frac{q}{4}$$

$$q = 0,64\,c$$

$$\begin{array}{ll} 1,6.10^{-19}\,c & 1e\ ederse \\ 0,64\ c & n \end{array}$$

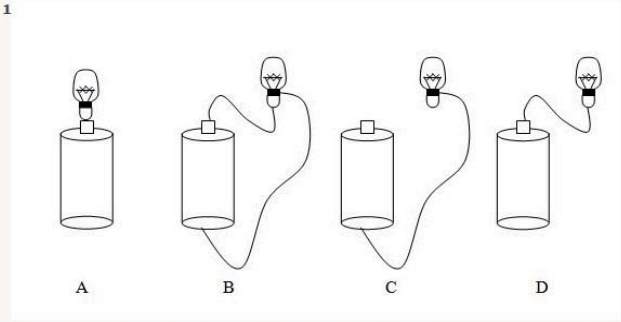
$$n = \frac{0,64}{1,6.10^{-19}}$$

$$n = 4.10^{18}\ \text{tan}\ e \quad elektron$$

1.4 Exercises

Adı Soyadı

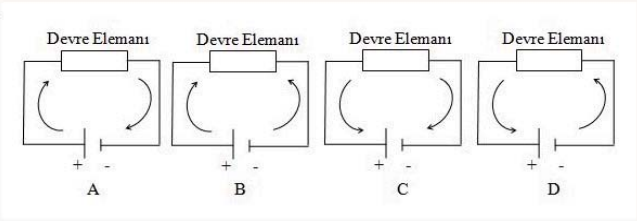
1



Yukarıdaki elektrik devrelerinin hangisinde ışık yanar?

- (•) A
- ( ) B
- ( ) C
- ( ) D

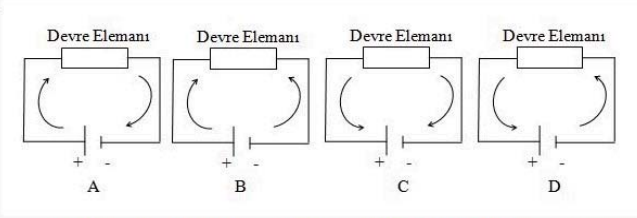
2.



Yukarıdaki elektrik devrelerinin hangisinde gösterilen elektrik akım yönü doğru gösterilmiştir?

- ( ) A
- ( ) B
- (•) C
- ( ) D

3.



Yukarıdaki elektrik devrelerinin hangisinde gösterilen elektron akım yönü doğru gösterilmiştir?

- ( ) Artar
- ( ) Azalır
- (•) Değişmez

Aşağıdaki cümleleri **doğru/yanlış** şeklinde sınıflandırın.

4. Pil elektrik devrelerinde potansiyel fark sağlayan devre elemanıdır.

- ( ) Doğru
- ( ) Yanlış

5. İletken içerisinden geçen yük miktarına akım denir.

- ○ Doğru
- ◉ Yanlış

6. Elektron akımı pilin + ucundan - ucuna doğrudur?

- ◉ Doğru
- ○ Yanlış

7. Elektrik akımının birimi Amperdir.

- ◉ Doğru
- ○ Yanlış

8. Bir elektrik devresinden 3 dakika boyunca 6 Amperlik akım geçtiğine göre; bu elektrik devresinden geçen yük miktarı kaç coulomb dur?

- ○ 2 coulomb
- ○ 6 coulomb
- ○ 18 coulomb
- ○ 360 coulomb
- ◉ 1080 coulomb

9.Bir iletkenin herhangi bir kesitinden 0,2 saniyede 3.10^{18} tane elektron geçtiğine göre, bu iletkenden geçen elektrik akımı kaç Amper'dir? (1 elektronun yükü $1,6.10^{-19}$ coulomb' dur.)

- ◉ 1,0 Amper
- ○ 1,2 Amper
- ○ 1,8 Amper
- ○ 2,4 Amper
- ○ 3,0 Amper

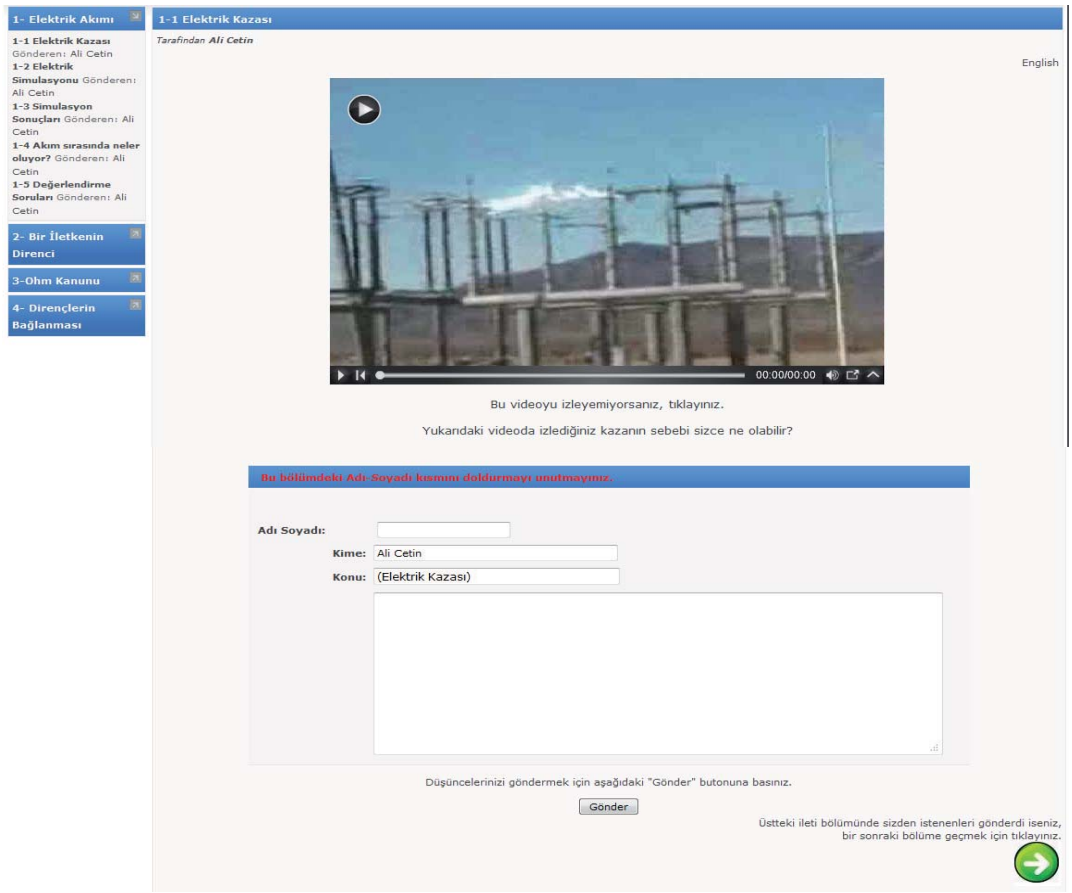
Cevaplarınızı göndermek için tıklayınız.

Gönder

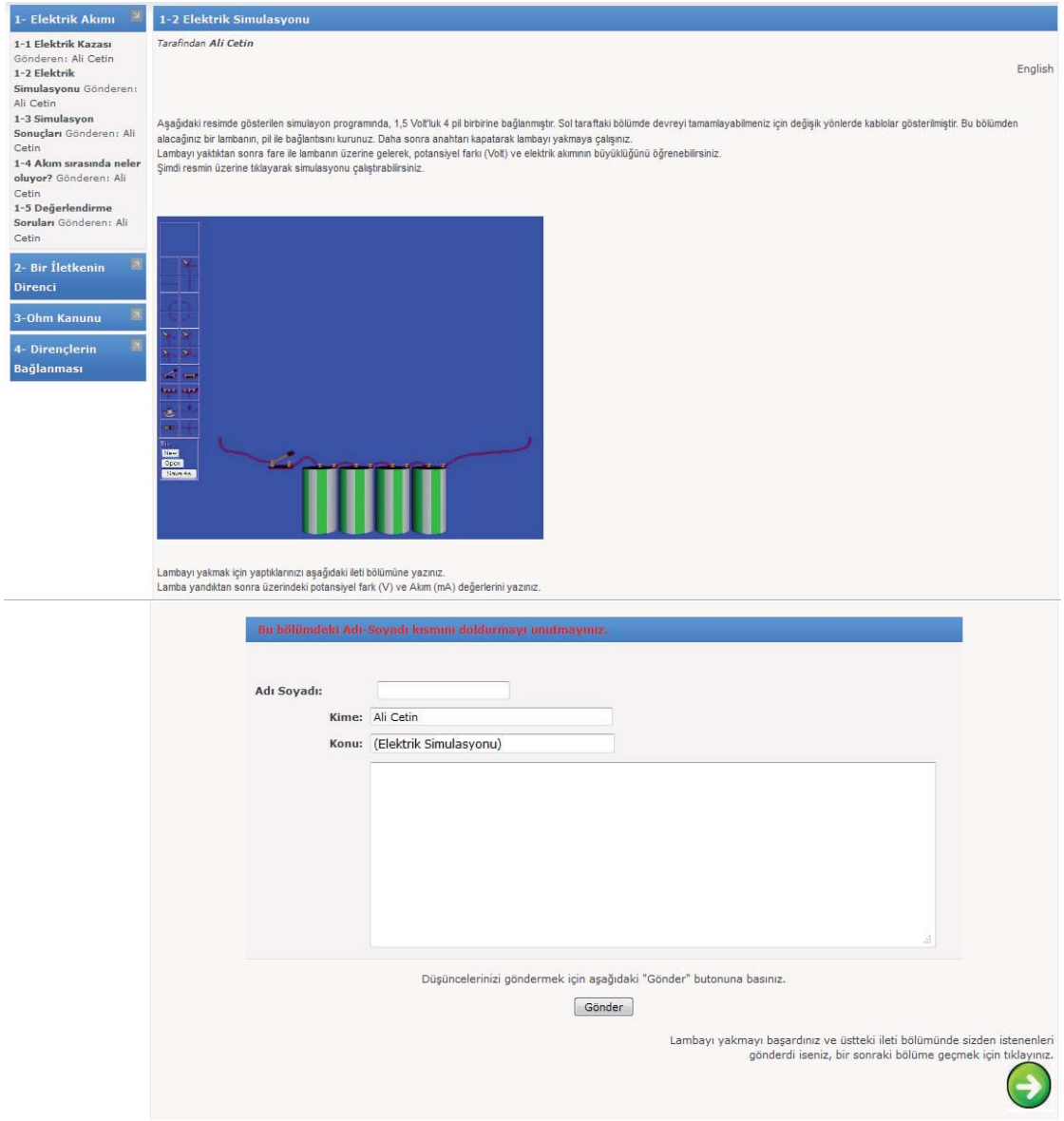
APPENDIX B-2

PAGES OF WEB BASED INQUIRY LEARNING ENVIRONMENT (WILE)

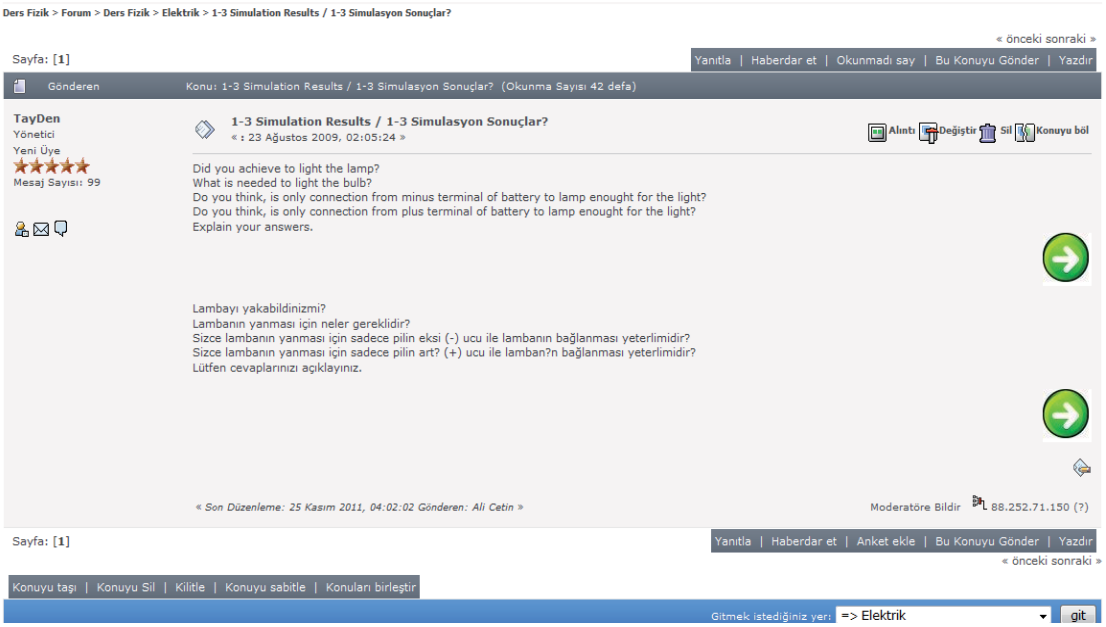
1.1 Engage Phase



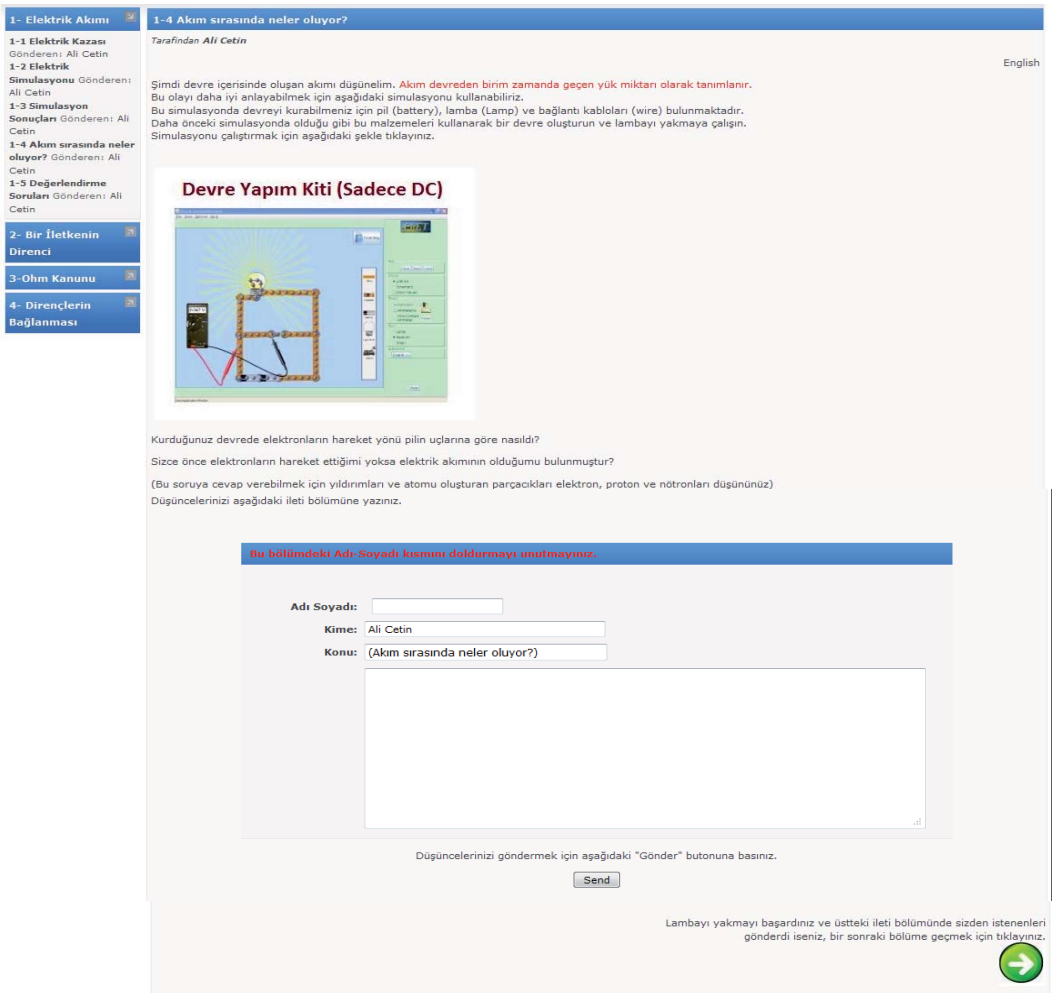
1.2 Explore Phase



1.3 Explain Phase



1.4 Elaborate Phase



1.5 Evaluation Phase

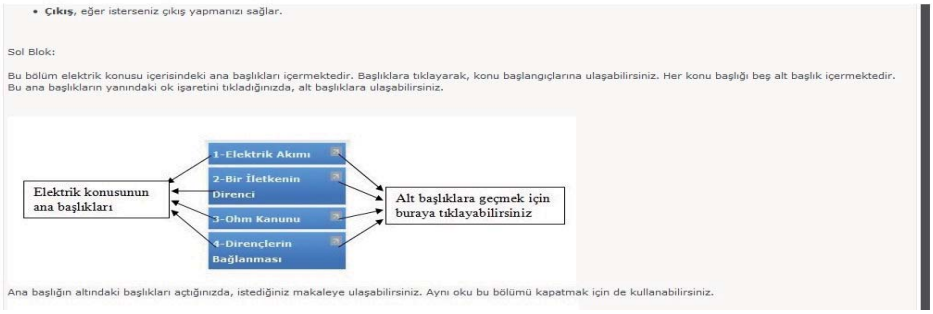
This page is the same with expository evaluation phase in Appendix B-1

APPENDIX B-3

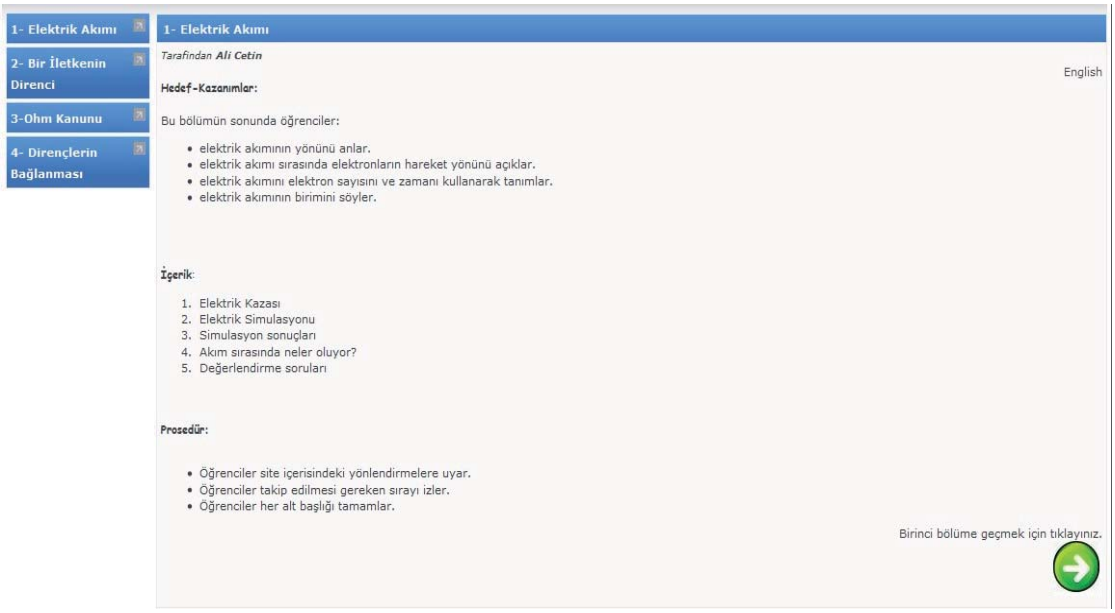
COMMON PARTS OF WEB BASED LEARNING ENVIRONMENTS

1. Data Mining

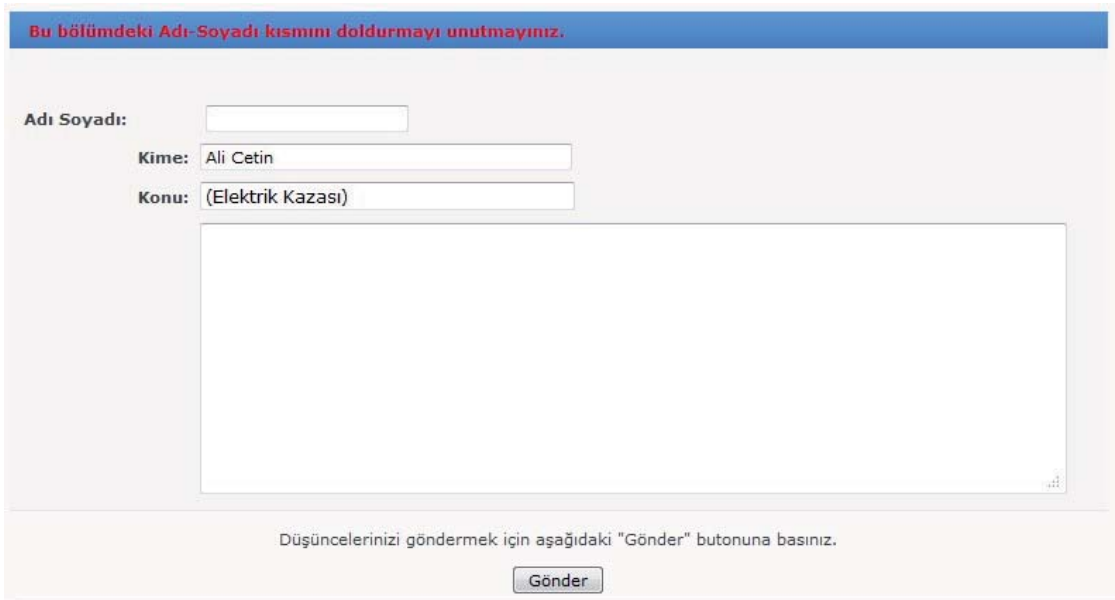
2. Introduction Pages of WILE and WELE



3. **Introduction page of each sub-topic.**



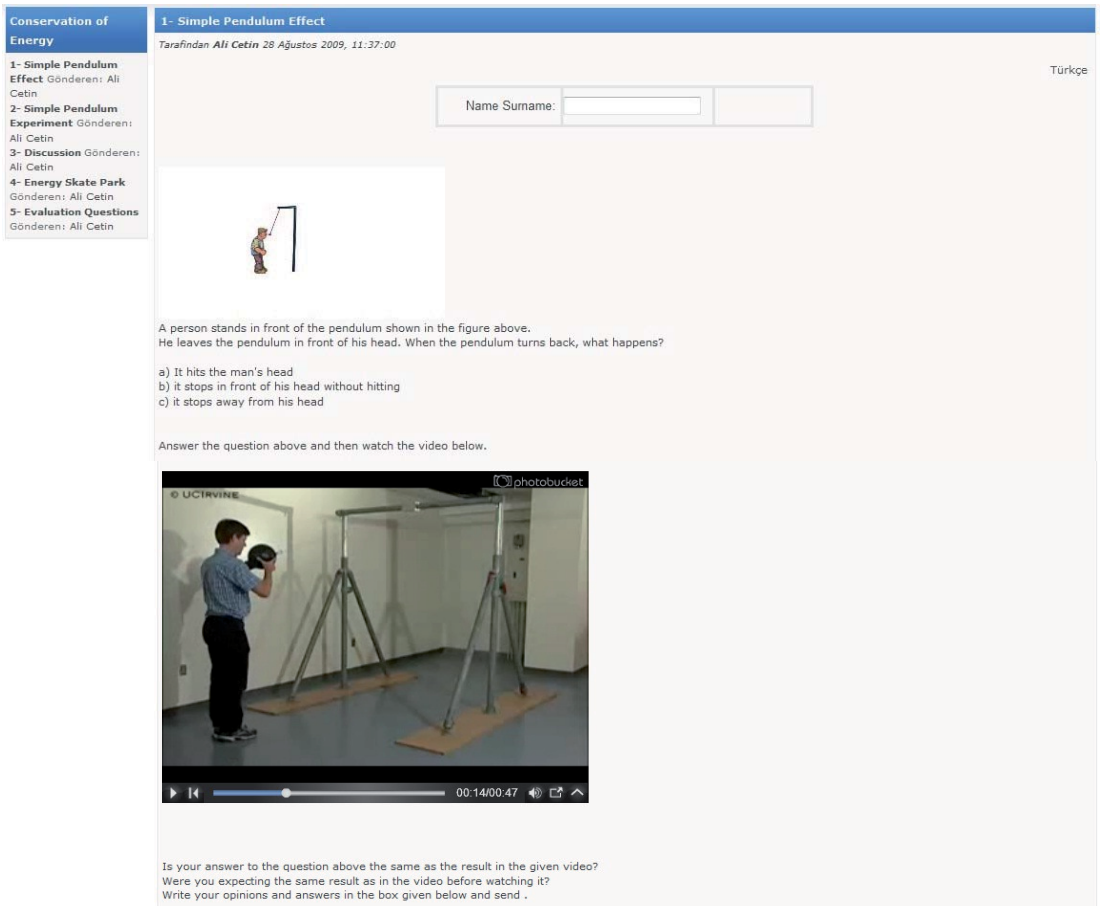
4. **Message Boards**



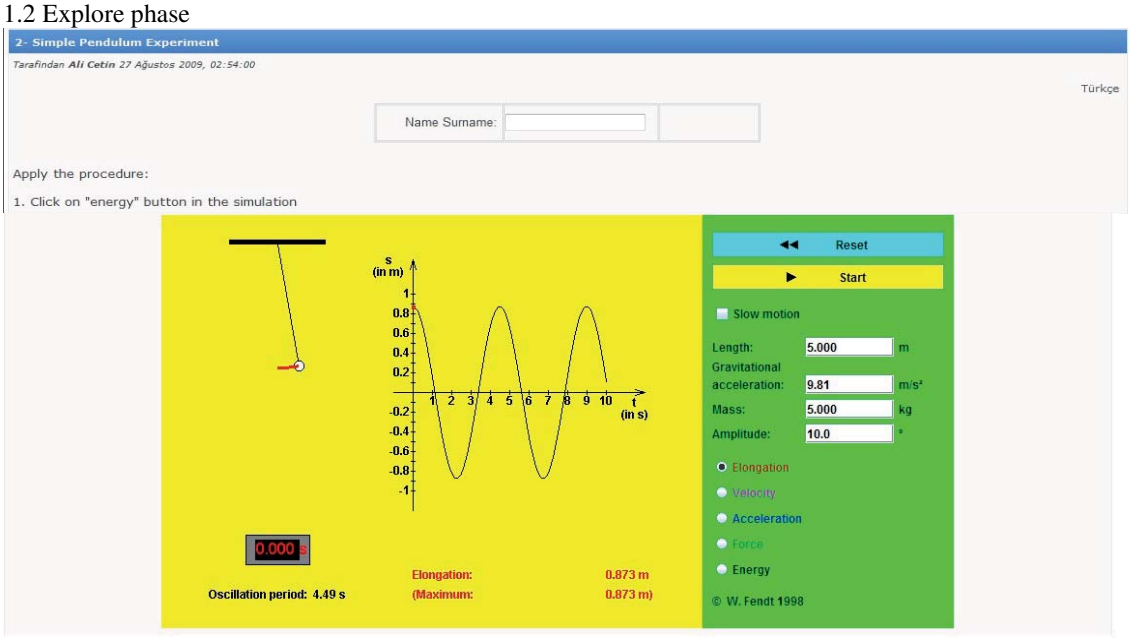
APPENDIX B-4

PAGES OF WEB BASED INQUIRY LEARNING ENVIRONMENT (WILE) IN TESTING

1.1 Engage Phase



1.2 Explore phase



2. Fill in the tables below

Adjust

Length: 5,00m
Gravitational Acceleration: 9,81 m/s^2
Amplitude: 10,0

Change mass value as in the table

Start the simulation and then pause in any time

and note the potential, kinetic and total energy values in that time.

Table 1

mass	Potential Energy	Kinetic Energy	Total Energy
2,500			
5,000			
7,500			

Adjust

Mass: 5,000 kg
Gravitational Acceleration: 9,81 m/s^2
Amplitude: 10,0

Change length value as in the table

Start the simulation and then pause in any time

and note the potential, kinetic and total energy values in that time.

Table 2

length	Potential Energy	Kinetic Energy	Total Energy
2,50			
5,00			
7,50			

Adjust

Mass: 5,000 kg
Lenght: 5,00 m
Amplitude: 10,0

Change Gravitational Acceleration value as in the table

Start the simulation and then pause in any time

and note the potential, kinetic and total energy values in that time.

Table 3

Gravitational Acceleration	Potential Energy	Kinetic Energy	Total Energy
5,00			
10,00			
15,00			

You can use below mail-box for your opinions about this part.

To: Ali Cetin

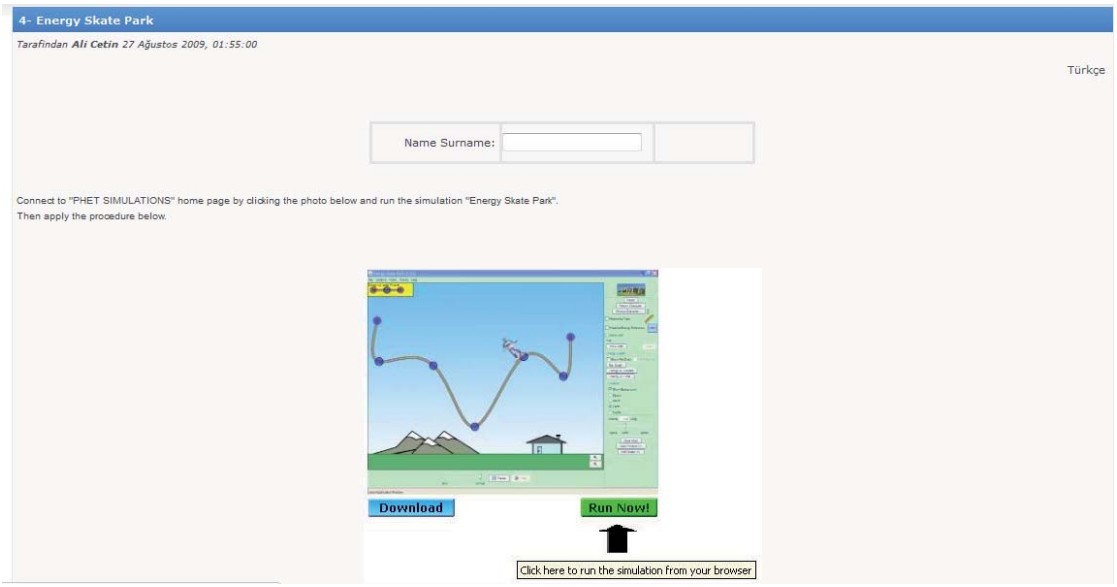
Subject: (Simple Pendulum Experiment)

Click this button to send your findings.

Send

1.3 Explain Phase

1.4 Elaborate Phase



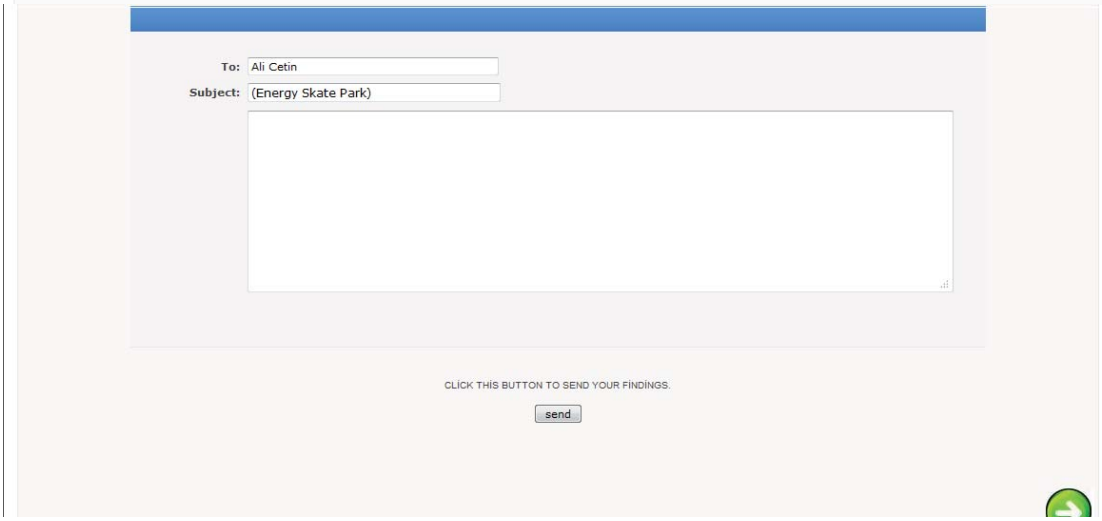
Procedure:

1. Play with the simulation a few minutes and try to understand the roles of the buttons.
2. Reset the simulation.
3. Don't change the track
4. Choose a skater
5. Click on the "show path" button. After two or three revolutions click on "stop" button.
6. Click on 5 points and note the values to the given table below.

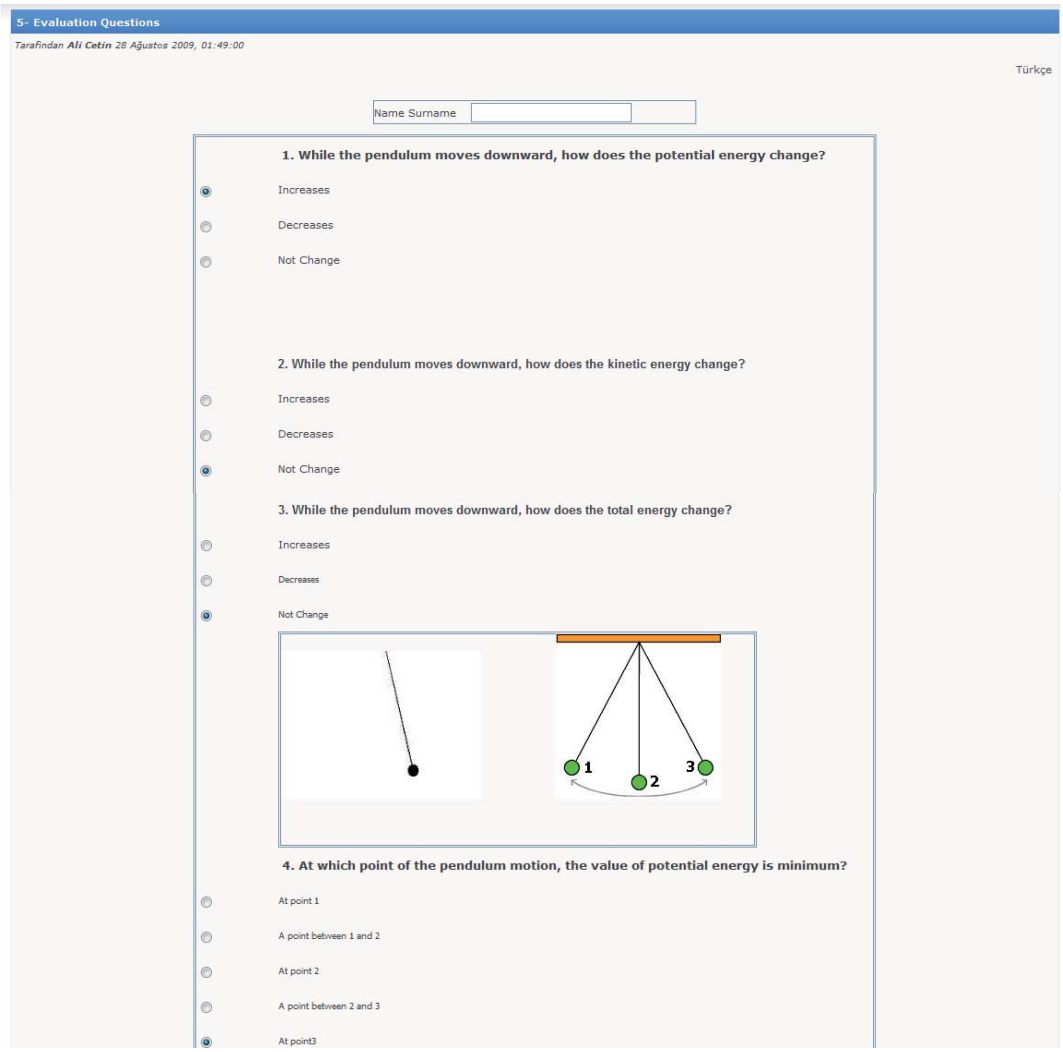
	Kinetic Energy	Potential Energy	Total Energy	Heigth	Speed
1					
2					
3					
4					
5					

Answer the questions below with the mail-box below.

What is the relationship between heigth and potential energy?
What is the relationship between speed and potential energy?



1.5 Evaluation Phase



5. At which point of the pendulum motion, the value of kinetic energy is maximum?

- At point 1
- A point between 1 and 2
- At point 2
- A point between 2 and 3
- At point 3

6. At which point of the pendulum motion, the value of velocity is maximum?

- At point 1
- A point between 1 and 2
- At point 2
- A point between 2 and 3
- At point 3

7. If the pendulum ball gets larger, which statement is the best correct?

- The potential energy of the system increases
- The kinetic energy of the system increases
- The total energy of the system increases

8....., the total energy is equal to the sum of kinetic and potential energies.

- When the ball is moving from 1 to 2
- When the ball is moving from 2 to 3
- When the ball is moving from 3 to 2
- When the ball is moving from 2 to 1
- During whole motion

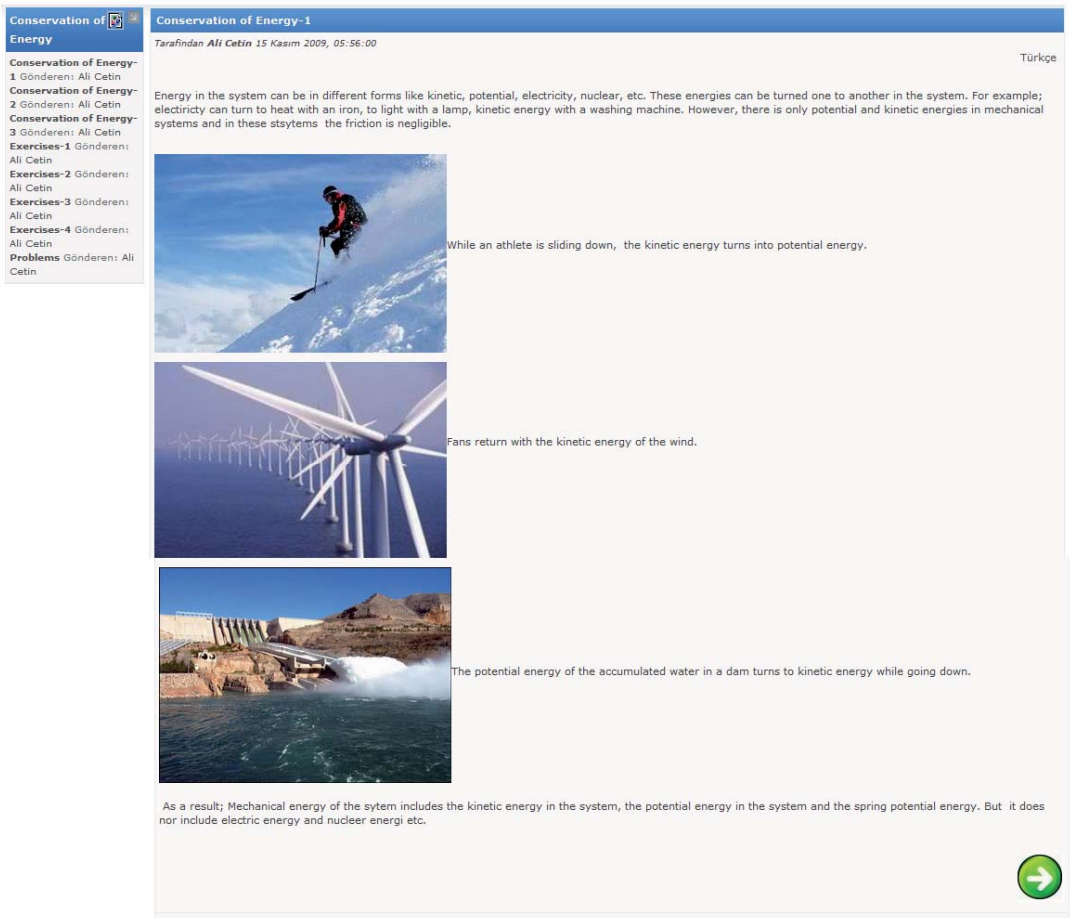
Click this button to send your findings.

Send

APPENDIX B-5

PAGES OF WEB BASED EXPOSITORY LEARNING ENVIRONMENT (WELE) IN TESTING

Conservation of Energy



Conservation of Energy -2

Conservation of Energy-2

*Tarafından **Ali Cetin** 07 Kasım 2009, 06:23:00*

Türkçe

The mechanical energy of the system can change with the external forces. So, we can write;

$$W_{External} = \Delta E_{Mechanical}$$

This is called as work-energy theorem. However, if there is no external forces acted on the system, $W_{External} = 0$;

$$0 = E_2 - E_1$$

so $E_2 = E_1$

As a result; If there is no external forces acted on the system, the mechanical energy (total energy) of the system does not change. So We can write for the conservation of mechanical energy;

$$\Sigma E_{initial} = \Sigma E_{final}$$

Here $\Sigma E_{initial}$ is the total mechanical energy of the system before the event and ΣE_{final} is the total mechanical energy of the system after the event.

- Spring forces and gravitational forces are not the external forces in the system. Because they are added to the system as the spring potential energy and gravitational potential energies. In addition to these, we can not think the perpendicular forces and normal forces as the external forces.

Conservation of Energy -3

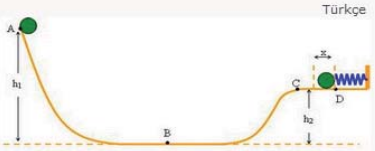
Conservation of Energy-3

*Tarafından **Ali Cetin** 15 Kasım 2009, 06:29:00*

Türkçe

To understand the law of conservation of mechanical energy, let us consider the shown figure.

An object is released from the point A and move on the frictionless surface untill to the point D. Let us write the energies of the objcet in different points in the system.



Mekanik enerjinin korunduğu bir sistem.
(Yüzeyler sürtünmesizdir)

Energy of the system at point A: The object is released (initial velocity is zero), so the kinetic energy is zero. However, the heigth of the object is h_1, so it has only potential energy. As a result;

$$E_A = m\ g\ h_1$$

Energy of the system at point B:The energy at point A is totally converted to the kinetic energy. As a result;

$$E_B = \frac{1}{2} . m . v_B^2$$

Energy of the system at point C: The object has the potential energy because of the heigth from the referans plane and kinetic energy because of the velocity at point C. As a result;

$$E_C = m\ g\ h_2 + \frac{1}{2} . m . v_C^2$$

Energy of the system at point D: The object can compress the spring untill the point D so the kintic energy at this point is zero. There is only spring potential energy at this point. As a result;

$$E_D = m\ g\ h_2 + \frac{1}{2} . k . x^2$$

The eneregy in the system is concerved so the energies are equal to each other at any two different points. As a result;

$$E_A = E_B = E_C = E_D$$

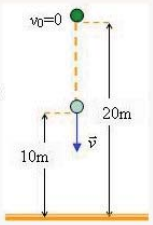
Exercise-1 and Its Solution

Exercises-1

*Tarafından **Ali Cetin** 15 Kasım 2009, 06:39:00*

Türkçe

2kg object is released from the heigth of 20 meters, what is the velocity of the object while passing from 10 meters high? (Frictions are negligible)



Solution:

Let us select the ground level as the reference plane. While the object heigth is h_1 = 20 m, it has only potential energy and its kinetic energy is zero. While the object heigth is h_2 = 10 m, it has both kinetic and potential energy. İnitial and final energies are equal to each other;

$$\Sigma E_{ilk} = \Sigma E_{son}$$

$$m\,g\,h_1 + 0 = \frac{1}{2}\,.\,m\,.\,v^2 + m\,g\,h_2$$

$$m10.\,20 + 0 = \frac{1}{2}\,.\,m\,.\,v^2 + m\,10.\,10$$

$$200m = \frac{1}{2}\,.\,m\,.\,v^2 + 100m$$

$$100m = \frac{1}{2}\,.\,m\,.\,v^2$$

$$200 = v^2$$

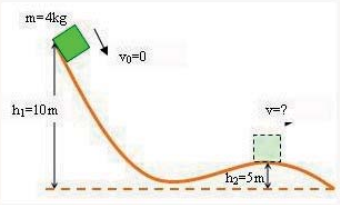
$$v = 10\sqrt{2}\ m/s$$

Exercise-2 and Its Solution

Exercises-2

*Tarafından **Ali Cetin** 15 Kasım 2009, 06:30:00*

m=4kg object is released from h_1=10m high. What is the velocity of the object, while passing from h_2=5m high?
(Frictions are negligible, g=10m/s^2)



Solution:

Let us choose as the ground level reference plane. In the first case the ball has potential energy only. In the second case the system has both potential energy and kinetic energy. According to this principle by using conservation of mechanical energy.

$$\sum E_{ilk} = \sum E_{son}$$

$$m.g.h_1 = m.g.h_2 + \frac{1}{2}.m.v^2$$

$$4.10.10 = 4.10.5 + \frac{1}{2}.4.v^2$$

$$400 = 200 + 2v^2$$

$$200 = 2v^2$$

$$v^2 = 100$$

$$v = 10 m/s$$

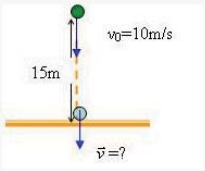
Problems

Problems

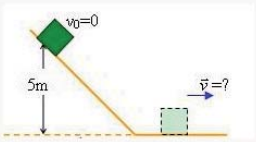
*Tarafından **Ali Cetin** 15 Kasım 2009, 07:41:00*

Türkçe

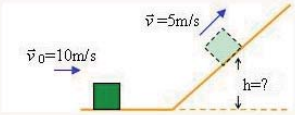
1. 2kg object is thrown with 10m/s velocity from the heigth of 15 meters. What is the final velocity of the object just before hit the ground?



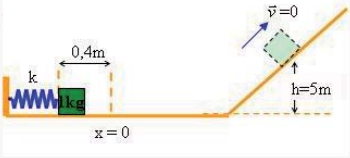
2. 2kg object is released from the heigth of 5 meters. What is the final velocity of the object when it pass to the inclined plane?



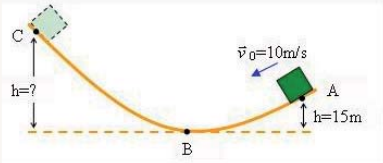
3. 2kg object is thrown with 10m/s velocity as in the figure. What is the heigth of the object, when its velocity is 5m/s?



4. 1 kg object is placed in front of the spring which is comppressed 0,4 meters as in the figure. When the spring is released, the object can reach 5meter high in the inclined plane.
a) What is the velocity of the object just after spring?
b) What is the spring coefficient "k"?



5. 2kg object is thrown with 10 m/s velocity in the heigth of 15 meters. The object can reach untill to the point C in the figure.
a) What is the velocity of the object at point B?
b) What is the heigth of C?



APPENDIX C

INTERVIEW PROTOCOL USED IN PILOT STUDY

Görüşme Tutanağı

I. Giriş

- Seni buraya bir fizik dersinde kullandığınız web-sayfası ile ilgili olarak görüşme yapmak için davet ettim. Bu bir sınav değildir, bu nedenle bana konu ile ilgili olarak görüşlerini açıklamanı veya anlatmanı istiyorum.

II. Sorular

- Daha önce hiç interneti kullanarak ders çalıştın mı?
- İnterneti en çok hangi amaç için kullanıyorsun?
- İnternette karşılaştığın web-siteleri hakkında ne düşünüyorsun?
- Bu zamana kadar interneti öğretmenlerin kullandı mı? Kulandıysalar nasıl?
- Bu çalışmayı yapmadan önce beklediğinle, çalışma sırasında gördüklerin seni tatmin etimi?
- www.dersfizik.net sitesinde gördüğün konuyu anladın mı?
- Sence bu konu sınıf ortamında mı yoksa internet temi daha iyi anlaşılır?
- Sence fizikte karşılaştığın diğer konularda bu şekilde web üzerinden anlatılabilir mi?
- Bu web sitesi senin fizik dersine olan ilgini değiştirdi mi?
- İlk bölümdeki video sence yeteri kadar ilgi çekici mi?
- Web sitesi içerisindeki en çok hangi bölümü yaparken sevdin?
- Web sitesi içerisinde başka bir siteden program indirmen gerekirken, bunu kolaylıkla yapabildin mi?
- Web sitesini kullanırken doldurduğun tablolar hakkında ne düşünüyorsun?
- Web sitesinin sonunda cevaplandırdığın, değerlendirme soruları sence konuyu tamamen ölçüyor mu?
- Enerjinin korunumu ile ilgili olarak karşına çıkacak sorulara cevap verebileceğini düşünüyor musun?
- Sence bu sitenin en iyi ve en kötü yanı nedir?
- Site içerisindeki yönlendirmeler sence yeterlimiydi?
- Sence bütün arkadaşların bu çalışmaya gereken önemi verdimi? Hayırsa neden?
- Eve gittiğinde bu siteyi tekrar açıp kaldığın yerden devam ettin mi?
- Sence bu sitenin daha etkili olması için neler yapılabilir?
- Bu çalışmaya katılmaktan zevk aldın mı?
- Site içerisinde bulunan forum bölümü kullandın mı? Kullanmadıysan neden?
  Evet ise Forum bölümünde arkadaşlarınla fizik tartışmak hoşuna gitti mi?
- Sence sınıf içersisinde yaptığımız tartışmalar mı yoksa internet ortamında yapılan forum bölümü mü daha etkili? İkisi arasında fark var mı?
- Site içerisinde bazı deneyler gerçekleştirdiniz. Sence bu deneyleri laboratuarda mı yapsak yoksa internet ortamı yapsak daha ilgi çekici ve anlaşılır olur?
- Web sitesinde karşılaştığın zorluklardan bahseder misin?
- Web sitesinin kullanımı için ayrılan süre sence yeterlimiydi?
- Sence bu siteyi geliştirmek için daha ne yapılabilir?

III. Kapanış

Buraya gelip bana bu açıklamaları yaptığın için sana teşekkür ederim. Umarım burada karşılaştıkların sana hayatının ilerleyen döneminde yardımcı olur.

Görüşme Sonuçları

- Daha önce hiç interneti kullanarak ders çalıştın mı?

Expo1	Evet. Matematik, çalışma kağıtları ve Türkçe konu anlatımı.
Expo2	Evet, deney videoları izledim.
Inqu1	Evet. İngilizce dersinde exercise yapmak için
İnqu2	Evet, sözlük olarak, araştırma yapmak için derslerde şiir v.s., matematikte.
Inqu3	Hayır.
Inqu4	Araştırma ödevlerim için.

- İnterneti en çok hangi amaç için kullanıyorsun?

Expo1	Oyun ve bazen ders (dersfizik.net)
Expo2	Ders, msn, facebook
Inqu1	Ders, oyun, video, chat.
İnqu2	Her amaçlı kullanıyorum. msn, facebook, ders v.s.
Inqu3	Oyun ve facebook.
Inqu4	Oyun ve mail.

- İnternette karşılaştığın web-siteleri hakkında ne düşünüyorsun?

Expo1	Hepsi iyi
Expo2	İsimlerini hatırlamıyor, ama yeterliler.
Inqu1	Her tür sitte var, kötü ve iyi. Kullanmayı biliyorsanız sorun yok.
İnqu2	Binlerce site çıkıyor ve çoğunun görsel yanı ve içeriği iyi değil.
Inqu3	İnternette derse zaman ayırmak istemiyorum.
Inqu4	En son sizin sitenize girdim.

- Bu zamana kadar interneti öğretmenlerin kullandı mı? Kulandıysalar nasıl?

Expo1	Evet, edebiyat, internetteki slaytlar üzerinden ders anlatılıyor.
Expo2	Evet video göstermek için kullanıyorlar.
Inqu1	Evet, slaytlar üzerinden ders anlatılıyor.
İnqu2	Bilgisayar kullanıyorlar ama interneti az kullanıyorlar.
Inqu3	6. sınıfta fen dersi için oyun sitesi yapmışlardı. Sizinkinden daha kötüydü. Sadece sorular vardı. Kimse zevk almadı.
Inqu4	Evet tarih dersinde haritaları indiriyoruz.

- Bu çalışmayı yapmadan önce beklediğinle, çalışma sırasında gördüklerin seni tatmin etimi?

Expo1	İyiydi ama daha fazla konu eklenebilir.
Expo2	Tek konu olmasını beklemiyordum. Şaşırdım..
Inqu1	Böyle bir site bekliyordum.
İnqu2	Ne çok farklı, ne de çok benzer oldu. Ben herhalde soru çözdükçe puan alacağız gibi şeyler bekledim.
Inqu3	-
Inqu4	Evet bence güzel bir site. Tekrar olsa ben girerim.

- www.dersfizik.net sitesinde gördüğün konuyu anladın mı?

Expo1	Türkçe kısmı kullanarak anladım.Konunu adı: potansiyel, kinetik enerji.
Expo2	Evet, Konun adı kuvvet hareket ti.
Inqu1	Evet anladım. Konunun adı : enerji.
İnqu2	Evet.
Inqu3	Evet. Konunun adı kuvvet ve hareket
Inqu4	Evet konuyu anladım. Mekanik enerjinin değişmediğini gözlemlemek.

- Sence bu konu sınıf ortamında mı yoksa internet temi daha iyi anlaşılır?

Expo1	İkisi de bence aynı
Expo2	Sınıf içerisinde işlenen.
Inqu1	Her ikside kullanılabilir. Hem sınıf, hem de internet.
İnqu2	İnternette bazen dikkat dağılabiliyor. Ama hareketli ve görsel olması sadece bununla ilgilendiğimizde çok faydalı.
Inqu3	Farklı olmadıklarını düşünüyorum.
Inqu4	İkisi de olur.

- Sence fizikte karşılaştığın diğer konularda bu şekilde web üzerinden anlatılabilir mi?

Expo1	Bazı konular anlatılabilir. Isı anlatılmaz diğerleri anlatılabilir.
Expo2	9. sınıf tüm konular olabilirdi.
Inqu1	Bence dersler sınıf ortamında daha iyi anlaşılıyor.
İnqu2	-
Inqu3	Olabilir. Bilmiyorum.
Inqu4	Belki sıcaklık anlatılamaz.

- Bu web sitesi senin fizik dersine olan ilgini değiştirdi mi?

Expo1	İlgimi değiştirmedi, hala aynı nötr üm.
Expo2	Zaten seviyordum. Değiştirmedi.
Inqu1	-
İnqu2	Pek ilgimi değiştirmedi.
Inqu3	İlgimi artırdı. Kay-kay simulasyonu felan çok güzeldi.
Inqu4	Seviyordum hala seviyorum.

- İlk bölümdeki video sence yeteri kadar ilgi çekici mi?

Expo1	Bizde video yoktu.
Expo2	-
Inqu1	Videoyu açamadım.
İnqu2	Hayır, hiç internete giremedim.
Inqu3	-
Inqu4	-

- Web sitesi içerisindeki en çok hangi bölümü yaparken sevdin?

Expo1	-
Expo2	-

Inqu1	Forum bölümünü.Arkadaşlarımın yaptığı yorumlara baktım.
İnqu2	Kaykaylı bölümü yapmaktan zevk aldım.
Inqu3	Kaykaylı bölümü yapmaktan zevk aldım.
Inqu4	Kaykaylı bölümü yapmaktan zevk aldım.

- Web sitesi içerisinde başka bir siteden program indirmen gerekirken, bunu kolaylıkla yapabildin mi?

Expo1	-
Expo2	-
Inqu1	Evet. Bir zorluğu yoktu.
İnqu2	Evet, hemen açıldı.
Inqu3	Evet açabildim.
Inqu4	O bölüme kadar okulda gelemedim. Evded babamla beraber yaptık.

- Web sitesini kullanırken doldurduğun tablolar hakkında ne düşünüyorsun?

Expo1	-
Expo2	-
Inqu1	-
Inqu2	Siz anlattıktan sonra kolayca değiştirip yapabildik.
Inqu3	Biraz yardımla çözülebilir. Ben Türkçe yaptım ama kendi başıma anlayamadım.
Inqu4	-

- Web sitesinin sonunda cevaplandırdığın, değerlendirme soruları sence konuyu tamamen ölçüyor mu?

Expo1	-
Expo2	-
Inqu1	Bence ölçüyordu. Girip yaptım.
İnqu2	Son bölüme kadar gelemedim.
Inqu3	Son bölüme gelemedim.
Inqu4	Son bölüme kadar gelemedim.

- Enerjinin korunumu ile ilgili olarak karşına çıkacak sorulara cevap verebileceğini düşünüyor musun?

Expo1	Evet.
Expo2	Galiba çözebilirim.
Inqu1	Evet çözebilirim.
İnqu2	Herhalde cevaplayabilirim.
Inqu3	Sorusuna bağlı.
Inqu4	-

- Sence bu sitenin en iyi ve en kötü yanı nedir?

Expo1	Teknolojiyi kullanarak daha iyi öğreniriz. Kötü yan yok.
Expo2	Bize derslerde yardımcı olması.
Inqu1	Öğretmenimizin yapmış olması iyi yanı.
İnqu2	Hem İngilizce hem de Türkçe olması. Kötü yan bilmiyorum.
Inqu3	Simulasyon ve oyunların olması
Inqu4	Simulasyonlar, kaykaylı bölüm. Baştaki soru bölümü kötüdü, ben soru sevmem.

- Site içerisindeki yönlendirmeler sence yeterlimiydi?

Expo1	Evet. Sonraki sayfaya geçişler vardı. Soru çözümleri vardı.
Expo2	Evet. Kullanım kolaydı.
Inqu1	Evet kesinlikle yeterliydi.
İnqu2	Evet kesinlikle anlaşılırdı. Her şey açıktı.
Inqu3	Bence yeterliydi. Kendim yapabildim.
Inqu4	Site içerisinde rahatça geçiş yapabildim.

- Sence bütün arkadaşların bu çalışmaya gereken önemi verdimi? Hayırsa neden?

Expo1	-
Expo2	-
Inqu1	Bazı arkadaşlarım zorlanmış olabilir.
İnqu2	Siz gözlemlediniz. Ama muhakkak iyi yapanlar olmuştur.
Inqu3	Bazı kişiler tamamlamadı galiba.
Inqu4	-

- Eve gittiğinde bu siteyi tekrar açıp kaldığın yerden devam ettin mi?

Expo1	Evet. Soruları çözdüm.
Expo2	Ben şifremi unuttum o yüzden girmedim.
Inqu1	Evet çalışmayı tamamlamak ve başka neler var bakmak için girdim.
İnqu2	Denedim son bölüm için ama internet sorunluydu açamadım.
Inqu3	Hayır açmadım.
Inqu4	Evet babamla beraber açtım ve devam ettim.

- Sence bu sitenin daha etkili olması için neler yapılabilir?

Expo1	Daha fazla konu eklenmeli, videolar ve oyunlar eklenebilir.
Expo2	Videolar eklenmeli. Kapsam değiştirilmemeli.
Inqu1	Animasyon ve videoların sayısı artırılabilir.
İnqu2	Animasyonların sayısı artırılabilir.
Inqu3	Bilmiyorum.
Inqu4	Simulasyonlu bölüm sayısı artırılabilir.

- Bu çalışmaya katılmaktan zevk aldın mı?

Expo1	Evet
Expo2	Evet sitede ders çalışmak güzeldi.
Inqu1	Evet eğlenceliydi.
İnqu2	Evet özellikle kay-kay bölümünde çok eğlendik.
Inqu3	Normal dersten daha iyiydi.
Inqu4	Evet, okuldan ayrılmayacak olsam ikinci dönem devam ederdim.

- Site içerisinde bulunan forum bölümü kullandın mı? Kullanmadıysan neden?
  Evet ise Forum bölümünde arkadaşlarınla fizik tartışmak hoşuna gitti mi?

Expo1	Forum bölümünü görmedim.
Expo2	Gördüm ama kullanmadım.
Inqu1	Evet forumları çok severim.
İnqu2	Normal bir forum sitesine göre daha basit ve öz bence daha iyi ve kullanışlı.
Inqu3	Cevapları karşılaştırmak için iyi bir bölüm.
Inqu4	Hayır görmedim.

- Sence sınıf içersisinde yaptığımız tartışmalar mı yoksa internet ortamında yapılan forum bölümü mü daha etkili? İkisi arasında fark var mı?

Expo1	Sınıf içi daha etkilidir.
Expo2	-
Inqu1	Sınıf içerisinde yapılan daha etkilidir.
İnqu2	İnternet ortamında çünkü sınıf ortamında kaçırabiliyorsunuz ama internet te dönüp tekrar bakabiliyorsunuz.
Inqu3	Bence fark yok. Sadece içerik farklı.
Inqu4	-

- Site içerisinde bazı deneyler gerçekleştirdiniz. Sence bu deneyleri laboratuarda mı yapsak yoksa internet ortamı yapsak daha ilgi çekici ve anlaşılır olur?

Expo1	-
Expo2	-
Inqu1	-
İnqu2	Fizik labında yapılan deneyler üç boyutlu anlayabilmek için daha uygun ama bundan sıkılanlar da oluyor. Onlar için bilgisayar daha iyi.
Inqu3	Üç boyutlu yaparsak daha etkili olabilir.Ama bilgisayarın değerleri göstermesi daha kolay ve anlaşılır.
Inqu4	-

- Web sitesinde karşılaştığın zorluklardan bahseder misin?

Expo1	Üye olmakta zorlandık, bir sorun vardı.
Expo2	Hiçbir zorluğu yoktu.
Inqu1	Benim için yoktu.
İnqu2	Her şeyi anlayabildim. Yoktu.
Inqu3	Tabloların üzerine adımı yazmayı unuttum. O şekilde gönderdim.Tabloları doldururken zorlandım.
Inqu4	Eve gidince java yüklemem gerekti.

- Web sitesinin kullanımı için ayrılan süre sence yeterlimiydi?

Expo1	75-80 dakika lazım yetiştiremedik.
Expo2	Önce okudum, sonra anlamadığım yerleri tekrar okudum. Problemlerin yarısında süre bitti. Süre yeterli değildi.
Inqu1	Bence yeterliydi. Ben açıklama kısmı yüzünden yetiştiremedim. 5 dakikam daha olsaydı siteyi burada bitirebilirdim.
İnqu2	İlk kullanım olduğu için yetiştiremedim. Tabloları geri tuşuna basınca kaybettim. Ama ikinci kullanımda yetiştirlebilir.
Inqu3	İki ders saati yapılabilir.
Inqu4	Bana göre süre yeterli değildi.

- Sence bu siteyi geliştirmek için daha ne yapılabilir?

Expo1	Üye yeri açılabilir, google a reklam verilebilir, videolar eklenebilir.
Expo2	Videolar eklenebilir.
Inqu1	Görsel şeylerin sayısı artırılabilir.
İnqu2	Resimler eklenebilir. Animasyonların sayısı artırılabilir.
Inqu3	Dili anlayamadım. Daha sade bir dil kullanılabilir.
Inqu4	Simulasyon ve alıştırmalar eklenebilir.

APPENDIX D-1

GOALS AND OBJECTIVES OF MINISTRY OF EDUCTAOIN ABOUT ELECTRICITY

9. Sınıf Üniteler

E. Öğrenci Kazanımları

5. ÜNİTE: ELEKTRİK VE MANYETİZMA

KAZANIMLAR	AÇIKLAMALAR
1. Elektrik akımı ile ilgili olarak öğrenciler; 1.1 Potansiyel farkını, bir iletkenin iki ucu arasında akım oluşmasına neden olabilecek enerji farkının bir göstergesi olarak ifade edildiğini hatırlayarak basit bir elektrik devresindeki rolünü açıklar (BİB-4.c,d). 1.2 Bir iletkenin üzerinden geçen akım ile iletkenin uçları arasındaki potansiyel farkı arasındaki ilişkiyi deneyerek keşfeder (PÇB-1.e,f,g 2.a,c,d,f, 3.a,b,c,d,f,h). 1.3 Bir iletkenin direncinin bağlı olduğu faktörleri deneyle gösterir (PÇB-1.e,f,g 2.a,c,d,f, 3.a,b,c,d,f,h). 1.4 Seri ve paralel devrelerde akım, direnç ve potansiyel farkı arasındaki ilişkiyi deneyerek gösterir (PÇB-1.e,f,g 2.a,c,d,f, 3.a,b,c,d,f,h).	**[!] 1.1** Elektrik devrelerinde elektrik enerjisi kaynaklarının bir potansiyel farkı oluşturduğu ve Potansiyel farkının gerilim olarak da adlandırılabildiği vurgulanır. **[!] 1.1** Öğrenciler, evlerindeki veya okullarındaki elektrik prizlerine çeşitli maddeleri sokmamaları ve bunun tehlikeleri konusunda uyarılır. Yalıtkan maddelerin bazı durumlarda iletken olabilecekleri vurgulanır. ??? **1.2** "Elektrik akımı yüklerin pilin pozitif kutbundan çıkıp negatif kutbuna doğru hareket eder", " Akım elektrik devre elemanları tarafından tüketilir." ve "Akım pilin pozitif ve negatif kutbundan çıkıp ampul üzerinde çarpışır." **[!] 1.2** Akım, potansiyel fark ve enerji kavramlarının aynı şeyler olmadığı etkinliklerle fark ettirilmelidir. **[!] 1.2** Öğrenciler Ohm yasasını keşfedecekleri devreleri kurarken ampermetre, voltmetre, reosta gibi devre elemanlarının bağlanma şekillerinin gerekçeleri konusunda temel bilgiler verilmelidir. **1.3** Öğrenciler 7. sınıf Fen ve Teknoloji dersinde iletkenin direncinin dik kesit, cins ve uzunluğa göre değişimini bir ampulün parlaklığını gözlemleyerek irdelemişti. Bu düzeyde ise voltmetre ve ampermetre kullanarak kuracakları bir elektrik devresi ile keşfeder. **1.2 ve 1.3** R=V/I, R=ρ. *l/A* formülleri kavramlar arasındaki ilişkiyi ifade etme kolaylığı sağlayacağından bu düzeyde verilmelidir. ??? **1.4** "Seri bağlı ampuller paralel bağlı ampullerden her zaman daha parlak yanarlar" ve "Paralel bağlı ampuller seri bağlı ampullerden her zaman daha parlak yanarlar"

: Ders İçi İlişkilendirme, : Diğer Derslerle İlişkilendirme, ???: Kavram Yanılgısı, [!]: Uyarı, : Sınırlamalar

APPENDIX D-2

OBJECTIVE LIST OF ELECTRICITY ACHIEVEMENT TEST

Kazanım Listesi

1. Verilen elektrik devrelerinin içinden açık ve kapalı olması durumuna bakarak elektrik enerjisinin iletildiği devreyi seçer.
2. Kaplı devre tanımını yapar.
3. Elektrik devresinde elektrik akımının yönünü pilin uçlarını kullanarak ifade eder.
4. Elektrik akımının tanımını yapar.
5. Elektrik devresinde pilin görevini tanımlar.
6. Devreden geçen elektron sayısını I=q/t formülünü kullanarak hesaplar.
7. Direnç büyüklüğünün iletkenin hangi fiziksel özelliklere bağlı olduğunu açıklar.
8. Direnç büyüklüğünün iletkenin boyu ile ilişkisini açıklar.
9. Direnç büyüklüğünü bağlı değişkenleri kullanarak hesaplar.
10. Potansiyel fark – Akım grafiğine göre direnç değerini hesaplar.
11. Elektrik devresinde, direnç sabit kalmak koşulu ile, pilin voltu arttıkça akımın artacağını bilir.
12. Elektrik devresinde, potansiyel sabit kalmak koşulu ile, direnç değişiminin akımı üzerine etkisini hesaplar.
13. Elektrik devresinde , potansiyel sabit kalmak koşulu ile, direnç değişiminin akımı ne şekilde değiştirdiğini açıklar.
14. Elektrik devrelerinde ampermetrenin ne şekilde kullanıldığını bilir.
15. Elektrik devrelerinde voltmetrenin ne şekilde kullanıldığını bilir.
16. Seri ve paralel bağlı elektrik devrelerini ayırt eder ve bu devrelerde eşdeğer dirençleri hesaplar.
17. Seri bağlı elektrik devrelerinde Ohm kanununu kullanarak devreden geçen elektrik akımını hesaplar.
18. Seri bağlı elektrik devrelerinde eşdeğer direncin nasıl hesaplandığını açıklar.
19. Seri bağlı elektrik devrelerinde dirençlerin üzerine düşen potansiyel farkı ayrı ayrı hesaplayabilir.
20. Paralel bağlı elektrik devrelerinde akımın kollara nasıl dağıldığını açıklar.
21. Paralel bağlı elektrik devrelerinde Ohm kanununu kullanarak devreden geçen elektrik akımını hesaplar.
22. Paralel bağlı elektrik devrelerinde eşdeğer direncin nasıl hesaplandığını açıklar.
23. Paralel bağlı elektrik devrelerinde dirençlerin üzerine düşen potansiyel farkı ayrı ayrı hesaplayabilir.
24. Karışık bağlı elektrik devrelerinde kollardan geçen akımı hesaplar.
25. Karışık bağlı elektrik devrelerinde dirençlerin üzerine düşen potansiyel farkı ayrı ayrı hesaplayabilir.
26. Paralel ve seri bağlı elektrik devrelerinde lambaların parlaklıkları ile kollardan geçen akım arasında ilişki kurar.

APPENDIX D-3

TABLE OF TEST SPECIFICATIONS OF ELECTRICITY ACHIEVEMENT TEST

Kazanım Düzeyi / Konu	**Bilme** Kazanım No (Soru No)	**Kavrama** Kazanım No (Soru No)	**Uygulama** Kazanım No (Soru No)	**Analiz** Kazanım No (Soru No)	**Sentez**	**Değer-lendirme**	**Toplam** Kazanım Sayısı (Soru Sayısı)	**Yüzdelik** Kazanım Yüzdesi (Soru Yüzdesi)
1. ELEKTRİK AKIMI **a.** Elektrik akımının meydana gelişi **b.** Bir İletkendeki Akım Şiddeti	2 (27) 3 (20,21) 4 (1) 5 (19)		6 (3)	1 (2)			6 (7)	22 (23)
2. BİR İLETKENİN DİRENCİ	7 (4) 8 (28)		9 (5,6)				3(4)	13(13)
3. OHM KANUNU	11 (22) 14 (17) 15 (18)		10 (7) 12 (8)	13 (10)			6(6)	23 (20)
4.DİRENÇLERİN BAĞLANMASI **a.** Dirençlerin Seri Bağlanması **b.** Dirençlerin Paralel Bağlanması **c.** Dirençlerin karışık Bağlanması	18 (23) 22 (25) 23 (29)	17 (24) 20 (12) 21 (26)	16 (11) 19 (9) 24 (13,14) 25 (15,16)	26 (30)			11 (13)	42 (44)
Toplam	12 (13)	3 (3)	8 (11)	3 (3)			26 (30)	100 (100)
Yüzdelik	46 (42)	12 (13)	30 (35)	12 (10)	0	0	100	100 (100)

APPENDIX D-4

ELECTRICITY ACHIEVEMENT TEST (EAT)

Elektrik Ünitesi Başarı Testi

Sevgili öğrenciler,

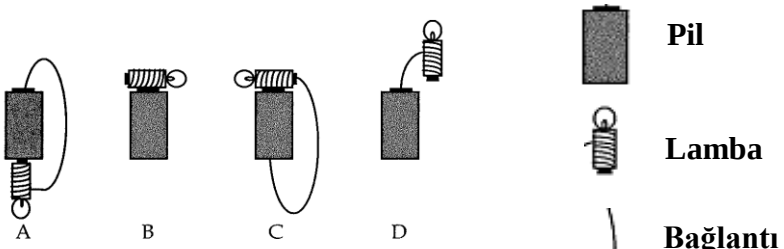
Bu test "Elektrik" ünitesindeki "Elektrik Devreleri" konusu ile ilgili olarak hazırlanmış 16 çoktan seçmeli, 10 eşleştirme ve 4 doğru-yanlış olmak üzere toplam 30 adet sorudan oluşan bir testtir.

Testin sonuçları sizlere daha iyi ve anlaşılır bir fizik dersinin geliştirilmesine katkıda bulunabileceğinden önem taşımaktadır. Aldığınız notlar kesinlikle ortalamanızı etkilemeyecektir. Lütfen tüm soruları cevaplamaya çalışınız. Sınav süresi 40 dakikadır. Katılımınız için teşekkür ederim.
Açıklama: testin cevaplarını sizlere dağıtılan cevap kâğıtlarına işaretleyiniz.

1. Elektrik Akımını aşağıdaki ifadelerden hangisi en iyi şekilde tanımlar?

A) Pozitif yüklerin iletken üzerindeki hareketi
B) Negatif yüklerin iletken üzerindeki hareketi
C) Nötronların iletken üzerindeki hareketi
D) Atomların iletken üzerindeki hareketi
E) Pozitif (+) ve negatif (-) yüklerin iletken üzerinde hareketi

2.



Yukarıdaki devrelerin hangisinde veya hangilerinde lamba yanar?

A) Yalnız A B) Yalnız C C) Yalnız D D) A ve C E) B ve D

3. Bir elektrik devresinden 1,6 Amper'lik akım geçtiğinde devre kesitinden 1 saniye içerisinde geçen elektron sayısı kaçtır? (1 elektronun yükü = 1,6. 10^{-19} coulomb)

A) 10^{-19} B) 10^{+19} C) 10^{+20} D)10^{-20} E) 10^{+18}

4. İletken bir telin direnci aşağıdakilerden hangilerine bağlıdır?

I. Boyuna
II. Cinsine
III. Kesit Alanına

A) Yalnız I B) Yalnız II C) Yalnız III D) I ve II E) I, II ve III

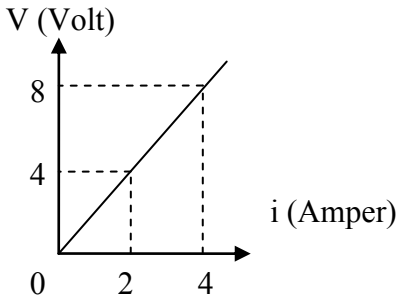
5. Öz direnci 4.10^{-5} Ω.m, boyu 3 metre ve kesit alanı 2 m^2 (metrekare) olan bir levhanın direnci kaç Ω dur?

A) 10^{-5} B) $6.\ 10^{-5}$ C) 7.10^{-5} D)12.10^{-5} E) 24.10^{-5}

6. Bir iletken telin uzunluğu 4, çapı 2 katına çıkarıldığında direnci ilk direncinin kaç katına çıkar?

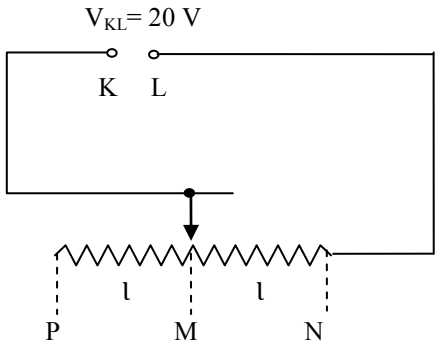
A) 1 B) 2 C) 4 D)8 E) 16

7. Potansiyel fark (V)-Akım (A) grafiği verilen devrenin direnci kaç Ω dur?



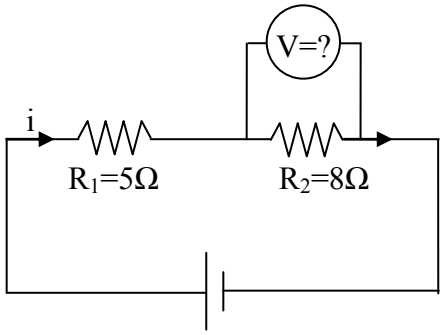
A) 1 B) 2 C) 4 D)8 E) 16

8. Şekildeki ayarlı direncin uçları arasında 20 V uygulanmıştır. Ayarlı direncin hareketli ucu M noktasında iken 2 A akım geçiyor. Hareketli uç P noktasına getirilerek direnç iki katına çıkarıldıktan sonra dirençten kaç A akım geçer?



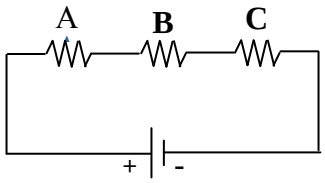
A) 1 B) 2 C) 4 D)10 E) 20

9. Şekildeki devre parçasında R_1=5 Ω direnç üzerinden 2A akım geçmektedir. Buna göre; R_2=8 Ω direncin uçları arasındaki potansiyel fark kaç volttur?



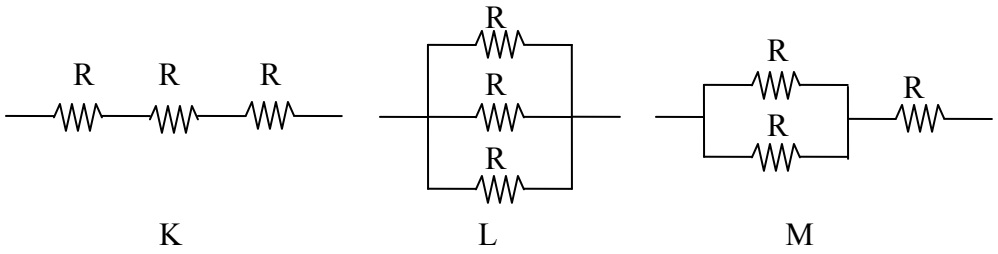
A) 16 B) 12 C) 10 D) 8 E) 4

10. Şekildeki devredeki A direncinin yerine daha yüksek direnç konulduğunda, devredeki akım bu değişiklikten nasıl etkilenir?



A) Devredeki akımda değişiklik olmaz, çünkü pil aynı akımı sağlamaya devam eder.
B) B ve C üzerindeki akımlar eşit olarak azalır, çünkü devredeki toplam direnç artar.
C) Sadece B ve C nin akımları değişir, çünkü B ve C dirençleri A dan sonra yer almaktadır.
D) B ve C bu durumdan etkilenmez, çünkü A da yapılan değişiklik sadece o bölgeyi etkiler.
E) C deki akım B dekinden azdır, çünkü akım yoluna harcanarak devam eder.

11.

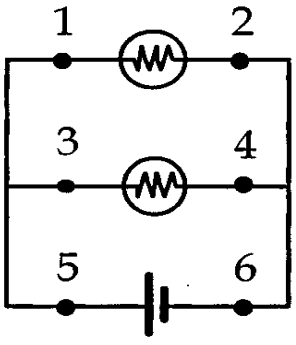


Şekildeki K, L, M devre parçaları özdeş dirençlerle oluşturulmuştur. K devre parçasının eşdeğer direnci R_K, L ninki R_L, M ninki de R_M dir. Buna göre R_K, R_L, R_M arasındaki ilişki nedir?

A) $R_K < R_M < R_L$ B) $R_K < R_L < R_M$ C) $R_L < R_M < R_K$

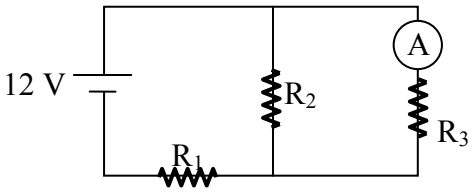
D) $R_K < R_L = R_M$ E) $R_M < R_K = R_L$

12. 1, 2, 3, 4, 5, ve 6 noktalarından geçen akımları büyükten küçüğe doğru sıralayınız. (Lambalar özdeştir.)



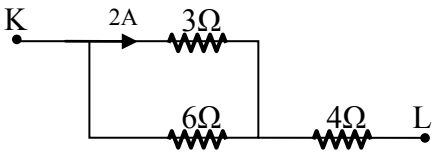
A) 5> 1> 2> 3> 4> 6
B) 5> 3> 1> 4> 2> 6
C) 5=6 > 3=4> 1=2
D) 5=6> 1=2=3=4
E) 1=2=3=4=5=6

13. Şekildeki elektrik devresinde R_1=2 Ω R_2=3 Ω R_3=6 Ω dur.Buna göre; ampermetre hangi değeri gösterir?



A) 1 B) 2 C) 4 D) 8 E) 12

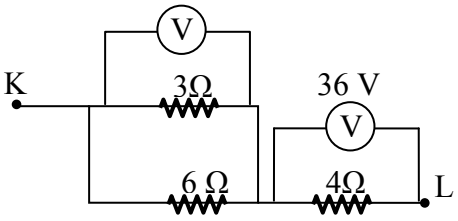
14.



Şekildeki devre parçasında 3 Ω luk dirençten 2 A lık akım geçtiğine göre K ve L noktaları arasındaki potansiyel farkı bulunuz. (Revised Version: Şekildeki devre parçasında 3 Ω luk dirençten 2 A lık akım geçtiğine göre K ve L noktaları arasındaki potansiyel farkı kaç Volt'tur?)

A) 6 B) 12 C) 18 D) 24 E) 30

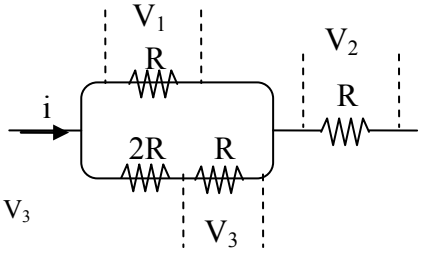
15.



Şekildeki devre parçasında 4 Ω luk direncin uçlarına bağlanan voltmetre 36 V gösterdiğine göre 3Ω luk direncin uçlarına bağlı voltmetre kaç voltu gösterir?

A) 6 B) 12 C) 18 D) 24 E) 30

16. Şekildeki devre parçasından i şiddetinde elektrik akımı geçmektedir. Buna göre, R dirençlerinin uçları arasındaki V_1 , V_2 , V_3 potansiyel farkları arasında nasıl bir ilişki vardır?



A) $V_2 < V_1 < V_3$ B) $V_3 < V_1 < V_2$ C) $V_2 < V_1 = V_3$
D) $V_1 = V_3 < V_2$ E) $V_1 = V_2 = V_3$

17-26 arasındaki boşluklara aşağıdaki tabloda verilen kelimeleri doğru şekilde yerleştirin. Cevap anahtarınızda bu bölüm için ayrılan kısmı uygun kelimelerin yanındaki harfleri yazarak doldurunuz. Bu bölümdeki aynı kelimeyi birden fazla kullanabilirsiniz.

(A)Pozitif	**(B)Negatif**	**(C)Doğru**	**(D)Ters**
(E)Artar	**(F)Azalır**	**(G)Değişmez**	**(H)Ampermetre**
(I)Voltmetre	**(J)Pil**		

(17) _____ elektrik devrelerine seri olarak bağlanır ve elektrik akımını ölçer.
(18) _____ elektrik devrelerine paralel olarak bağlanır ve potansiyel farkı ölçer.
Elektrik devrelerinde kimyasal enerjiyi elektrik enerjisine çeviren devre elemanına (19)_____ denir.
Kabul edilen elektrik akımı pilin (20)_____ ucundan (21)_____ ucuna doğrudur.

(Revised Version: Bir pilin iki ucu arasına iletken bir tel bağlandığında, **tel üzerinden geçen** elektrik akımının pilin (20)_____ ucundan (21)_____ ucuna doğru **hareket ettiği kabul edilir**.)
Ohm kanununa göre kullanılan pilin potansiyel farkı ile akım şiddeti arasında (22)_____ orantı vardır..
(Revised Version: Ohm kanununa göre kullanılan pilin potansiyel farkı ile **devreden geçen** akım şiddeti arasında (22)_____ orantı vardır.)
Seri bağlı devrelerde, direnç sayısı arttıkça eşdeğer (toplam) direnç değeri (23)_____ ve devreden geçen akım miktarı (24)_____.
Paralel bağlı devrelerde, direnç sayısı arttıkça eşdeğer (toplam) direnç değeri (25)_____ ve anakoldan geçen akımın büyüklüğü (26)_____ .

27-30 arasındaki soruları okuduktan sonra cevap anahtarınızda doğru olduğunu düşündüğünüz cümleler için "D" harfini, yanlış olduğunu düşündüğünüz cümleler için "Y" harfini yuvarlak içine alınız.

Doğru Yanlış
27. __D__ __Y__ Elektrik akımının oluşabilmesi için bir pilin sürekliliği olan iletken bir yola bağlı olması gereklidir.

(Revised Version: Elektrik akımının oluşabilmesi için bir pilin **iki ucu arasında** sürekliliği olan iletken bir **tele** bağlı olması gereklidir.)

28. __D__ __Y__ Bir iletkenin boyu artarsa direnç değeri de doğru orantılı olarak artar.
29. __D__ __Y__ Paralel bağlı devrelerde dirençlerin uçları arasındaki potansiyel farklar aynıdır.

(Revised Version: Elektrik devrelerinde, paralel bağlı dirençlerin uçları arasındaki potansiyel farklar aynıdır.)
30. __D__ __Y__ Evlerimizdeki lambalar birbirlerine seri olarak bağlanmışlardır.

(Revised Version: Evlerimizdeki lambalar birbirlerine seri olarak bağlanmışlardır. **(her lamba ayrı bir elektrik düğmesi ile yanmaktadır)**)

Elektrik Ünitesi Başarı Testi Cevap Kağıdı

Adı Soyadı:
Okulu:
Sınıfı:
Cinsiyeti: Kız ☐ Erkek ☐
I. Dönem Fizik Notu:

Soru Numarası	Cevaplar A. B. C. D. E.	Soru Numarası	Cevaplar A. B. C. D. E.	Soru Numarası	Cevaplar
1	○ ○ ○ ○ ○	11	○ ○ ○ ○ ○	21	A B C D E F G H I J
2	○ ○ ○ ○ ○	12	○ ○ ○ ○ ○	22	A B C D E F G H I J
3	○ ○ ○ ○ ○	13	○ ○ ○ ○ ○	23	A B C D E F G H I J
4	○ ○ ○ ○ ○	14	○ ○ ○ ○ ○	24	A B C D E F G H I J
5	○ ○ ○ ○ ○	15	○ ○ ○ ○ ○	25	A B C D E F G H I J
6	○ ○ ○ ○ ○	16	○ ○ ○ ○ ○	26	A B C D E F G H I J
7	○ ○ ○ ○ ○	17	A B C D E F G H I J	27	D Y
8	○ ○ ○ ○ ○	18	A B C D E F G H I J	28	D Y
9	○ ○ ○ ○ ○	19	A B C D E F G H I J	29	D Y
10	○ ○ ○ ○ ○	20	A B C D E F G H I J	30	D Y

APPENDIX D-5

ITEMAN OUTPUT FOR POSTEST OF ELECTRICITY ACHIEVEMENT TEST

MicroCAT (tm) Testing System
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Item and Test Analysis Program -- ITEMAN (tm) Version 3.00

Item analysis for data from file postdata.Dat Page 1

Item Statistics					Alternative Statistics				
Seq. No.	Scale -Item	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
1	0-1	0.455	0.568	0.452	A	0.102	-0.181	-0.107	
					B	0.455	0.568	0.452	*
					C	0.010	-0.406	-0.107	
					D	0.061	-0.047	-0.024	
					E	0.299	-0.013	-0.010	
					Other	0.073	-1.000	-0.661	
2	0-2	0.519	0.343	0.273	A	0.213	0.191	0.136	
					B	0.166	0.002	0.001	
					C	0.032	-0.269	-0.109	
					D	0.519	0.343	0.273	*
					E	0.003	-0.668	-0.115	
					Other	0.067	-1.000	-0.668	
3	0-3	0.242	0.315	0.230	A	0.271	0.277	0.206	
					B	0.242	0.315	0.230	*
					C	0.073	-0.076	-0.040	
					D	0.092	-0.018	-0.010	
					E	0.051	-0.249	-0.119	
					Other	0.271	-0.455	-0.339	
4	0-4	0.895	1.000	0.693	A	0.006	-0.303	-0.068	
					B	0.016	-0.522	-0.166	
					C	0.003	-0.101	-0.017	
					D	0.010	-0.600	-0.158	
					E	0.895	1.000	0.693	*
					Other	0.070	-1.000	-0.665	
5	0-5	0.481	0.491	0.391	A	0.029	-0.279	-0.109	
					B	0.481	0.491	0.391	*
					C	0.073	-0.058	-0.031	
					D	0.115	-0.002	-0.001	
					E	0.140	0.046	0.030	
					Other	0.162	-0.729	-0.486	

6	0-6	0.086	0.222	0.124	A	0.086	0.222	0.124	*
					B	0.525	0.469	0.374	?
		CHECK THE KEY			C	0.118	-0.037	-0.023	
		A was specified, B works better			D	0.143	-0.115	-0.074	
					E	0.019	0.024	0.008	
					Other	0.108	-1.000	-0.610	
7	0-7	0.768	0.825	0.597	A	0.006	-0.026	-0.006	
					B	0.768	0.825	0.597	*
					C	0.096	0.003	0.002	
					D	0.022	-0.607	-0.218	
					E	0.022	-0.588	-0.212	
					Other	0.086	-1.000	-0.673	
8	0-8	0.478	0.577	0.460	A	0.478	0.577	0.460	*
					B	0.032	0.100	0.041	
					C	0.118	-0.082	-0.050	
					D	0.150	-0.062	-0.041	
					E	0.064	-0.204	-0.104	
					Other	0.159	-0.745	-0.494	
9	0-9	0.487	0.603	0.481	A	0.487	0.603	0.481	*
					B	0.057	-0.348	-0.172	
					C	0.134	0.043	0.027	
					D	0.051	-0.111	-0.053	
					E	0.080	-0.101	-0.055	
					Other	0.191	-0.672	-0.466	
10	0-10	0.385	0.576	0.453	A	0.236	0.069	0.050	
					B	0.385	0.576	0.453	*
					C	0.102	-0.268	-0.158	
					D	0.070	-0.071	-0.037	
					E	0.096	0.000	0.000	
					Other	0.111	-0.972	-0.586	
11	0-11	0.729	0.899	0.670	A	0.073	-0.115	-0.061	
					B	0.061	-0.474	-0.239	
					C	0.729	0.899	0.670	*
					D	0.019	-0.072	-0.025	
					E	0.019	-0.350	-0.119	
					Other	0.099	-1.000	-0.687	
12	0-12	0.382	0.561	0.440	A	0.038	-0.153	-0.066	
					B	0.089	-0.092	-0.052	
					C	0.182	-0.071	-0.049	
					D	0.382	0.561	0.440	*
					E	0.159	0.123	0.082	
					Other	0.150	-0.847	-0.553	
13	0-13	0.204	0.511	0.359	A	0.204	0.511	0.359	*
					B	0.226	0.240	0.172	
					C	0.194	0.019	0.013	
					D	0.064	-0.081	-0.041	
					E	0.143	-0.100	-0.064	
					Other	0.169	-0.751	-0.505	

14	0-14	0.150	0.290	0.189	A	0.178	-0.068	-0.047	
					B	0.322	0.287	0.220	?
		CHECK THE KEY			C	0.150	0.290	0.189	*
		C was specified, B works better			D	0.127	0.156	0.098	
					E	0.057	0.051	0.025	
					Other	0.166	-0.768	-0.514	
15	0-15	0.433	0.663	0.527	A	0.099	-0.034	-0.020	
					B	0.096	-0.111	-0.064	
					C	0.433	0.663	0.527	*
					D	0.115	-0.089	-0.054	
					E	0.054	-0.242	-0.117	
					Other	0.204	-0.680	-0.478	
16	0-16	0.255	0.335	0.247	A	0.092	0.057	0.033	
					B	0.255	0.335	0.247	*
					C	0.076	-0.066	-0.036	
					D	0.166	0.288	0.193	
					E	0.159	0.111	0.073	
					Other	0.252	-0.646	-0.475	
17	0-17	0.812	1.000	0.726	A	0.812	1.000	0.726	*
					B	0.061	-0.283	-0.143	
					C	0.000	-9.000	-9.000	
					Other	0.127	-1.000	-0.749	
18	0-18	0.806	1.000	0.738	A	0.051	-0.187	-0.089	
					B	0.806	1.000	0.738	*
					C	0.006	-0.414	-0.093	
					Other	0.137	-1.000	-0.771	
19	0-19	0.838	1.000	0.767	A	0.010	-0.523	-0.138	
					B	0.003	-0.050	-0.008	
					C	0.838	1.000	0.767	*
					Other	0.150	-1.000	-0.754	
20	0-20	0.713	0.809	0.609	A	0.713	0.809	0.609	*
					B	0.159	-0.099	-0.065	
					C	0.003	-0.462	-0.079	
					D	0.010	-0.678	-0.179	
					Other	0.115	-1.000	-0.721	
21	0-21	0.701	0.807	0.612	A	0.146	-0.061	-0.040	
					B	0.701	0.807	0.612	*
					C	0.025	-0.391	-0.148	
					D	0.013	-0.361	-0.106	
					Other	0.115	-1.000	-0.726	
22	0-22	0.643	0.770	0.599	A	0.643	0.770	0.599	*
					B	0.182	0.002	0.002	
					Other	0.175	-1.000	-0.757	
23	0-23	0.685	0.867	0.663	A	0.685	0.867	0.663	*
					B	0.108	-0.235	-0.140	
					C	0.025	0.103	0.039	
					Other	0.182	-1.000	-0.702	

24	0-24	0.525	0.627	0.500	A	0.092	-0.105	-0.060	
					B	0.525	0.627	0.500	*
					C	0.194	0.169	0.117	
					Other	0.188	-1.000	-0.713	
25	0-25	0.315	0.473	0.362	A	0.153	-0.005	-0.003	
					B	0.315	0.473	0.362	*
					C	0.220	0.181	0.129	
					Other	0.312	-0.624	-0.476	
26	0-26	0.162	0.271	0.181	A	0.162	0.271	0.181	*
					B	0.140	0.120	0.077	
	CHECK THE KEY				C	0.366	0.360	0.281	?
	A was specified, C works better				Other	0.331	-0.631	-0.487	
27	0-27	0.866	1.000	0.641	A	0.866	1.000	0.641	*
					B	0.029	-0.241	-0.094	
					Other	0.105	-1.000	-0.660	
28	0-28	0.761	0.891	0.648	A	0.761	0.891	0.648	*
					B	0.150	-0.338	-0.221	
					Other	0.089	-1.000	-0.693	
29	0-29	0.535	0.492	0.392	A	0.535	0.492	0.392	*
					B	0.360	-0.002	-0.002	
					Other	0.105	-1.000	-0.634	
30	0-30	0.650	0.747	0.580	A	0.248	-0.226	-0.166	
					B	0.650	0.747	0.580	*
					Other	0.102	-1.000	-0.678	

There were 314 examinees in the data file.

Scale Statistics

Scale:	0
N of Items	30
N of Examinees	314
Mean	15.962
Variance	40.935
Std. Dev.	6.398
Skew	-1.058
Kurtosis	0.600
Minimum	0.000
Maximum	27.000
Median	17.000
Alpha	0.886
SEM	2.156
Mean P	0.532
Mean Item-Tot.	0.487
Mean Biserial	0.651

APPENDIX E-1

SCIENCE PROCESS SKILLS TEST (SPST)

Bilimsel Süreç Becerileri Testi

Adı Soyadı: **Sınıfı:** **Okulu:**

Değerli Öğrenciler;
Bu test sizlerin değişkenleri belirleme ve hipotez kurma, değişken değiştirme, tablo oluşturma, grafik çizme ve grafik okuma becerilerinizi ölçmek amacıyla geliştirilmiştir. Testte 22 adet çoktan seçmeli ve açık uçlu soru bulunmaktadır.
Aşağıdaki kutuda; testte geçen "Değişken" ve "Hipotez" kavramlarının tanımlarını bulunmaktadır. Teste başlamadan önce lütfen aşağıdaki açıklamaları okuyunuz.

Açıklamalar:

Değişken; Belirli şartlar altında değişimi veya sabit tutulması olayların gidişatını etkileyebilecek tüm faktörlerdir. Bir bilimsel araştırmada üç çeşit değişken bulunur.

- **Bağımsız değişken (değiştirilen değişken):** Bir deneyde araştırmacı tarafından araştırma problemine uygun olarak bilinçli değiştirilen faktör veya koşuldur.
- **Bağımlı değişken (cevap veren değişken):** Bağımsız değişkendeki değişiklikten etkilenebilecek değişkendir.
- Araştırma boyunca değiştirilmeyen sabit tutulan değişkenlere ise **kontrol edilen (sabit tutulan) değişkenler** denir. Bir deneyde genellikle birden çok kontrol edilen değişken vardır.

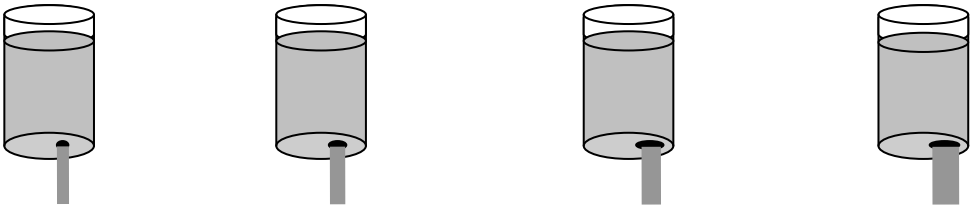
Hipotez (varsayım): Değişkenler arasındaki ilişkiler hakkındaki tahminlerdir. Bilimsel bir deney veya araştırma, bir hipotezi test etme amacıyla yapılır. Bilimsel bir hipotezin en önemli özelliği deneyle sınanabilir olmasıdır.

Küçük bir araştırma örneği aşağıda verilmiştir.

Araştırma Sorusu: Acaba, bitkilere verilen su miktarı ile bitkilerin büyüme hızı arasında bir ilişki var mıdır?

Testteki soruların cevaplarını üzerine işaretleyiniz.
Cevaplama için verilen **süre 40 dakikadır**.
Testten alacağınız puanlar fizik dersi öğretmeninize de verilecektir. Lütfen testi ciddiyetle cevaplayınız.
Katkılarınız için teşekkür eder, başarılar dileriz.

Ayşe, dibinde çeşitli büyüklüklerde delik bulunan dört özdeş bardak ile aşağıdaki yeni deneyi yapmıştır. 1, 2, 3 ve 4. soruları aşağıda verilen paragrafa göre cevaplandırınız.



I. deneme **II. deneme** **III. deneme** **IV. deneme**

Ayşe, I. denemesinde tabanında 2 mm çapında delik bulunan bardağa 15 cm yüksekliğinde sıvı koyup, sıvının bardaktan tamamen boşalması için geçen süreyi 15 saniye olarak ölçmüş. II. denemesinde tabanında 3 mm çapında delik bulunan bardağa aynı sıvıdan 15 cm koyup boşalma süresini 10 saniye olarak ölçmüş. III. denemesinde tabanında 4 mm çapında delik bulunan bardağa aynı sıvıdan 15 cm koyup boşalma süresini 7 saniye olarak ölçmüş ve IV. denemesinde tabanında 5 mm çapında delik bulunan bardağa aynı sıvıdan 15 cm koyup, boşalma süresini 7 saniye olarak ölçmüştür.

1. Aşağıdakilerden hangisi bu araştırmadaki bağımsız değişkendir?
a. Bardağa konulan sıvı yüksekliği
b. Sıvının boşalma süresi
c. Bardağın tabanındaki delik sayısı
d. Bardağın tabanındaki deliğin büyüklüğü
e. Bardağa konulan sıvının cinsi

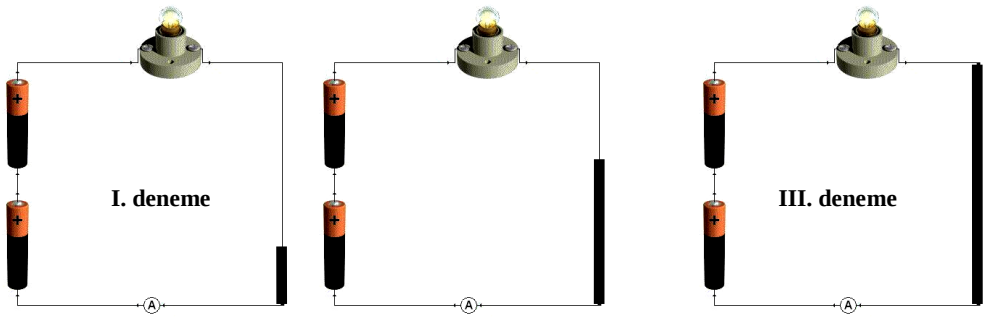
2. Aşağıdakilerden hangisi bu araştırmadaki bağımlı değişkendir?
a. Bardağa konulan sıvı yüksekliği
b. Sıvının boşalma süresi
c. Bardağın tabanındaki delik sayısı
d. Bardağın tabanındaki deliğin büyüklüğü
e. Bardağa konulan sıvının cinsi

3. Aşağıdakilerden hangisi veya hangileri bu araştırmadaki kontrol edilen değişkenlerdir?
i. Bardağa konulan sıvı yüksekliği
ii. Sıvının boşalma süresi
iii. Bardağın tabanındaki delik sayısı
iv. Bardağın tabanındaki deliğin büyüklüğü
v. Bardağa konulan sıvının cinsi
a. Yalnız i b. i ve ivc. i, iii ve v d. iii, iv ve v e. ii ve iv

4. Bu araştırmada test edilmek istenilen hipotez aşağıdakilerden hangisi olabilir?
a. Bardağın tabanındaki deliğin çapı küçüldükçe, sıvının yoğunluğu azalır.
b. Bardağa konulan sıvının yüksekliği arttıkça, delikten boşalma süresi artar.
c. Bardağın tabanındaki delik sayısı arttıkça, delikten boşalma süresi kısalır.
d. Bardağa konulan sıvının yoğunluğu arttıkça, delikten boşalma süresi uzar.
e. Bardağın tabanındaki deliğin çapı büyüdükçe, delikten boşalma süresi azalır.

Aliye, kalınlıkları eşit, boyları farklı bakır teller kullanarak elektrik devreleri kurmuş ve devrelerden geçen akımları ampermetre kullanarak ölçmüştür. 5, 6, 7 ve 8. soruları aşağıda verilen paragrafa göre cevaplandırınız.

Aliye, I.denemesinde devreyi; 10 cm uzunluğunda bakır tel, bir ampul, iki kalem pil ve bağlantı



kabloları kullanarak kurmuş ve ampermetreden geçen akımı 1 Amper olarak ölçmüştür. İkinci denemesinde devredeki 10 cm'lik teli çıkarıp yerine 25 cm boyunda ve aynı kalınlıkta bakır tel takmış ve yeni durumda devreden 0,4 Amperlik akım geçtiğini ölçmüştür. Üçüncü denemesinde ise devredeki 25 cm'lik teli çıkarıp yerine 40 cm boyunda ve aynı kalınlıkta bir bakır tel takmış ve yeni durumda devreden 0,25 Amperlik akım geçtiğini ölçmüştür.

5. Aşağıdakilerden hangisi bu araştırmadaki bağımsız değişkendir?

a. Devreden geçen akım
b. Telin yapıldığı madde türü
c. Telin kalınlığı
d. Telin boyu
e. Devredeki pil sayısı

6. Aşağıdakilerden hangisi bu araştırmadaki bağımlı değişkendir?

a. Devreden geçen akım
b. Telin yapıldığı madde türü
c. Telin kalınlığı
d. Telin boyu
e. Devredeki pil sayısı

7. Aşağıdakilerden hangisi veya hangileri bu araştırmadaki kontrol edilen değişkenlerdir?

i. Devreden geçen akım
ii. Telin yapıldığı madde türü
iii. Telin kalınlığı
iv. Telin boyu
v. Devredeki pil sayısı

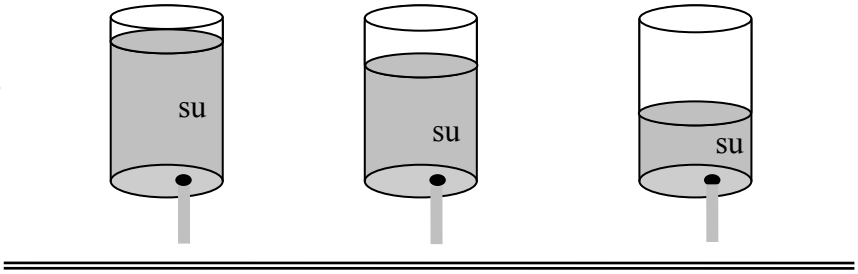
a. ii, iii ve v b. i ve ivc. Yalnız i d. iii ve iv e. ii, iv ve v

8. Bu araştırmada test edilmek istenilen hipotez aşağıdakilerden hangisi olabilir?

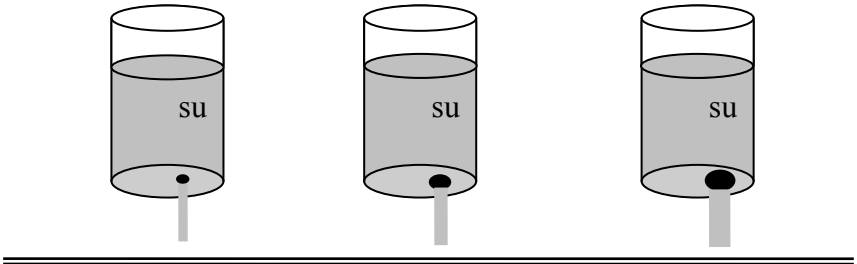
a. Elektrik akımı bakır telden alüminyum tele göre daha kolay geçer.
b. Pil sayısı arttıkça deveden geçen akım da artar.
c. Devredeki telin boyu uzadıkça devreden geçen akım azalır.
d. Ampul sayısı arttıkça devreden geçen akım azalır.
e. Devredeki telin kalınlığı arttıkça devreden geçen akım artar.

9. "Dibinde delik bulunan bir kaptaki suyun boşalma süresi, delik çapı arttıkça azalır." hipotezini test etmek için aşağıda verilen deney düzeneklerinden hangisi en uygun olanıdır?

a.

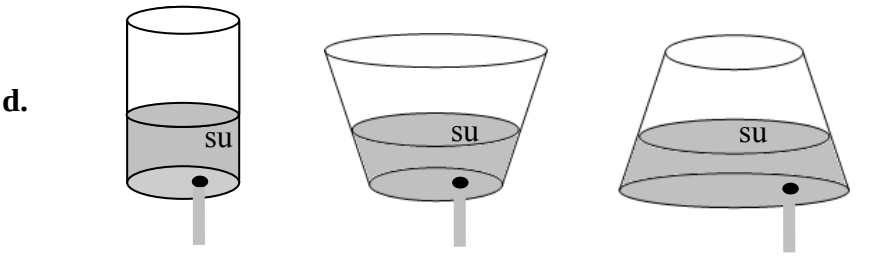


b.

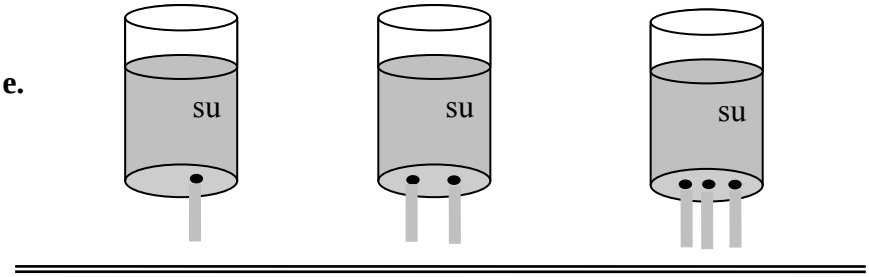


c.

d.



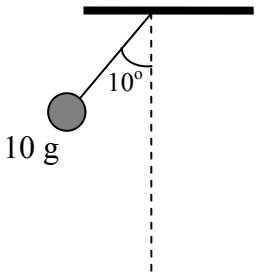
e.

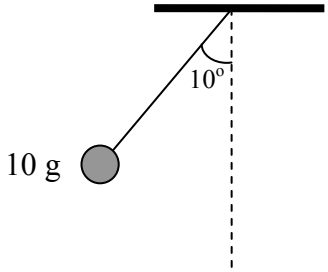


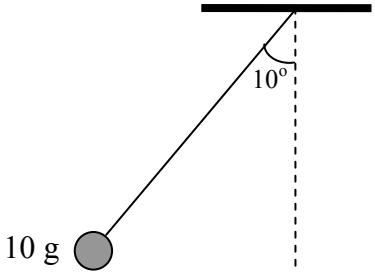
10. "Bir sarkacın ucundaki kütle arttıkça gidip gelme süresi de artar." hipotezini test etmek için aşağıda verilen deney düzeneklerinden hangisi en uygun olanıdır?

a.

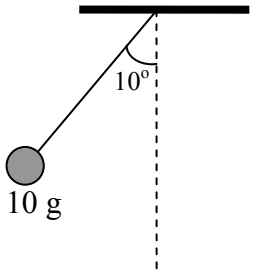
.

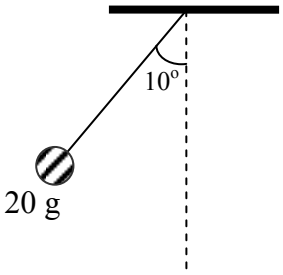


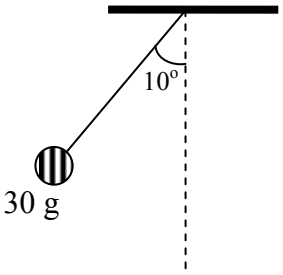




b.

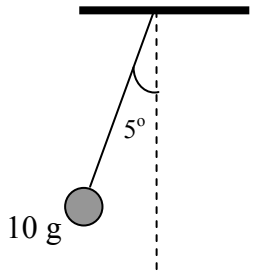


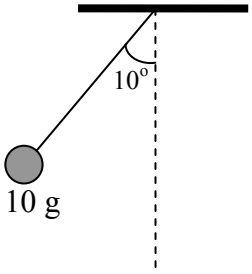


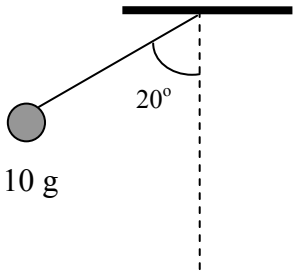


c.

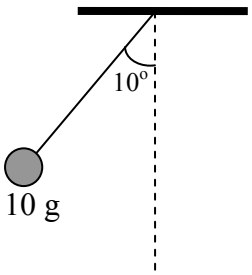
d.

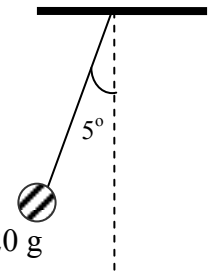


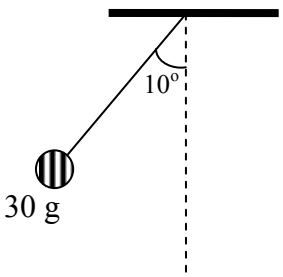


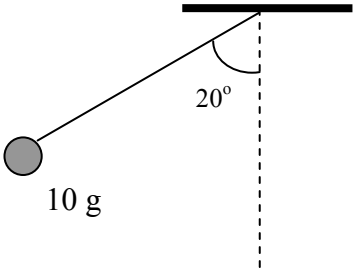


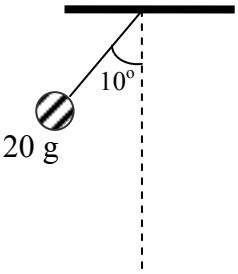
e.

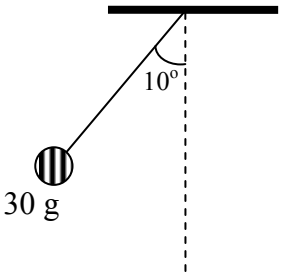










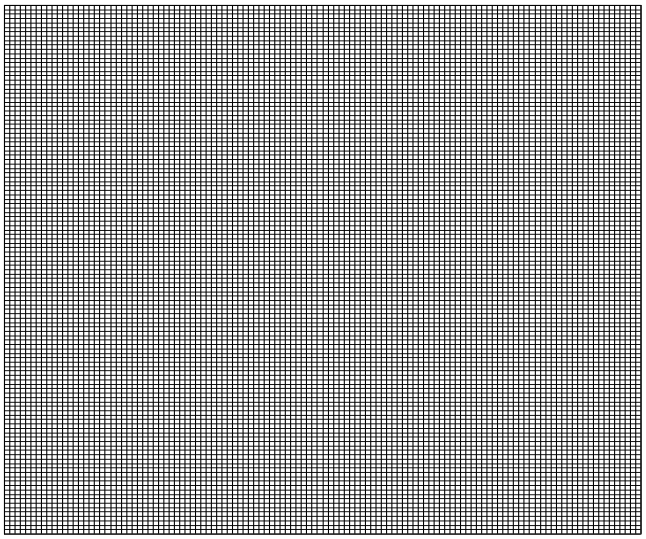


11. Murat bir bilyeyi yerden belirli bir yükseklikten bıraktığında, yere çarpıp zıpladığını gözlemlemiştir. Murat bilyenin serbest bırakılma yüksekliği ile zıplama yüksekliği arasında bir ilişki olup olmadığını araştırmak için aşağıdaki deneyi yapmıştır. Birinci denemesinde bilyeyi 1 metre yükseklikten bırakmış ve 0,7 metre yükseğe zıpladığını ölçmüştür. İkinci denemesinde bilyeyi 1,5 metre yükseklikten bırakmış ve 1 metre yükseğe zıpladığını ölçmüştür. Üçüncü denemesinde bilyeyi 2 metre yükseklikten bırakmış ve 1,4 metre yükseğe zıpladığını ölçmüştür. Dördüncü denemesinde bilyeyi 2,5 metre yükseklikten bırakmış ve 1,7 metre yükseğe zıpladığını ölçmüştür. Beşinci denemesinde bilyeyi 0,5 metre yükseklikten bırakmış ve 0,3 metre yükseğe zıpladığını ölçmüştür. Murat'ın topladığı verileri aşağıdaki boş alana çizeceğiniz uygun bir veri tablosunda gösteriniz.

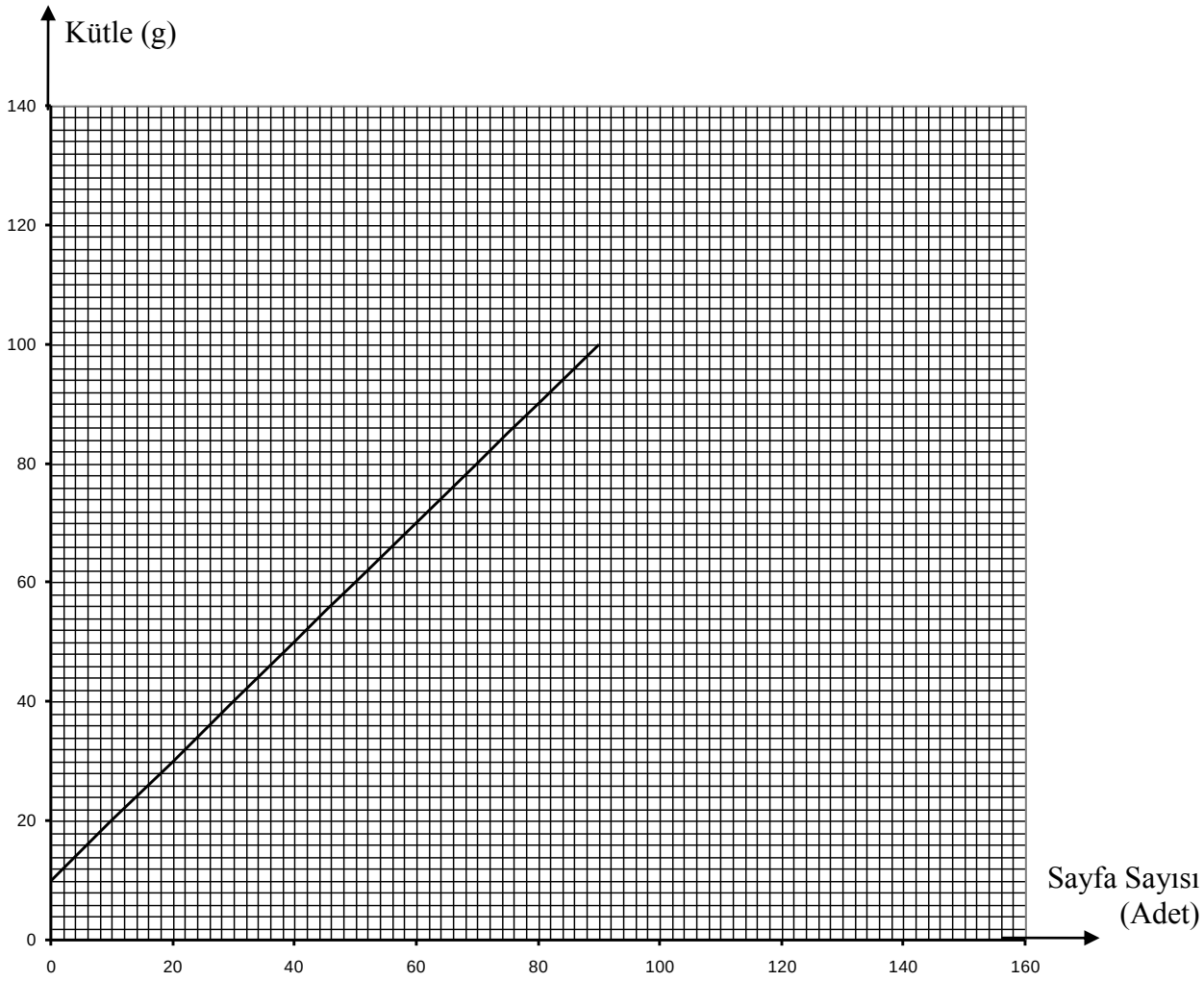
12. Bir otomobil belirli bir hızla giderken sürücüsü frene basarak, otomobilin yavaşlamasını sağlar. Fren yapmaya başladıktan sonra, otomobilin sürati belirli zaman aralıklarıyla ölçülmüş ve veriler aşağıdaki tabloya kaydedilmiştir. Tablodaki verileri kullanarak aşağıdaki grafik kağıdı üzerine sürat-zaman grafiğini çiziniz.

Tablo: Otomobilinin Süratinin Zamanla Değişimi

Zaman (Saniye)	Sürat (Metre/saniye)
0	80
5	70
10	60
15	50
20	40
25	30
30	20
35	10



Can, bir kitabın sayfa sayısı ile kütlesi arasındaki ilişkiyi araştırmış ve aşağıdaki grafiği çizmiştir. 26, 27, 28 ve 29. soruları grafiğe göre cevaplayınız.



13. Kitabın kütlesi ile sayfa sayısı arasında nasıl bir ilişki vardır?

a) Kütle, sayfa sayısı ile doğru orantılı olarak azalmaktadır.
b) Kütle, sayfa sayısı ile ters orantılıdır.
c) Kütle, sayfa sayısının karesi ile doğru orantılıdır.
d) Kütle, sayfa sayısının karesi ile ters orantılıdır.
e) Kütle, sayfa sayısı ile doğru orantılı olarak artmaktadır

14. Grafiğin eğimi aşağıdakilerden hangisidir?

a) 0,5 b) 1 c) 2 d) 10 e) 20

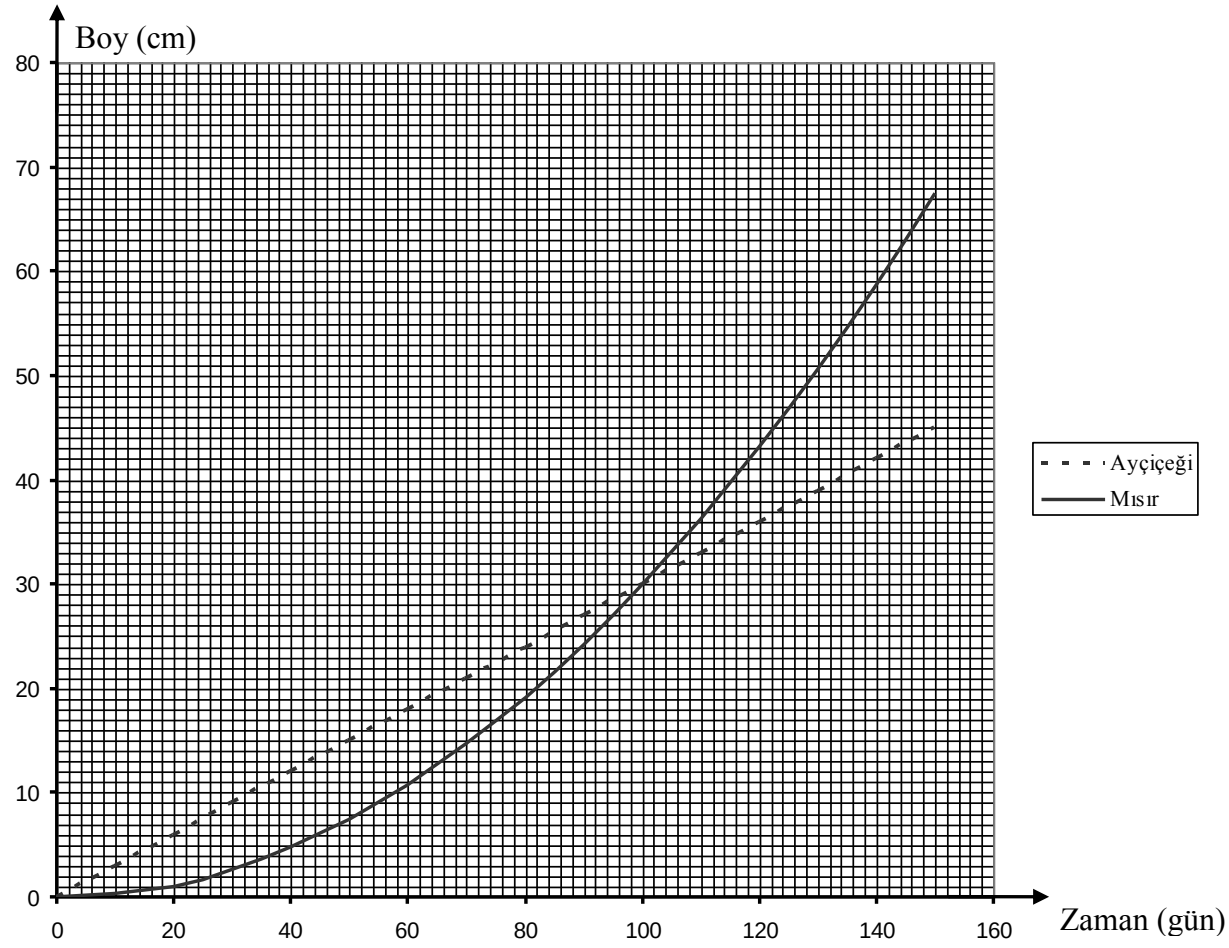
15. Grafiğe göre 120 sayfalık bir kitabın kütlesi kaç gram olmalıdır?

a) 110 b) 115 c) 120 d) 125 e) 130

16. Kütle (m) ile sayfa sayısı (s) arasındaki matematiksel ilişkiyi gösteren eşitlik aşağıdakilerden hangisidir?

a) m=2s+10 b) m=s+10 c) m=10-s d) m=s-10 e) m=10-2s

Mehmet, bahçelerinde bulunan mısır ve ayçiçeği bitkilerinin büyümelerini gözlemleyerek, bitkilerin boylarının zamanla değişimlerini gösteren aşağıdaki grafiği çizmiştir. 35, 36, 37 ve 38. soruları grafikten yararlanarak cevaplayınız.



17. Grafiğe göre iki bitkinin boyu hangi gün eşit olmuştur?

a)30 b) 35 c) 60 d) 90 e) 100

18. Grafiğe göre aşağıdaki zaman aralıklarından hangisinde mısırın boyu ayçiçeğinin boyundan büyüktür?

a) 0-20 b) 20-40 c) 60-80 d) 80-100 e) 100-120

19. Ayçiçeğinin boyu 20. gün mısırın boyunun kaç katıdır?

a) 6 b) 5 c) 4 d) 0,3 e) 0,2

20. Grafiğe göre aşağıdaki yargılardan hangisi veya hangilerine ulaşılabilir?

1. Ayçiçeği sabit bir hızla büyümektedir
2. Mısırın büyüme hızı giderek artmaktadır.
3. Ayçiçeğinin boyu 200 gün sonra mısırın boyunu geçecektir.
4. 100. günden sonra ayçiçeği bitkisinin boyu azalmaya başlamıştır.

a) Yalnız I b) III ve IV c) I ve II d) II ve III e) Yalnız IV

APPENDIX E-2

RUBRICS FOR ESSAY TYPE ITEMS IN SCİENCE PROCESS SKILLS TEST

Modül-3
İKİ DEĞİŞKENLİ VERİLERİN KAYDEDİLMESİ (TABLOLAŞTIRILMASI) İLE İLGİLİ ANALİTİK KRİTER ÖLÇEĞİ

<table>
<tr><td>Kategori</td><td colspan="2">Açıklama</td><td></td></tr>
<tr><td rowspan="4">Tablo Yapısı</td><td rowspan="4">1</td><td>Tablo yapısı aşağıdaki şekillerden birine uygun çizilmiş
<table><tr><td>Bağımsız değişken ⇩</td><td>Bağımlı değişken ⇩</td></tr></table> veya <table><tr><td>Bağımsız değişken</td><td>⇨</td></tr><tr><td>Bağımlı değişken</td><td>⇨</td></tr></table></td><td>3</td></tr>
<tr><td>Tablo yapısı aşağıdaki şekillerden birine uygun çizilmiş
<table><tr><td>Bağımlı değişken ⇩</td><td>Bağımsız değişken ⇩</td></tr></table> veya <table><tr><td>Bağımlı değişken</td><td>⇨</td></tr><tr><td>Bağımsız değişken</td><td>⇨</td></tr></table></td><td>3</td></tr>
<tr><td>Veriler yukarıda belirtilenlerin dışında bir tablo yapısında kaydedilmiş</td><td>1</td></tr>
<tr><td>Veriler tablo dışında bir formda (resim, çizim, grafik, metin vb.) kaydedilmiş</td><td>0</td></tr>
<tr><td rowspan="4">Değişken adları</td><td rowspan="2">2</td><td>Bağımsız değişken için sütun (veya satır) başlığı var</td><td>1</td></tr>
<tr><td>Bağımsız değişken için sütun (veya satır) başlığı yok veya yanlış (verilerle uyumsuz)</td><td>0</td></tr>
<tr><td rowspan="2">3</td><td>Bağımlı değişken için sütun (veya satır) başlığı var</td><td>1</td></tr>
<tr><td>Bağımlı değişken için sütun (veya satır) başlığı yok veya yanlış (verilerle uyumsuz)</td><td>0</td></tr>
<tr><td rowspan="4">Veri Kaydı</td><td rowspan="4">4</td><td>Tüm veri grupları doğrulukla kaydedilmiş</td><td rowspan="4">Veriler tablo dışında başka bir formda kaydedilmiş veya Veri grupları arası eşleşmeler anlaşılmıyorsa 0 puan</td><td>3</td></tr>
<tr><td>1-2 veri grubu hatalı, diğerleri doğru kaydedilmiş</td><td>2</td></tr>
<tr><td>3’den çok hatalı veri kaydı var</td><td>1</td></tr>
<tr><td>Hiçbir veri grubu doğrulukla kaydedilmemiş</td><td>0</td></tr>
</table>

Modül-4
ÇİZGİ GRAFİK KONTROL LİSTESİ

Kategori		Açıklama	Evet (1puan)
Başlıklar	1	Yatay eksenin yanına ait olduğu değişken adı veya sembolu yazılmış	
	2	Düşey eksenin yanına ait olduğu değişken adı veya sembolu yazılmış	
Eksenler	3	Eksenler koordinat sisteminin uygun bölgesinde ve grafik kağıdındaki çizgilere oturacak sekilde düzgün cizilmis	
	4	Eksenler aynı 0 noktasından başlatılmış ve her iki eksen de numaralandırılmış	
Yatay Eksen	5	Yatay eksen 0'dan (veya bir başlangıç değerinden) itibaren eşit aralıklarla ve artan sırayla bölmelendirilmiş (bölmeler eşit aralıklı değilse 11 ve 12 de 0 puan)	
	6	Yatay eksende sadece ana bölmelendirme rakamları gösterilmiş	
	7	Yatay eksendeki aralık genişlikleri tablodaki verilerle uyumlu ve ilgili tüm verileri açıkça gösterebilecek şekilde seçilmiş.(aralık genişlikleri eşit değilse 0 puan) (aralıklar belirli bir katsayı ile genişletilmiş olabilir, ancak genişletme oranı ilgili eksenin yanına belirtilmemişse 0 puan)	
Düşey Eksen	8	Düşey eksen 0'dan (veya bir başlangıç değerinden) itibaren eşit aralıklarla ve artan sırayla bölmelendirilmiş (bölmeler eşit aralıklı değilse 14 ve 15 de 0 puan)	
	9	Düşey eksende sadece ana bölmelendirme rakamları gösterilmiş (aralıklar belirli bir katsayı ile genişletilmiş olabilir)	
	10	Düşey eksendeki aralık genişlikleri tablodaki verilerle uyumlu ve ilgili tüm verileri açıkça gösterebilecek şekilde seçilmiş.(aralık genişlikleri eşit değilse 0 puan) (aralıklar belirli bir katsayı ile genişletilmiş olabilir, ancak genişletme oranı ilgili eksenin yanına belirtilmemişse 0 puan)	
Noktaları işaretleme ve Birleştirme	11	Tablodaki tüm veri çiftleri yapılan bölmelendirmeye uygun olarak eksenlere doğrulukla yerleştirilmiş	3
		1 veya 2 veri çiftinde hata var diğerleri doğru olarak yerleştirilmiş	2
		3'den çok sayıda hatalı veri çifti var	1
		Hiçbir veri doğru olarak yerleştirilememiş veya Eksenlerin bölmelendirilmesi tamamen hatalı	0
	12	İşaretli noktalar çember içine alınarak (veya başka bir işaretle) belirginleştirilmiş.	
	13	Verilen verilere uygun bir çizgi grafiği formatı seçilmiş.	
	14	İşaretli noktalar en uygun çizgilerle birleştirilmiş (Fonksiyon doğrusal veya eğri olabilir.) (16'dan en az 1 puan alınmış olmalı yoksa 0 puan verilecek)	

APPENDIX E-3

PERMISSION TO USE SCIENCE PROCESS SKILLS TEST

Re: Bilimsel Süreç Beceri Testi hakkında Önemli

Hide Details

FROM: Burak Kağan TEMİZ +

Wednesday, March 17, 2010 10:26 AM

TO: ali cetin

Merhaba Ali bey,
Atıfta bulunmak şartıyla testi kullanabilirsiniz. (bazen internette kendi geliştirdiğim materyallere başkalarının adlarıyla rastlıyorum, o nedenle atıfta bulunmanızı isterim) İyi çalışmalar...

Temiz, B. K. (2007). "Fizik Öğretiminde Öğrencilerin Bilimsel Süreç Becerilerinin Ölçülmesi" Yayımlanmamış Doktora Tezi. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

--
Yrd. Doç. Dr. Burak Kağan TEMİZ
Niğde Üniversitesi, Eğitim Fakültesi
İlköğretim Fen Bilgisi Öğretmenliği A.B.D.
Tel: +90

APPENDIX F

PHYSICS ATTITUDE SCALE (PAS)

ELEKTRİK TUTUM ÖLÇEĞİ

Adı Soyadı: **Sınıfı:** **Okulu:**

Sevgili öğrenciler,
Bu ölçekte Elektrik ünitesindeki konulara ilişkin görüş veya yargı bildiren cümleler yer almaktadır. Bu cümleleri dikkatlice okuyunuz. Belirtilen ifadelere ne ölçüde katılıp katılmadığınızı sağ taraftaki sütunda yanıt olarak verilen beş seçenekten birine (X) işareti yazarak belirtiniz. Lütfen testi içten ve samimi olarak cevaplayınız. Cevaplarınız gizli tutulacak ve hiçbir kimseyle paylaşılmayacaktır.

Elektrik Ünitesi **A. Elektrik Akımı ve Akım Şiddeti** **B. Bir İletkenin Direnci** **C. Ohm Kanunu** **D. Dirençlerin Bağlanması** - **Dirençlerin Seri Bağlanması** - **Dirençlerin Paralel Bağlanması** - **Dirençlerin Karışık Bağlanması**	**Kesinlikle katılıyrum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Kesinlikle katılmıyorum**
1. "Elektrik Ünitesi" konularını severim.					
2. "Elektrik Ünitesi" konularına karsı olumlu hislerim vardır.					
3. "Elektrik Ünitesi" konularından öğrendiklerimin hayatımı kolaylaştıracağına inanıyorum.					
4. "Elektrik Ünitesi" konularının gelecekte öneminin artacağına **inanmıyorum**.					
5. "Elektrik Ünitesi" konularının, ilerideki çalışmalarımda bana yararlı olacağına inanıyorum.					
6. "Elektrik Ünitesi" konularında başarılı olmak için elimden geleni yaparım.					
7. "Elektrik Ünitesi" konularında elimden gelenin en iyisini yapmaya çalışırım.					
8"Elektrik Ünitesi" konularında başarısız olduğumda daha çok **çabalamam**.					
9. "Elektrik Ünitesi" konularını öğrenebileceğimden eminim.					
10. "Elektrik Ünitesi" konularında başarılı olabileceğimden eminim.					
11."Elektrik Ünitesi" konularının kullanıldığı zor problemleri çözebileceğimden eminim.					
12. "Elektrik Ünitesi"" konularının geçerli olduğu problemler ne kadar zor olursa olsun, elimden geleni yaparım.					
13. "Elektrik Ünitesi" konularının ilerideki meslek hayatımda önemli bir yeri olacağını **düşünmüyorum**.					
14. "Elektrik Ünitesi" konularından öğrendiklerimin, gündelik hayatta isime yarayacağını düşünüyorum.					
15. "Elektrik Ünitesi" konuları veya teknolojideki uygulamaları ile ilgili kitaplar okumaktan hoşlanırım.					
16. "Elektrik Ünitesi" konuları benim için eğlencelidir.					
17. Okulda "Elektrik Ünitesi" konularını çalışmaktan **hoşlanmam**.					
18. "Elektrik Ünitesi" ile ilgili daha zor problemlerle basa çıkabileceğimden eminim.					
19. Okuldan sonra arkadaşlarla"Elektrik Ünitesi" konuları hakkında konuşmak zevklidir.					
20. Bana hediye olarak "Elektrik Ünitesi" ile ilgili bir kitap veya konu ile ilgili aletler, araçlar verilmesinden hoşlanırım.					
21. Yeterince vaktim olursa en zor "Elektrik Ünitesi" ile ilgili problemleri bile çözebileceğimden eminim.					
22. Arkadaşlarla "Elektrik Ünitesi" konuları veya teknolojideki uygulamaları ile ilgili meseleleri konuşmaktan hoşlanırım.					
23. "Elektrik Ünitesi" konuları el becerilerimin gelişmesinde etkilidir.					
24. "Elektrik Ünitesi" konuları ile ilgili ders saatlerinin daha çok olmasını **istemem**.					

APPENDIX G

EXPERT JUDGEMENT FORM

UZMAN DEĞERLENDİRME FORMU

Bu form ODTÜ Eğitim Fakültesi, orta öğretim fen ve matematik alanları eğitimi bölümünde yüksek lisans tez çalışması olarak yürütülen www.dersfizik.net isimli internet sayfasının değerlendirilmesi için hazırlanmıştır. Bu sayfa 5E modeli kullanılarak oluşturulmuştur ve Web desteği ile harmanlanmış sorgulayıcı (Blended web and inquiry) ve açıklayıcı (Blended web and expository)öğretim yöntemleri ile 9. sınıflarda uygulanması planlanmaktadır. Bu amaçla oluşturulan internet sayfasına uzmanların görüşü çok önemlidir.

Hazırlanan web sayfası ilk olarak "Enerjinin Korunumu" konusunda pilot uygulaması yapılmış ve site içerisindeki linklerin çalışmasına bakılmıştır. Asıl çalışma "Elektrik Akımı" konusunda geliştirilerek ana çalışma yapılacaktır. Bu nedenle şu an değerlendirmeniz istenen "Elektrik Akımı" isimli bölümdür.

Aşağıda vereceğiniz bilgiler araştırmacı tarafından gizli tutulacak ve uzmana ilişkin kişisel bilgiler hiçbir şekilde yayınlanmayacaktır.

1. Formu dolduran uzmana ilişkin bilgiler:

Çalıştığı iş: ....
Çalıştığı işte deneyimi (yıl): ....
Eğitim durumu: ....
Uzmanlık alanları: ....

Lütfen aşağıdaki tabloyu her bir uzmanlık alanı için bir uzmanlık derecesi işaretleyerek doldurunuz.

	Uzmanlık Derecesi		
Uzmanlık Alanı	Az	Orta	Yüksek
Bilgisayar destekli eğitim			
Elektrik konuları eğitimi			
Materyal geliştirme			
Fen veya matematik eğitimi			

Tel (isteğe bağlı olarak doldurabilirsiniz):..... ....
e-posta (isteğe bağlı olarak doldurabilirsiniz): ....

Varsa daha önce değerlendirmesini yaptığınız öğrenim materyallerinin veya bilgisayar destekli eğitim araçlarının kapsamı hakkında kısa bilgi veriniz.
.....

Varsa üzerinde araştırma çalışması yürüttüğünüz öğrenim materyallerinin ve bilgisayar destekli eğitim araçlarının kapsamı hakkında kısa bilgi veriniz.
.....
Varsa fen eğitimi, matematik eğitimi veya enerji-elektrik konuları eğitimi ile ilgili yürüttüğünüz araştırma çalışmalarının kapsamı hakkında kısa bilgi veriniz.
.....

Varsa materyal geliştirme veya bilgisayar destekli eğitim araçları üzerine yayınlarınızı kısaca yazınız.
.....

Varsa fen eğitimi, matematik eğitimi veya enerji-elektrik konuları eğitimi üzerine yayınlarınızı kısaca yazınız.
.....

2. www.dersfizik.net/inqu Değerlendirme Maddeleri ve Görüşler

Bu kısımda dersfizik.net isimli internet sayfasının değerlendirmesi için sorular ve tablolar yer almaktadır. Bu internet sitesine girmek için aşağıdaki kullanıcı adı ve parolayı kullanabilirsiniz.

Kullanıcı Adı: deneme Şifre:332211

a) Teknik ve Görsel Değerlendirme

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Sayfanın yüklenmesi uzun süre alıyor mu?						
Sayfa içerisinde dilbilgisi hatası var mı?						
Sayfa içerisinde açık ve anlaşılır bir dil kullanılmış mı?						
Arka plan ve metin arasında renk uyumu var mı?						
Site 9. sınıf öğrencilerinin kullanımı için uygun mu?						
Sizin internet servis sağlayıcınız (Explorer, firefox, chrome v.b.) ile sayfa görünümü nasıl?						
Her sayfada "Anasayfa"ya dönüş mümkün mü?						
Sayfa içerisinde dolaşım yeteri kadar açık ve net mi? (linkler)						
İleti bölümü öğrencilerin fikirlerini belirtmeleri için uygun bir araç mı?						
Sayfalardaki video ve simülasyonlar çalışıyor mu?						

b) İçerik Değerlendirmesi

Lütfen aşağıdaki tabloyu www.dersfizik.net/inqu adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı "1-1 Elektrik Kazası" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Videonun seviyesi öğrencilerin seviyelerine uygun mu?						

Video öğrencinin ilgisini çekmek için yeterli mi?						
Bölüm sorusu öğrencilerin cevap verebileceği seviyede mi?						

Lütfen aşağıdaki tabloyu www.dersfizik.net/inqu adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı "1-2 Elektrik Simülasyonu" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Simülasyonun seviyesi öğrencilerin seviyelerine uygun mu?						
Simülasyon için verilen yönergeler yeterli mi?						
Simülasyon 5E yöntemindeki araştırma (explore) için yeterli mi?						

Lütfen aşağıdaki tabloyu www.dersfizik.net/inqu adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı "1-3 Simülasyon Sonuçları" için belirlenen ölçütlere göre doldurunuz. Bu bölüm öğrencilerin kullanımı sırasında, eksik oldukları kısımlara göre öğretmen ve araştırmacı tarafından açıklamalar içerecektir.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Bu bölümdeki sorular konuyu açıklamak için yeterli midir?						
Sorular bir önceki bölümünde kullanılan simülasyonu açıklamak için yeterlimidir?						
Sorular öğrenciler tarafından anlaşılabilir mi?						

Lütfen aşağıdaki tabloyu www.dersfizik.net/inqu adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı "1-4 Akım Sırasında neler oluyor?" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Simülasyonun seviyesi öğrencilerin seviyelerine uygun mu?						
Simülasyon için verilen yönergeler yeterli mi?						
Simülasyon 5E yöntemindeki detaylandırmak (Elaborate) için yeterli mi?						
Sorular öğrenciler tarafından anlaşılabilir mi?						

Lütfen aşağıdaki tabloyu www.dersfizik.net/inqu adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı olan "1-5 Değerlendirme Soruları" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	Açıklama
Sorular konunun hedefleri ile uygun mu?						
Sorular hedefleri ölçmek için yeterli sayıda mı?						
Sorular bilimsel hata içeriyor mu?						
Değişik bilişsel seviyelerden sorular içeriyor mu?						

Lütfen aşağıdaki soruları yanıtlayınız.

Hazırlanan web sayfasının 5E modeline uygunluğu hakkındaki görüşleriniz nelerdir?
.....

Sizce hazırlanan bu web sayfası sınıf ortamı ve web harmanlanması sırasında kullanılabilir mi? Neden?
.....

Sizce hazırlanan bu web sayfasına neler eklenebilir veya çıkarılabilir?
.....

Bu web sitesi ve çalışma ile ilgili olarak görüşlerinizi kısaca belirtiniz.
.....

3. www.dersfizik.net/expo Değerlendirme Maddeleri ve Görüşler

Bu kısımda dersfizik.net isimli internet sayfasının değerlendirmesi için sorular ve tablolar yer almaktadır. Bu internet sitesine girmek için aşağıdaki kullanıcı adı ve parolayı kullanabilirsiniz.

Kullanıcı Adı: deneme Şifre:332211

a) Teknik ve Görsel Değerlendirme

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	Açıklama
Sayfanın yüklenmesi uzun süre alıyor mu?						
Sayfa içerisinde dilbilgisi hatası var mı?						
Sayfa içerisinde açık ve anlaşılır bir dil kullanılmış mı?						
Arka plan ve metin arasında renk uyumu var mı?						

Site 9. sınıf öğrencilerinin kullanımı için uygun mu?						
Sizin internet servis sağlayıcınız (Explorer, firefox, chrome v.b.) ile sayfa görünümü nasıl?						
Her sayfada "Anasayfa"ya dönüş mümkün mü?						
Sayfa içerisinde dolaşım yeteri kadar açık ve net mi? (linkler)						
"Yorumlar" bölümü öğrencilerin fikirlerini belirtmeleri için uygun bir araç mı?						

b) İçerik Değerlendirmesi

Lütfen aşağıdaki tabloyu www.dersfizik.net/expo adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı "1-1 Elektrik Akımının meydana gelişi" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Şekiller öğrencilerin konuyu anlamaları için uygun mu?						
Konu anlatımı yeterli mi?						
Konu anlatımı seviye ye uygun mu?						
Konu anlatımı içerisinde bilimsel hata var mı?						
Bölüm soruları bu bölüm için yeterli mi?						

Lütfen aşağıdaki tabloyu www.dersfizik.net/expo adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı "1-2 Bir İletkendeki Akım Şiddeti" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Şekiller öğrencilerin konuyu anlamaları için uygun mu?						
Konu anlatımı yeterli mi?						
Konu anlatımı seviye ye uygun mu?						
Konu anlatımı içerisinde bilimsel hata var mı?						
Bölüm soruları bu bölüm için yeterli mi?						

Lütfen aşağıdaki tabloyu www.dersfizik.net/expo adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı "1-3 Çözümlü Örnekler" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Çözümlü örneklerin sayısı yeterli mi?						
Çözümlü örnekler konuya uygun mu?						
Çözümler sorunun çözümü için yeterli mi?						
Çözüm bilimsel hata içeriyor mu?						

Lütfen aşağıdaki tabloyu www.dersfizik.net/expo adresindeki "1-Elektrik Akımı" başlıklı bölümün alt başlığı olan "1-4 Değerlendirme Soruları" için belirlenen ölçütlere göre doldurunuz.

Ölçüt	Çok kötü	Kötü	Orta	İyi	Çok iyi	**Açıklama**
Sorular konunun hedefleri ile uygun mu?						
Sorular hedefleri ölçmek için yeterli sayıda mı?						
Sorular bilimsel hata içeriyor mu?						
Değişik bilişsel seviyelerden sorular içeriyor mu?						

Lütfen aşağıdaki soruları yanıtlayınız.

Hazırlanan web sayfasının açıklayıcı (expository) yönteme uygunluğu hakkındaki görüşleriniz nelerdir?

.....

Sizce hazırlanan bu web sayfası sınıf ortamı ve web harmanlanması sırasında kullanılabilir mi? Neden?

.....

Sizce hazırlanan bu web sayfasına neler eklenebilir veya çıkarılabilir?

.....

Bu web sitesi ve çalışma ile ilgili olarak görüşlerinizi kısaca belirtiniz.

.....

APPENDIX H

CLASSROOM OBSERVATION CHECKLIST

Sınıf: …… Değerlendirilen grup…… Tarih: ……. Ders süresi: ……. Degerlendiren: …… **Sınıf Gözlem Formu (Expo)**		**Evet**	**Kısmen**	**Hayır**	**NA**
1	Öğretmen derste kendisine verilen "ders planını" takip ediyor mu?				
2	Öğretmen ödev sorularının yapılıp yapılmadığını kontrol etti mi?				
3	Öğrenme öğretmenin konuyu anlatması ile mi başlıyor?				
4	Öğretmen konu anlatımı sırasında öğrencilere soru soruyor mu?				
5	Öğretmen öğrenciye sürekli bilgi veren konumda mıdır?				
6	Derste çözümlü örnekler çözüldü mü?				
7	Öğrenciler öğretmene soru soruyorlar mı?				
8	Öğretmen değerlendirme veya ödev sorularını sınıfta çözdü mü?				
9	Öğretmen ders islenebilecek rahat bir ortam sağlayabiliyor mu?				
10	Ders sonunda ödev soruları dağıtıldı mı?				
11	Ders saati içerisinde öğretmen ders planını tamamlayabildi mi?				

Sınıf: …… Değerlendirilen grup…… Tarih: ……. Ders süresi: ……. Değerlendiren: …… **Sınıf Gözlem Formu (W-Expo)**		**Evet**	**Kısmen**	**Hayır**	**NA**
	WEB-ÇALIŞMASI				
1	Öğrenciler bilgisayar başında ikili gruplar halinde mi oturuyorlar?				
2	Öğrenciler bilgisayarda internet sitesini kullanıyorlar mı?				
3	Öğrenciler öğretmene soru soruyorlar mı?				
4	Öğrenciler bilgisayardaki sorulara birlikte cevap veriyorlar mı?				
5	Öğretmen öğrencilerin internet sitesindeki sorularına cevap verebiliyor mu?				
6	Öğrenciler internet sitesindeki konu anlatımını takip edebiliyorlar mı?				
7	Öğrenciler ders sırasında değerlendirme soruları bölümüne gelebildiler mi?				
8	Öğrenciler teknik bir sorun ile karşılaştılar mı?				
9	Ders saati içerisinde öğrenciler ders planına göre istenen yere gelebildiler mi?				
	SINIF ÇALIŞMASI				
10	Öğretmen ödev sorularının yapılıp yapılmadığını kontrol etti mi?				
11	Öğretmen derste kendisine verilen “ders planını” takip ediyor mu?				
12	Öğretmen öğrenciye sürekli bilgi veren konumda mıdır?				
13	Öğretmen konu anlatımı sırasında öğrencilere soru soruyor mu?				
14	Derste çözümlü örnekler çözüldü mü?				
15	Öğrenciler öğretmene soru soruyorlar mı?				
16	Öğretmen değerlendirme veya ödev sorularını sınıfta çözdü mü?				
17	Öğretmen ders islenebilecek rahat bir ortam sağlayabiliyor mu?				

Sınıf: …… Değerlendirilen grup…… Tarih: ……. Ders süresi: ……. Değerlendiren: …… **Sınıf Gözlem Formu (Inqu)**		**Evet**	**Kısmen**	**Hayır**	**NA**
1	Sınıfta gruplar oluşturulmuş mu?				
2	Öğretmen ödev sorularının yapılıp yapılmadığını kontrol etti mi?				
3	Öğretmen derste kendisine verilen "ders planını" takip ediyor mu?				
4	Öğretmen ilgi çekme bölüm sorularını öğrencilere yöneltiyor mu?				
5	Öğrenciler öğretmene soru soruyorlar mı?				
6	Öğrenciler deneyleri grup halinde mi yapıyorlar?				
7	Öğrenciler grup içinde tartışıyorlar mı?				
8	Öğrenciler deney düzeneklerini kurabiliyorlar mı?				
9	Öğrenciler deneyi kendilerinden istenen süre içerisinde tamamlayabildiler mi?				
10	Öğrenciler deneylerden sonra sorulara cevap verebiliyor mu?				
11	Öğrenciler deney sonunda öğretmenin sorularına cevap verebiliyorlar mı?				
12	Öğretmen açıklama bölümünde yeterli açıklamaları yapabiliyor mu?				
13	Öğrenciler grup içinde aldıkları cevapları paylaşıyorlar mı?				
14	Öğretmen ders islenebilecek rahat bir ortam sağlayabiliyor mu?				
15	Öğretmen grupça çalışmaları için öğrencileri cesaretlendiriyor mu?				
16	Ders sonunda ödev soruları dağıtıldı mı?				
17	Ders saati içerisinde öğretmen ders planını tamamlayabildi mi?				

Sınıf: ……. Değerlendirilen grup……. Tarih: ……. Ders süresi: ……. Değerlendiren: ……. **Sınıf Gözlem Formu (W-Inqu)**		**Evet**	**Kısmen**	**Hayır**	**NA**
	WEB-ÇALIŞMASI				
1	Öğrenciler bilgisayar başında ikili gruplar halinde mi oturuyorlar?				
2	Öğrenciler bilgisayarda internet sitesini kullanıyorlar mı?				
3	Öğrenciler öğretmene soru soruyorlar mı?				
4	Öğrenciler bilgisayardaki sorulara birlikte cevap veriyorlar mı?				
5	Öğretmen öğrencilerin internet sitesindeki sorularına cevap verebiliyor mu?				
6	Öğrenciler simülasyon programlarını çalıştırabiliyorlar mı?				
7	Öğrenciler deney düzeneklerini kurabiliyorlar mı?				
8	Öğrenciler grup içinde tartışıyorlar mı?				
9	Öğrenciler deneylerden sonra sorulara cevap verebiliyor mu?				
10	Öğretmen açıklama bölümünde yeterli açıklamaları yapabiliyor mu?				
11	Öğrenciler ders sırasında değerlendirme soruları bölümüne gelebildiler mi?				
12	Öğrenciler teknik bir sorun ile karşılaştılar mı?				
13	Ders saati içerisinde öğrenciler ders planına göre istenen yere gelebildiler mi?				
	SINIF ÇALIŞMASI				
14	Öğretmen bir önceki dersi tekrar etti mi?				
15	Öğrenme ilgi çekme bölümü ile mi başlıyor?				
16	Öğretmen ilgi çekme bölüm sorularını öğrencilere yöneltiyor mu?				
17	Ders, tartışma merkezli olarak mı yürütülüyor?				
18	Öğrenciler öğretmene soru soruyorlar mı?				
19	Öğretmen ödev sorularının yapılıp yapılmadığını kontrol etti mi?				
20	Öğretmen derste kendisine verilen “ders planını” takip ediyor mu?				
21	Öğretmen öğrenciye sürekli bilgi veren konumda mıdır?				
22	Öğretmen konu anlatımı sırasında öğrencilere soru soruyor mu?				
23	Öğretmen değerlendirme veya ödev sorularını sınıfta çözdü mü?				
24	Öğretmen ders islenebilecek rahat bir ortam sağlayabiliyor mu?				

APPENDIX I-1

LISREL OUTPUT OF PRETEST DATA FOR CONMATORY FACTOR ANALYSIS

DATE: 4/ 4/2012
TIME: 13:42

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. Jöreskog and Dag Sörbom

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Lincolnwood, IL 60712, U.S.A.
Phone: (800)247-6113, (847)675-0720, Fax: (847)675-2140

The following lines were read from file **C:\Users\HakiPESMAN\Documents\ali\pre-post factor\pre cfa\model pre.SPJ:**

```
Raw Data from file 'C:post factorcfa.psf'
Latent Variables  phyatt
Relationships
PREENJOY = phyatt
PRESEFFI = phyatt
PREIMPHY = phyatt
PREACHMO = phyatt
PREINTRE = phyatt
Path Diagram
End of Problem

Sample Size =   245

precfa

        Covariance Matrix

           PREENJOY   PRESEFFI   PREIMPHY   PREACHMO   PREINTRE
           --------   --------   --------   --------   --------
PREENJOY       0.84
PRESEFFI       0.55       0.68
```

PREIMPHY	0.48	0.38	0.77		
PREACHMO	0.37	0.39	0.35	0.52	
PREINTRE	0.61	0.48	0.46	0.32	0.96

precfa

Number of Iterations = 5

LISREL Estimates (Maximum Likelihood)

Measurement Equations

PREENJOY = 0.80*phyatt, Errorvar.= 0.21 , Rý = 0.75
(0.049) (0.031)
16.30 6.87

PRESEFFI = 0.69*phyatt, Errorvar.= 0.21 , Rý = 0.70
(0.045) (0.026)
15.38 7.84

PREIMPHY = 0.61*phyatt, Errorvar.= 0.41 , Rý = 0.47
(0.052) (0.041)
11.75 9.83

PREACHMO = 0.51*phyatt, Errorvar.= 0.26 , Rý = 0.49
(0.042) (0.027)
12.06 9.73

PREINTRE = 0.72*phyatt, Errorvar.= 0.43 , Rý = 0.55
(0.056) (0.046)
12.95 9.40

Correlation Matrix of Independent Variables

phyatt
1.00

Goodness of Fit Statistics

Degrees of Freedom = 5
Minimum Fit Function Chi-Square = 32.80 (P = 0.00)
Normal Theory Weighted Least Squares Chi-Square = 31.31 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 26.31
90 Percent Confidence Interval for NCP = (12.25 ; 47.86)

Minimum Fit Function Value = 0.13
Population Discrepancy Function Value (F0) = 0.11
90 Percent Confidence Interval for F0 = (0.050 ; 0.20)
Root Mean Square Error of Approximation (RMSEA) = 0.15
90 Percent Confidence Interval for RMSEA = (0.10 ; 0.20)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00060

Expected Cross-Validation Index (ECVI) = 0.21
90 Percent Confidence Interval for ECVI = (0.15 ; 0.30)
ECVI for Saturated Model = 0.12
ECVI for Independence Model = 3.55

Chi-Square for Independence Model with 10 Degrees of Freedom = 856.67
Independence AIC = 866.67
Model AIC = 51.31
Saturated AIC = 30.00
Independence CAIC = 889.18
Model CAIC = 96.32
Saturated CAIC = 97.52

Normed Fit Index (NFI) = 0.96
Non-Normed Fit Index (NNFI) = 0.93
Parsimony Normed Fit Index (PNFI) = 0.48
Comparative Fit Index (CFI) = 0.97
Incremental Fit Index (IFI) = 0.97
Relative Fit Index (RFI) = 0.92

Critical N (CN) = 113.23

Root Mean Square Residual (RMR) = 0.027
Standardized RMR = 0.039
Goodness of Fit Index (GFI) = 0.95
Adjusted Goodness of Fit Index (AGFI) = 0.85
Parsimony Goodness of Fit Index (PGFI) = 0.32

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate
PREACHMO	PREENJOY	12.2	-0.08
PREACHMO	PRESEFFI	15.5	0.08
PREINTRE	PREENJOY	9.5	0.10

Time used: 0.016 Seconds

TIME: 13:43

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. J”reskog & Dag S”rbom

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precfa

Covariance Matrix

	PREENJOY	PRESEFFI	PREIMPHY	PREACHMO	PREINTRE
PREENJOY	0.84				
PRESEFFI	0.55	0.68			
PREIMPHY	0.48	0.38	0.77		
PREACHMO	0.37	0.39	0.35	0.52	
PREINTRE	0.61	0.48	0.46	0.32	0.96

precfa

Number of Iterations = 7

LISREL Estimates (Maximum Likelihood)

Measurement Equations

PREENJOY = 0.82*phyatt, Errorvar.= 0.17 , R^2 = 0.80
(0.049) (0.032)
16.89 5.25

PRESEFFI = 0.66*phyatt, Errorvar.= 0.25 , R^2 = 0.64
(0.046) (0.030)
14.30 8.25

PREIMPHY = 0.60*phyatt, Errorvar.= 0.41 , R^2 = 0.47
(0.052) (0.042)
11.56 9.80

PREACHMO = 0.47*phyatt, Errorvar.= 0.30 , R^2 = 0.42
(0.044) (0.031)
10.63 9.81

PREINTRE = 0.74*phyatt, Errorvar.= 0.41 , R^2 = 0.57
(0.056) (0.045)
13.25 9.10

Error Covariance for PREACHMO and PRESEFFI = 0.084
(0.023)
3.58

Correlation Matrix of Independent Variables

	phyatt
	1.00

Goodness of Fit Statistics

Degrees of Freedom = 4
Minimum Fit Function Chi-Square = 17.81 (P = 0.0013)
Normal Theory Weighted Least Squares Chi-Square = 17.41 (P = 0.0016)
Chi-Square Difference with 1 Degree of Freedom = 13.90 (P = 0.00019)
Estimated Non-centrality Parameter (NCP) = 13.41
90 Percent Confidence Interval for NCP = (4.06 ; 30.28)

Minimum Fit Function Value = 0.073
Population Discrepancy Function Value (F0) = 0.055
90 Percent Confidence Interval for F0 = (0.017 ; 0.12)
Root Mean Square Error of Approximation (RMSEA) = 0.12
90 Percent Confidence Interval for RMSEA = (0.064 ; 0.18)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.021

Expected Cross-Validation Index (ECVI) = 0.16
90 Percent Confidence Interval for ECVI = (0.12 ; 0.23)
ECVI for Saturated Model = 0.12
ECVI for Independence Model = 3.55

Chi-Square for Independence Model with 10 Degrees of Freedom = 856.67
Independence AIC = 866.67
Model AIC = 39.41
Saturated AIC = 30.00
Independence CAIC = 889.18
Model CAIC = 88.92
Saturated CAIC = 97.52

Normed Fit Index (NFI) = 0.98
Non-Normed Fit Index (NNFI) = 0.96
Parsimony Normed Fit Index (PNFI) = 0.39
Comparative Fit Index (CFI) = 0.98
Incremental Fit Index (IFI) = 0.98
Relative Fit Index (RFI) = 0.95

Critical N (CN) = 182.92

Root Mean Square Residual (RMR) = 0.021
Standardized RMR = 0.033
Goodness of Fit Index (GFI) = 0.97
Adjusted Goodness of Fit Index (AGFI) = 0.90
Parsimony Goodness of Fit Index (PGFI) = 0.26

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate
PREACHMO	PREIMPHY	16.3	0.10

Time used: 0.016 Seconds

DATE: 4/ 4/2012
TIME: 13:43

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. Jöreskog and Dag Sörbom

precfa

Covariance Matrix

	PREENJOY	PRESEFFI	PREIMPHY	PREACHMO	PREINTRE
PREENJOY	0.84				
PRESEFFI	0.55	0.68			
PREIMPHY	0.48	0.38	0.77		
PREACHMO	0.37	0.39	0.35	0.52	
PREINTRE	0.61	0.48	0.46	0.32	0.96

precfa

Number of Iterations = 5

LISREL Estimates (Maximum Likelihood)

Measurement Equations

PREENJOY = 0.83*phyatt, Errorvar.= 0.15 , R^2 = 0.82
(0.049) (0.032)
17.10 4.73

PRESEFFI = 0.66*phyatt, Errorvar.= 0.25 , R^2 = 0.63
(0.046) (0.030)

14.25 8.33

PREIMPHY = 0.59*phyatt, Errorvar.= 0.43 , R^2 = 0.45
(0.052) (0.043)
11.23 9.91

PREACHMO = 0.44*phyatt, Errorvar.= 0.33 , R^2 = 0.37
(0.045) (0.032)
9.92 10.21

PREINTRE = 0.74*phyatt, Errorvar.= 0.41 , R^2 = 0.57
(0.056) (0.045)
13.25 9.06

Error Covariance for PREACHMO and PRESEFFI = 0.10
(0.023)
4.49

Error Covariance for PREACHMO and PREIMPHY = 0.096
(0.025)
3.84

Correlation Matrix of Independent Variables

	phyatt
	1.00

Goodness of Fit Statistics

Degrees of Freedom = 3
Minimum Fit Function Chi-Square = 1.24 (P = 0.74)
Normal Theory Weighted Least Squares Chi-Square = 1.25 (P = 0.74)
Chi-Square Difference with 1 Degree of Freedom = 16.16 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 0.0
90 Percent Confidence Interval for NCP = (0.0 ; 4.21)

Minimum Fit Function Value = 0.0051
Population Discrepancy Function Value (F0) = 0.0
90 Percent Confidence Interval for F0 = (0.0 ; 0.017)
Root Mean Square Error of Approximation (RMSEA) = 0.0
90 Percent Confidence Interval for RMSEA = (0.0 ; 0.076)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.87

Expected Cross-Validation Index (ECVI) = 0.11
90 Percent Confidence Interval for ECVI = (0.11 ; 0.13)
ECVI for Saturated Model = 0.12
ECVI for Independence Model = 3.55

Chi-Square for Independence Model with 10 Degrees of Freedom = 856.67
Independence AIC = 866.67
Model AIC = 25.25
Saturated AIC = 30.00
Independence CAIC = 889.18

Model CAIC = 79.26
Saturated CAIC = 97.52

Normed Fit Index (NFI) = 1.00
Non-Normed Fit Index (NNFI) = 1.01
Parsimony Normed Fit Index (PNFI) = 0.30
Comparative Fit Index (CFI) = 1.00
Incremental Fit Index (IFI) = 1.00
Relative Fit Index (RFI) = 1.00

Critical N (CN) = 2238.41

Root Mean Square Residual (RMR) = 0.0066
Standardized RMR = 0.0080
Goodness of Fit Index (GFI) = 1.00
Adjusted Goodness of Fit Index (AGFI) = 0.99
Parsimony Goodness of Fit Index (PGFI) = 0.20

Time used: 0.016 Seconds

APPENDIX I-2

LISREL OUTPUT OF POSTTEST DATA FOR CONFIRMATORY FACTOR ANALYSIS

DATE: 4/ 4/2012
TIME: 15:14

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. Jöreskog and Dag Sörbom

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The following lines were read from file **C:\Users\HakiPESMAN\Documents\ali\pre-post factor\post cfa\path.SPJ:**

```
Raw Data from file 'C:post factorcfa.psf'
Latent Variables  phyatt
Relationships
POSTENYO = phyatt
POSTSEFF = phyatt
POSTIMPH = phyatt
POSTACHM = phyatt
POSTINTR = phyatt
Path Diagram
End of Problem

Sample Size =   245
```

postcfa

Covariance Matrix

	POSTENYO	POSTSEFF	POSTIMPH	POSTACHM	POSTINTR
POSTENYO	0.82				
POSTSEFF	0.51	0.68			
POSTIMPH	0.54	0.39	0.70		
POSTACHM	0.38	0.38	0.31	0.53	
POSTINTR	0.62	0.45	0.52	0.28	1.00

postcfa

Number of Iterations = 4

LISREL Estimates (Maximum Likelihood)

Measurement Equations

POSTENYO = 0.82*phyatt, Errorvar.= 0.16 , Rý = 0.81
(0.047) (0.027)
17.31 5.84

POSTSEFF = 0.63*phyatt, Errorvar.= 0.28 , Rý = 0.59
(0.046) (0.031)
13.62 9.25

POSTIMPH = 0.66*phyatt, Errorvar.= 0.26 , Rý = 0.63
(0.046) (0.030)
14.30 8.88

POSTACHM = 0.48*phyatt, Errorvar.= 0.30 , Rý = 0.43
(0.043) (0.030)
11.10 10.10

POSTINTR = 0.74*phyatt, Errorvar.= 0.45 , Rý = 0.55
(0.057) (0.047)
13.01 9.52

Correlation Matrix of Independent Variables

	phyatt
phyatt	1.00

Goodness of Fit Statistics

Degrees of Freedom = 5
Minimum Fit Function Chi-Square = 35.97 (P = 0.00)
Normal Theory Weighted Least Squares Chi-Square = 35.46 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 30.46

90 Percent Confidence Interval for NCP = (15.18 ; 53.22)

Minimum Fit Function Value = 0.15
Population Discrepancy Function Value (F0) = 0.12
90 Percent Confidence Interval for F0 = (0.062 ; 0.22)
Root Mean Square Error of Approximation (RMSEA) = 0.16
90 Percent Confidence Interval for RMSEA = (0.11 ; 0.21)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00015

Expected Cross-Validation Index (ECVI) = 0.23
90 Percent Confidence Interval for ECVI = (0.16 ; 0.32)
ECVI for Saturated Model = 0.12
ECVI for Independence Model = 3.64

Chi-Square for Independence Model with 10 Degrees of Freedom = 876.98
Independence AIC = 886.98
Model AIC = 55.46
Saturated AIC = 30.00
Independence CAIC = 909.49
Model CAIC = 100.47
Saturated CAIC = 97.52

Normed Fit Index (NFI) = 0.96
Non-Normed Fit Index (NNFI) = 0.93
Parsimony Normed Fit Index (PNFI) = 0.48
Comparative Fit Index (CFI) = 0.96
Incremental Fit Index (IFI) = 0.96
Relative Fit Index (RFI) = 0.92

Critical N (CN) = 103.36

Root Mean Square Residual (RMR) = 0.031
Standardized RMR = 0.047
Goodness of Fit Index (GFI) = 0.95
Adjusted Goodness of Fit Index (AGFI) = 0.84
Parsimony Goodness of Fit Index (PGFI) = 0.32

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate
POSTACHM	POSTSEFF	25.9	0.11
POSTINTR	POSTACHM	14.9	-0.11

Time used: 0.031 Seconds

TIME: 15:14

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. J"reskog & Dag S"rbom

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Website: www.ssicentral.com

postcfa

Covariance Matrix

	POSTENYO	POSTSEFF	POSTIMPH	POSTACHM	POSTINTR
POSTENYO	0.82				
POSTSEFF	0.51	0.68			
POSTIMPH	0.54	0.39	0.70		
POSTACHM	0.38	0.38	0.31	0.53	
POSTINTR	0.62	0.45	0.52	0.28	1.00

postcfa

Number of Iterations = 5

LISREL Estimates (Maximum Likelihood)

Measurement Equations

POSTENYO = 0.83*phyatt, Errorvar.= 0.14 , R^2 = 0.83
(0.047) (0.029)
17.51 4.92

POSTSEFF = 0.61*phyatt, Errorvar.= 0.31 , R^2 = 0.54
(0.047) (0.033)
12.85 9.45

POSTIMPH = 0.66*phyatt, Errorvar.= 0.26 , R^2 = 0.63
(0.047) (0.030)
14.30 8.71

POSTACHM = 0.45*phyatt, Errorvar.= 0.33 , R^2 = 0.38
(0.044) (0.032)
10.17 10.19

POSTINTR = 0.75*phyatt, Errorvar.= 0.44 , R^2 = 0.56
(0.057) (0.047)
13.22 9.34

Error Covariance for POSTACHM and POSTSEFF = 0.11
(0.025)
4.38

Correlation Matrix of Independent Variables

	phyatt
	1.00

Goodness of Fit Statistics

Degrees of Freedom = 4
Minimum Fit Function Chi-Square = 11.23 (P = 0.024)
Normal Theory Weighted Least Squares Chi-Square = 10.60 (P = 0.031)
Chi-Square Difference with 1 Degree of Freedom = 24.85 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 6.60
90 Percent Confidence Interval for NCP = (0.49 ; 20.31)

Minimum Fit Function Value = 0.046
Population Discrepancy Function Value (F0) = 0.027
90 Percent Confidence Interval for F0 = (0.0020 ; 0.083)
Root Mean Square Error of Approximation (RMSEA) = 0.082
90 Percent Confidence Interval for RMSEA = (0.022 ; 0.14)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.15

Expected Cross-Validation Index (ECVI) = 0.13
90 Percent Confidence Interval for ECVI = (0.11 ; 0.19)
ECVI for Saturated Model = 0.12
ECVI for Independence Model = 3.64

Chi-Square for Independence Model with 10 Degrees of Freedom = 876.98
Independence AIC = 886.98
Model AIC = 32.60
Saturated AIC = 30.00
Independence CAIC = 909.49
Model CAIC = 82.12
Saturated CAIC = 97.52

Normed Fit Index (NFI) = 0.99
Non-Normed Fit Index (NNFI) = 0.98
Parsimony Normed Fit Index (PNFI) = 0.39
Comparative Fit Index (CFI) = 0.99
Incremental Fit Index (IFI) = 0.99
Relative Fit Index (RFI) = 0.97

Critical N (CN) = 289.37

Root Mean Square Residual (RMR) = 0.018
Standardized RMR = 0.025
Goodness of Fit Index (GFI) = 0.98
Adjusted Goodness of Fit Index (AGFI) = 0.94
Parsimony Goodness of Fit Index (PGFI) = 0.26

The Modification Indices Suggest to Add an Error Covariance

Between	and	Decrease in Chi-Square	New Estimate
POSTINTR	POSTACHM	8.8	-0.08

Time used: 0.016 Seconds

DATE: 4/ 4/2012
TIME: 15:14

LISREL 8.80 (STUDENT EDITION)

BY

Karl G. Jöreskog and Dag Sörbom

postcfa

Covariance Matrix

	POSTENYO	POSTSEFF	POSTIMPH	POSTACHM	POSTINTR
POSTENYO	0.82				
POSTSEFF	0.51	0.68			
POSTIMPH	0.54	0.39	0.70		
POSTACHM	0.38	0.38	0.31	0.53	
POSTINTR	0.62	0.45	0.52	0.28	1.00

postcfa

Number of Iterations = 5

LISREL Estimates (Maximum Likelihood)

Measurement Equations

POSTENYO = 0.82*phyatt, Errorvar.= 0.16 , R^2 = 0.81
(0.047) (0.028)
17.28 5.52

POSTSEFF = 0.61*phyatt, Errorvar.= 0.31 , R^2 = 0.54
(0.047) (0.033)
12.86 9.40

POSTIMPH = 0.67*phyatt, Errorvar.= 0.26 , R^2 = 0.63
(0.046) (0.029)
14.43 8.79

POSTACHM = 0.47*phyatt, Errorvar.= 0.31 , R^2 = 0.41
(0.044) (0.032)
10.58 9.76

POSTINTR = 0.76*phyatt, Errorvar.= 0.42 , R^2 = 0.58
(0.056) (0.046)
13.45 9.11

Error Covariance for POSTACHM and POSTSEFF = 0.096
(0.025)
3.77

Error Covariance for POSTINTR and POSTACHM = -0.08
(0.025)
-3.06

Correlation Matrix of Independent Variables

	phyatt
	1.00

Goodness of Fit Statistics

Degrees of Freedom = 3
Minimum Fit Function Chi-Square = 1.90 (P = 0.59)
Normal Theory Weighted Least Squares Chi-Square = 1.94 (P = 0.58)
Chi-Square Difference with 1 Degree of Freedom = 8.66 (P = 0.0033)
Estimated Non-centrality Parameter (NCP) = 0.0
90 Percent Confidence Interval for NCP = (0.0 ; 6.13)

Minimum Fit Function Value = 0.0078
Population Discrepancy Function Value (F0) = 0.0

90 Percent Confidence Interval for F0 = (0.0 ; 0.025)
Root Mean Square Error of Approximation (RMSEA) = 0.0
90 Percent Confidence Interval for RMSEA = (0.0 ; 0.092)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.77

Expected Cross-Validation Index (ECVI) = 0.11
90 Percent Confidence Interval for ECVI = (0.11 ; 0.14)
ECVI for Saturated Model = 0.12
ECVI for Independence Model = 3.64

Chi-Square for Independence Model with 10 Degrees of Freedom = 876.98
Independence AIC = 886.98
Model AIC = 25.94
Saturated AIC = 30.00
Independence CAIC = 909.49
Model CAIC = 79.96
Saturated CAIC = 97.52

Normed Fit Index (NFI) = 1.00
Non-Normed Fit Index (NNFI) = 1.00
Parsimony Normed Fit Index (PNFI) = 0.30
Comparative Fit Index (CFI) = 1.00
Incremental Fit Index (IFI) = 1.00
Relative Fit Index (RFI) = 0.99

Critical N (CN) = 1456.65

Root Mean Square Residual (RMR) = 0.0062
Standardized RMR = 0.0081
Goodness of Fit Index (GFI) = 1.00
Adjusted Goodness of Fit Index (AGFI) = 0.98
Parsimony Goodness of Fit Index (PGFI) = 0.20

Time used: 0.016 Seconds

APPENDIX K

SPSS OUTPUT FOR HOMOGENEITY OF REGRESSION FOR MANCOVA ASSUMPTION

The default error term in MANOVA has been changed from WITHIN CELLS to WITHIN+RESIDUAL. Note that these are the same for all full factorial designs.

* * * * * * A n a l y s i s o f V a r i a n c e * * * * * *

253 cases accepted.
0 cases rejected because of out-of-range factor values.
0 cases rejected because of missing data.
4 non-empty cells.

4 designs will be processed.

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 1 * * * * * *

Order of Variables for Analysis

Variates Covariates

postEAT
postSPST
postPAS

3 Dependent Variables
0 Covariates

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 1 * * * * * *

Multivariate Tests of Significance
Tests using UNIQUE sums of squares and WITHIN+RESIDUAL error term

Source of Variation	Wilks	Approx F	Hyp. DF	Error DF	Sig of F
PREEAT_1	,895	9,232	3,00	235,000	,000

PRESPST_1 ,901 8,647 3,00 235,000 ,000
PREPAS_1 ,578 57,290 3,00 235,000 ,000
MOT ,965 2,878 3,00 235,000 ,037
MODE ,989 ,834 3,00 235,000 ,476
MOT BY MODE ,993 ,543 3,00 235,000 ,653
POOL(PREEAT_1 PRESP ,852 1,432 27,00 686,964 ,073
ST_1 PREPAS_1) BY MO
T + POOL(PREEAT_1 PR
ESPST_1 PREPAS_1) BY
MODE + POOL(PREEAT_
1 PRESPST_1 PREPAS_1
) BY MOT BY MODE

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 2 * * * * * *

Order of Variables for Analysis

Variates Covariates

postEAT

1 Dependent Variable
0 Covariates

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 2 * * * * * *

Tests of Significance for postEAT using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	3855,16	237	16,27		
PREEAT_1	395,78	1	395,78	24,33	,000
PRESPST_1	5,40	1	5,40	,33	,565
PREPAS_1	,20	1	,20	,01	,912
MOT	5,76	1	5,76	,35	,552
MODE	4,08	1	4,08	,25	,617
MOT BY MODE	25,22	1	25,22	1,55	,214
POOL(PREEAT_1 PRESPS T_1 PREPAS_1) BY MOT + POOL(PREEAT_1 PRE SPST_1 PREPAS_1) BY MODE + POOL(PREEAT_1 PRESPST_1 PREPAS_1) BY MOT BY MODE	119,16	9	13,24	,81	,604
(Model)	1247,72	15	83,18	5,11	,000
(Total)	5102,88	252	20,25		

R-Squared = ,245
Adjusted R-Squared = ,197

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 3 * * * * * *

Order of Variables for Analysis

Variates Covariates

postSPST

1 Dependent Variable
0 Covariates

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 3 * * * * * *

Tests of Significance for postSPST using UNIQUE sums of squares

Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	6390,82	237	26,97		
PREEAT_1	181,03	1	181,03	6,71	,010
PRESPST_1	602,11	1	602,11	22,33	,000
PREPAS_1	23,56	1	23,56	,87	,351
MOT	179,42	1	179,42	6,65	,010
MODE	13,14	1	13,14	,49	,486
MOT BY MODE	6,34	1	6,34	,24	,628
POOL(PREEAT_1 PRESPST_1 PREPAS_1) BY MOT + POOL(PREEAT_1 PRESPST_1 PREPAS_1) BY MODE + POOL(PREEAT_1 PRESPST_1 PREPAS_1) BY MOT BY MODE	511,09	9	56,79	2,11	,030
(Model)	6804,55	15	453,64	16,82	,000
(Total)	13195,38	252	52,36		

R-Squared = ,516
Adjusted R-Squared = ,485

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 4 * * * * * *

Order of Variables for Analysis

Variates Covariates

postPAS

1 Dependent Variable
0 Covariates

- -

* * * * * * A n a l y s i s o f V a r i a n c e -- design 4 * * * * * *

Tests of Significance for postPAS using UNIQUE sums of squares

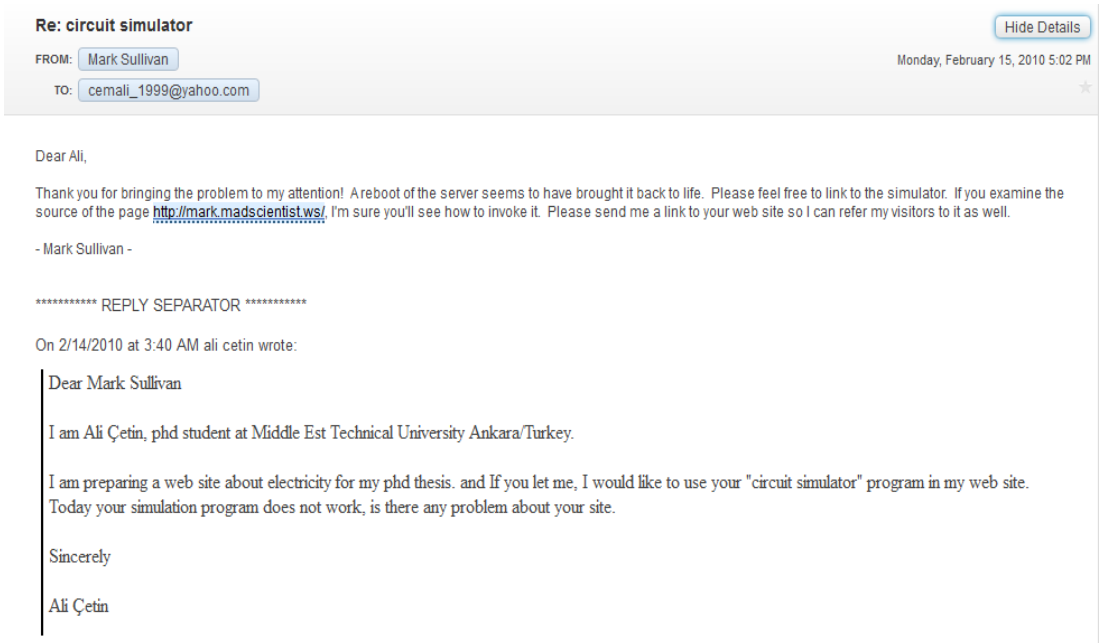
Source of Variation	SS	DF	MS	F	Sig of F
WITHIN+RESIDUAL	39472,94	237	166,55		
PREEAT_1	34,75	1	34,75	,21	,648
PRESPST_1	505,50	1	505,50	3,04	,083
PREPAS_1	28569,78	1	28569,78	171,54	,000
MOT	370,49	1	370,49	2,22	,137
MODE	305,24	1	305,24	1,83	,177
MOT BY MODE	11,26	1	11,26	,07	,795
POOL(PREEAT_1 PRESPST_1 PREPAS_1) BY MOT + POOL(PREEAT_1 PRESPST_1 PREPAS_1) BY MODE + POOL(PREEAT_1 PRESPST_1 PREPAS_1) BY MOT BY MODE	2468,01	9	274,22	1,65	,103
(Model)	32788,75	15	2185,92	13,12	,000
(Total)	72261,69	252	286,75		

R-Squared = ,454
Adjusted R-Squared = ,419

- -

APPENDIX L-1

PERMISSION FOR CIRCUIT SIMULATOR



Re: circuit simulator Hide Details

FROM: Mark Sullivan

TO: cemali_1999@yahoo.com

Monday, February 15, 2010 5:02 PM

Dear Ali,

Thank you for bringing the problem to my attention! A reboot of the server seems to have brought it back to life. Please feel free to link to the simulator. If you examine the source of the page http://mark.madscientist.ws/, I'm sure you'll see how to invoke it. Please send me a link to your web site so I can refer my visitors to it as well.

- Mark Sullivan -

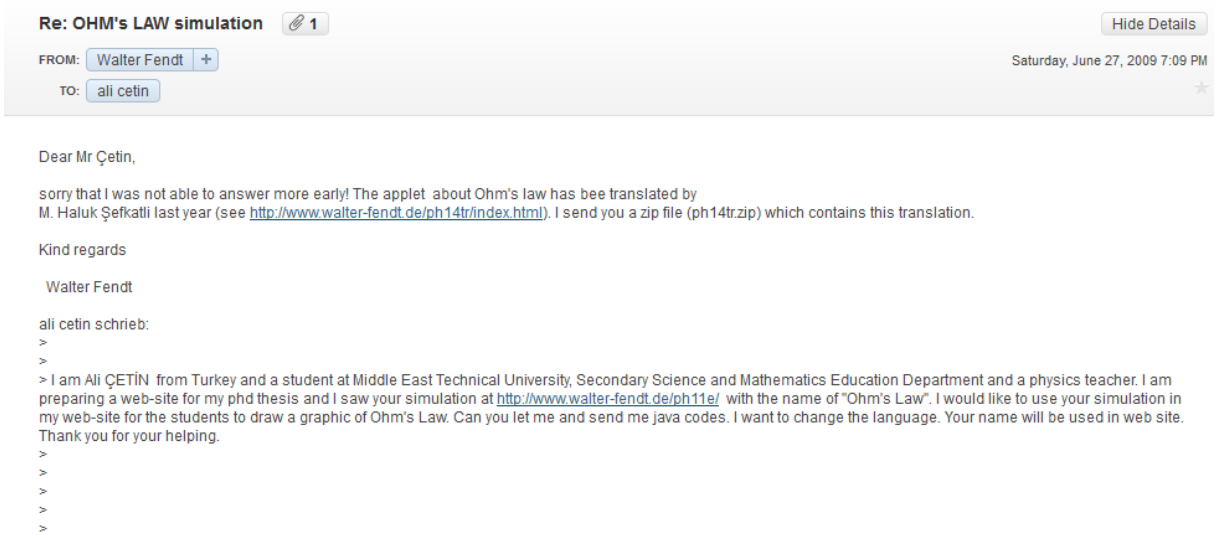
********** REPLY SEPARATOR **********

On 2/14/2010 at 3:40 AM ali cetin wrote:

> Dear Mark Sullivan
>
> I am Ali Çetin, phd student at Middle Est Technical University Ankara/Turkey.
>
> I am preparing a web site about electricity for my phd thesis. and If you let me, I would like to use your "circuit simulator" program in my web site. Today your simulation program does not work, is there any problem about your site.
>
> Sincerely
>
> Ali Çetin

APPENDIX L-2

PERMISSION FOR PHYSICS APPLETS



Re: OHM's LAW simulation 1 Hide Details

FROM: Walter Fendt + Saturday, June 27, 2009 7:09 PM

TO: ali cetin

Dear Mr Çetin,

sorry that I was not able to answer more early! The applet about Ohm's law has bee translated by
M. Haluk Şefkatli last year (see http://www.walter-fendt.de/ph14tr/index.html). I send you a zip file (ph14tr.zip) which contains this translation.

Kind regards

Walter Fendt

ali cetin schrieb:
>
>
> I am Ali ÇETİN from Turkey and a student at Middle East Technical University, Secondary Science and Mathematics Education Department and a physics teacher. I am preparing a web-site for my phd thesis and I saw your simulation at http://www.walter-fendt.de/ph11e/ with the name of "Ohm's Law". I would like to use your simulation in my web-site for the students to draw a graphic of Ohm's Law. Can you let me and send me java codes. I want to change the language. Your name will be used in web site. Thank you for your helping.
>
>
>
>
>

APPENDIX L-3

PERMISSION FOR PHET SIMULATIONS

Re: About your simulations Hide Details

FROM: phethelp Monday, February 15, 2010 7:16 PM

TO: ali cetin

Ali,
You are welcome to use our simulations in your research project. We do prefer that you link to our site as opposed to hosting the sims directly on your site. Here's an example of how you could do this for a sim translated into Turkish:
http://phet.colorado.edu/sims/circuit-construction-kit/circuit-construction-kit-ac_tr.jnlp
If you plan to use sims that are not already translated into Turkish you can use the Translation Utility to make and submit a translation.
Of course always make sure you are citing PhET as the source of the sims. Good luck with your research and we would love to hear about your progress and results when you'd like to share that information.
Best,
Marj

On Sun, Feb 14, 2010 at 3:51 AM, ali cetin <cemali_1999@yahoo.com> wrote:
> Dear Madam/Sir
>
> I am Ali Çetin phd student at Middle East Technical University Ankara/
> Turkey. I would like to use your three simulations in my research project.
>
> The name of my research is :
>
> The effects of blended web based learning with inquiry and expository
> teaching methods on 9th grade students' physics achievements, physics
> attitudes, science process skills and internet attitudes about electricity
> subject.
>
> For thi project, a web site is prepared with the name of
> www.dersfizik.net/inqu
>
> In this web site I used your three simulations:
> 1. Circuit construction Kit (DC Only)
> (http://www.dersfizik.net/inqu/index.php?page=79)
> 2. Resistance in a wire (http://www.dersfizik.net/inqu/index.php?page=32)
> 3. Battery resistor circuits
> (http://www.dersfizik.net/inqu/index.php?page=34)
>
> (If you want to see your simulations, click below links and use Id and
> passwords below.)
> (Id: deneme ; password: 332211)
>
> when students join my web site- there is a link to these simulations in your
> web site. and then they can use the simulations in English. However there
> will be nearly 300 students in my study and they don't know English well.
> Today I saw "translation utility" in your site. If you let me, I would like
> to download your simulations to my web site and use them directly (starting
> to simulations, it will be written "taken by phet.colorado.edu").
>
> Would you let me use it like that way?
>
> Sincerely
>
> Ali ÇETİN
>
>

--
PhET Help Desk
phethelp@colorado.edu

Physics Education Technology
University of Colorado
390 UCB
Boulder, CO 80309-0440

APPENDIX L-4

PERMISSION MINISTRY OF EDUCATION

T.C.
ÇANKAYA KAYMAKAMLIĞI
İlçe Milli Eğitim Müdürlüğü

BÖLÜM : Strateji Geliştirme
SAYI : B.08.4.MEM.4.06.02.11.312/ 13608 30 03 2010
KONU : Ali ÇETİN
Araştırma İzni

İLGİLİ OKUL MÜDÜRLÜKLERİNE

İlgi : Ankara Valiliği Milli Eğitim Müdürlüğünün 24/03/2010 tarihli ve 27570 sayılı yazısı.

ODTÜ Ortaöğretim Fen ve Matematik Alanları Eğitimi EABD Doktora öğrencisi Ali ÇETİN'in "***Web desteği ile harmanlanmış sorgulayıcı ve açıklayıcı öğretim yöntemlerinin 9. sınıf öğrencilerinin Fizik Dersine ve internete karşı tutumlarına, bilimsel süreç becerilerine ve fizik başarılarına elektrik konusundaki etkileri***" konulu tez çalışması ile ilgili okulunuzda yapma isteğinin uygun görüldüğüne ilişkin ilgi yazı ekte gönderilmiştir.

Mührülü anket örneği araştırmacıya İl Milli Eğitim Müdürlüğünce ulaştırılmış olup, uygulama yapılacak sayıda araştırmacı tarafından çoğaltılarak, araştırmanın **gönüllülük esasına** dayalı olarak yönerge esasları çerçevesinde uygulattırılması hususunda gereğini rica ederim.

Yaşar KOÇAK
Müdür a.
Şube Müdürü

Ek : 1 Yazı Örneği
1 Liste

Adres: Kumrular Caddesi 3.Sokak Kızılay/ANKARA
Tel: 418 68 75 – 418 84 58
Fax: 419 27 84 - 85
Web : http://cankaya.meb.gov.tr
e-posta : cankaya06_strateji@meb.gov.tr

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

BÖLÜM : İstatistik Bölümü
SAYI : B.B.08.4.MEM.4.06.00.06-312/ 27570 24/03/2010
KONU : Araştırma İzni
Ali ÇETİN

ÇANKAYA KAYMAKAMLIĞINA
(İlçe Milli Eğitim Müdürlüğü)

İlgi: a) M.E.B. Bağlı Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik İzin ve Uygulama Yönergesi.
b) MEB EARGED' in araştırma izinlerine ilişkin 11/04/2007 tarih ve 1950 sayılı yazısı.
c) 02/09/2009 tarih ve 74835 sayılı Valilik Onayı.
d) 05/11/2009 tarih ve 98610 sayılı Valilik Onayı.
e) Orta Doğu Teknik Üniversitesinin 10/03/2010 tarih ve 400-1584 sayılı yazısı.

Orta Doğu Teknik Üniversitesi Ortaöğretim Fen ve Matematik Alanları Eğitimi EABD Doktora öğrencisi Ali ÇETİN'in **"Web desteği ile harmanlanmış sorgulayıcı ve açıklayıcı öğretim yöntemlerinin 9. sınıf öğrencilerinin Fizik Dersine ve internete karşı tutumlarına, bilimsel süreç becerilerine ve fizik başarılarına elektrik konusunda ki etkiler."** konulu araştırma ile ilgili anketi, ek listedeki ilçeniz okullarında uygulama yapılması isteği Müdürlüğümüz Değerlendirme Komisyonunca uygun görülmüştür.

Mühürlü anket örnekleri (17 sayfa) araştırmacıya ulaştırılmış olup, uygulama yapılacak sayıda araştırmacı tarafından çoğaltılarak, araştırmanın ilgi (a) yönerge çerçevesinde gönüllülük esasına göre uygulanmasını rica ederim.

Gülçin UYSAL
Vali a.
Müdür Yardımcısı

EKLER :
1-Okul Listesi (1 Sayfa)

İl Milli Eğitim Müdürlüğü-Beşevler / ANKARA
İstatistik Bölümü
istatistik06@meb.gov.tr
Bilgi İçin : Nermin ÇELENK
Tel : 223 75 22----212 66 40-200
Fax: 223 75 22

ODTÜ 2006

Orta Doğu Teknik Üniversitesi İnsan Araştırmaları Etik Kurulu Başvuru Formu

Orta Doğu Teknik Üniversitesi (ODTÜ) bünyesinde yapılan ve/ya ODTÜ çalışanları/öğrencileri tarafından yürütülen ve insan katılımcılardan bilgi toplamayı gerektiren tüm çalışmalar, ODTÜ İnsan Araştırmaları Etik Kurulu incelemesine tabidir. Bu başvuru formu doldurulduktan sonra diğer gerekli belgelerle birlikte ODTÜ İnsan Araştırmaları Etik Kuruluna başvuru yapılmalıdır. Çalışmalar, Etik Kurulun onayının alınmasından sonra aktif olarak başlatılmalıdır.

1. Araştırmanın başlığı: Web desteği ile harmanlanmış sorgulayıcı ve açıklayıcı öğretim yöntemlerinin 9. sınıf öğrencilerinin fizik dersine ve internete karşı tutumlarına, bilimsel süreç becerilerine ve fizik başarılarına elektrik konusundaki etkileri

2. Araştırmanın niteliği (Uygun olan kutuyu işaretleyiniz) ☐ Öğretim Üyesi Araştırması ☒ Doktora Tezi
   ☐ Yüksek Lisans Tezi ☐ Diğer (belirtiniz) _____

3. Araştırmacının/Araştırmacıların:
   Adı-Soyadı ____Ali ÇETİN_____ Bölümü __QFMAE__Fizik Öğretmenliği_ Telefonu _505__3410679_____
   Adresi ____Natoyolu Caddesi Tuzluçayır Mahallesi No:41/6 Mamak /ANKARA_____
   _____ E-posta adresi _e115199@metu.edu.tr__

4. (Varsa) Danışmanın: Adı-Soyadı__Dr. Ömer Faruk Özdemir_____ Telefonu __312 210 3691 _____

5. Veri Toplanacak Dönem: Başlangıç __01_/_03_/_2010____ Bitiş _01_/_05_/_2010____

6. Veri Toplanması Planlanan Yerler/Mekanlar, Kurum ve Kuruluşlar:
   a. ____Özel _____ e. _____
   b. ____Özel _____ f. _____
   c. ____ Anadolu Lisesi_____ g. _____
   d. ____ Anadolu Lisesi_____ h. _____

7. Çalışmanın/Projenin desteklenip desteklenmediği: ☒ Desteksiz ☐ Destekli
   Desteklenen bir proje ise, destekleyen kurum: ☐ Üniversite ☐ TUBİTAK
   ☐ Uluslararası (belirtiniz) _____ ☐ Diğer (belirtiniz) _____

8. Başvurunun statüsü: ☒ Yeni başvuru ☐ Revize edilmiş başvuru ☐ Bir önceki projenin devamı
   Bir önceki projenin devamı ise, yürütülen çalışma önceden onaylanan çalışmadan herhangi bir farklılık gösteriyor mu? ☐ Evet ☐ Hayır
   Evet ise açıklayınız: _____
   _____
   _____

* Lisans Öğrencilerinin araştırmalarını yönlendiren akademik danışmanlarının veya hocalarının olması gerekmektedir.

APPENDIX M

DATA USED IN THE STUDY

GENDER	MOT	Mode	preEAT	prePAS	preSPST	postEAT	postPAS	postSPST
1	,00	,00	8,00	36,00	83,00	9,00	36,50	90,00
1	,00	,00	7,00	37,50	73,00	13,00	26,00	80,00
2	,00	,00	11,00	27,00	72,00	7,00	27,00	50,00
1	,00	,00	18,00	35,50	99,00	16,00	32,00	93,00
1	,00	,00	4,00	34,00	85,00	14,00	26,00	68,00
2	,00	,00	8,00	39,50	47,00	18,00	38,00	103,00
1	,00	,00	13,00	35,00	112,00	15,00	29,00	94,00
1	,00	,00	7,00	40,00	96,00	15,00	30,00	86,77
1	,00	,00	18,00	35,50	91,00	14,00	37,50	38,00
2	,00	,00	18,00	38,50	74,00	21,00	37,00	86,00
2	,00	,00	12,00	35,00	87,00	17,00	38,50	93,00
1	,00	,00	8,00	38,00	73,00	5,00	25,00	75,00
1	,00	,00	15,00	37,50	93,00	16,00	26,00	107,00
2	,00	,00	17,00	35,00	36,00	14,00	29,00	47,16
1	1,00	,00	17,00	38,00	95,00	19,00	30,50	88,00
2	1,00	,00	12,00	38,00	69,00	17,00	39,50	74,00
2	1,00	,00	13,00	37,00	73,00	20,00	39,50	72,74
2	1,00	,00	16,00	40,00	79,00	14,00	33,00	75,00
2	1,00	,00	19,00	39,00	76,00	23,00	37,50	79,00
1	1,00	,00	15,00	34,00	88,00	12,00	30,50	92,00
2	1,00	,00	21,00	35,00	88,00	21,00	34,50	89,00
2	1,00	,00	15,00	39,00	77,00	15,00	34,50	74,00
2	1,00	,00	15,00	32,00	85,00	14,00	37,00	89,00
1	1,00	,00	18,00	20,00	111,00	11,00	20,50	110,00
1	1,00	,00	17,00	38,00	79,00	14,00	32,00	103,00
2	1,00	,00	16,00	34,50	65,00	19,00	15,50	77,00
1	1,00	,00	6,00	36,00	72,00	15,00	34,50	84,00
1	1,00	,00	14,00	38,50	88,46	15,00	32,00	84,00
2	1,00	,00	17,00	36,00	62,00	17,00	35,50	66,00
2	1,00	,00	17,00	27,00	94,00	13,00	37,50	89,00
1	1,00	,00	12,00	38,00	73,00	19,00	15,50	74,33
2	1,00	,00	18,00	37,00	90,48	22,00	9,50	82,39
2	1,00	,00	12,68	33,00	80,44	9,00	33,00	76,00
2	1,00	,00	12,00	38,00	94,00	16,00	37,00	105,00
1	1,00	,00	11,00	37,00	84,00	19,00	38,50	78,00
1	1,00	,00	18,00	27,00	82,00	19,00	34,00	90,00

1	1,00	,00	18,00	31,50	119,00	11,00	21,00	120,00
2	,00	1,00	17,00	34,50	102,00	23,00	33,50	96,00
2	,00	1,00	13,00	33,50	56,00	20,00	40,00	60,00
2	,00	1,00	12,00	40,00	100,00	24,00	36,00	87,00
2	,00	1,00	18,00	37,00	75,43	21,00	39,00	78,46
2	,00	1,00	15,00	32,50	82,00	19,00	35,50	54,00
2	,00	1,00	16,00	31,00	78,00	24,00	40,00	89,00
1	,00	1,00	19,00	36,00	82,00	21,00	36,50	89,00
1	,00	1,00	11,00	24,50	79,30	19,00	38,50	81,00
2	,00	1,00	14,00	40,00	80,00	21,00	38,50	81,66
2	,00	1,00	11,00	39,00	94,00	21,00	39,50	110,42
2	,00	1,00	14,00	34,50	98,00	21,00	39,50	120,00
1	,00	1,00	22,00	30,00	93,22	24,00	29,00	95,00
1	,00	1,00	21,00	29,00	83,00	20,00	37,00	62,00
2	,00	1,00	12,00	27,00	45,00	22,00	39,00	52,00
2	,00	1,00	16,00	30,00	85,00	25,00	35,50	90,49
2	,00	1,00	16,00	38,00	57,00	23,00	40,00	63,00
2	,00	1,00	10,00	37,50	36,00	14,00	37,00	54,97
1	,00	1,00	17,00	36,00	77,00	25,00	39,00	76,00
2	,00	1,00	17,00	24,50	91,00	24,00	35,00	96,81
2	,00	1,00	17,00	34,50	80,00	23,00	39,50	71,00
1	,00	1,00	16,00	31,00	65,00	25,00	29,50	92,00
1	,00	1,00	12,68	24,00	111,00	25,00	25,50	92,00
2	1,00	1,00	15,00	37,00	92,92	26,00	39,00	99,00
1	1,00	1,00	6,00	30,50	101,00	23,00	30,50	96,00
1	1,00	1,00	16,00	36,50	28,00	25,00	35,50	120,00
1	1,00	1,00	14,00	35,50	100,00	18,00	36,00	114,00
1	1,00	1,00	15,00	31,00	88,00	24,00	30,00	94,00
2	1,00	1,00	17,00	38,00	75,00	24,00	39,00	79,00
2	1,00	1,00	19,00	39,00	71,00	24,00	38,50	80,00
2	1,00	1,00	18,00	38,00	78,00	27,00	40,00	84,00
2	1,00	1,00	15,00	36,00	80,44	23,00	37,00	74,12
2	1,00	1,00	19,00	37,50	82,00	25,00	40,00	84,00
2	1,00	1,00	13,00	39,00	47,00	19,00	36,50	79,00
2	1,00	1,00	16,00	37,00	63,00	25,00	39,00	71,00
2	1,00	1,00	13,00	32,50	70,00	18,00	38,00	79,00
2	1,00	1,00	18,00	37,00	119,00	25,00	40,00	85,00
1	1,00	1,00	10,00	35,50	81,30	5,00	36,00	81,00
2	1,00	1,00	15,00	37,00	84,00	23,00	39,50	96,00
2	1,00	1,00	14,00	37,00	86,00	24,00	39,50	82,00
2	1,00	1,00	15,00	35,00	108,00	21,00	38,50	102,00
2	1,00	1,00	16,00	30,50	90,00	26,00	36,00	101,00
1	1,00	1,00	14,00	37,50	90,72	21,00	38,00	87,00
2	1,00	1,00	18,00	29,00	64,00	23,00	35,00	69,00

2	1,00	1,00	17,00	26,00	74,00	24,00	35,50	79,00
1	1,00	1,00	14,00	39,50	76,00	18,00	35,00	81,00
1	1,00	1,00	18,00	38,00	75,00	21,00	37,00	94,46
1	1,00	,00	20,00	40,00	103,00	21,00	40,00	84,00
2	1,00	,00	17,00	38,00	96,00	18,00	39,00	98,00
1	1,00	,00	15,00	35,50	73,00	17,00	39,00	97,00
2	1,00	,00	16,00	31,00	87,00	19,00	37,00	81,00
1	1,00	,00	16,00	40,00	94,00	19,00	38,00	92,00
2	1,00	,00	18,00	38,00	93,00	21,00	40,00	109,00
1	1,00	,00	15,00	37,00	80,85	22,00	28,00	81,00
1	1,00	,00	18,00	39,00	81,00	19,00	38,00	80,00
1	1,00	,00	12,00	23,00	92,00	11,00	25,00	102,00
1	1,00	,00	14,00	34,00	91,00	20,00	26,00	71,22
2	1,00	,00	14,00	38,00	65,00	16,00	40,00	40,00
1	1,00	,00	16,00	38,00	72,00	21,00	39,00	77,00
1	1,00	,00	16,00	37,00	81,00	17,00	38,00	99,00
1	1,00	,00	17,00	35,00	80,34	22,00	39,00	96,77
1	1,00	,00	15,00	38,00	94,00	20,00	36,50	82,00
2	1,00	,00	17,00	35,00	91,00	20,00	39,00	86,00
2	1,00	,00	12,00	38,00	95,00	20,00	39,00	94,00
2	1,00	,00	21,00	28,50	76,85	22,00	36,00	74,50
2	1,00	,00	11,00	34,00	67,00	23,00	37,00	61,12
2	1,00	,00	14,00	38,00	74,00	22,00	37,00	87,00
1	1,00	,00	11,00	32,50	84,00	20,00	33,00	88,00
1	1,00	,00	16,00	38,00	102,00	20,00	35,00	88,00
2	1,00	,00	20,00	34,00	86,00	22,00	38,00	67,00
2	1,00	,00	13,00	40,00	58,00	20,00	39,00	57,00
1	1,00	,00	15,00	34,00	79,00	19,00	32,00	82,00
2	1,00	,00	20,00	38,00	84,00	18,00	38,50	70,00
2	1,00	,00	13,00	38,00	53,00	10,00	40,00	59,24
2	1,00	,00	12,68	31,69	80,98	16,00	25,50	86,77
2	1,00	,00	12,68	31,69	80,98	21,00	36,00	66,00
2	1,00	,00	12,68	31,69	80,98	20,00	36,00	59,00
1	1,00	1,00	11,00	35,00	87,00	17,00	32,00	86,00
1	1,00	1,00	7,00	39,00	92,00	17,00	27,00	92,92
1	1,00	1,00	12,00	36,00	81,00	24,00	40,00	68,00
1	1,00	1,00	14,00	40,00	93,00	17,00	38,50	96,00
1	1,00	1,00	15,00	38,00	63,34	21,00	38,50	51,89
1	1,00	1,00	18,00	37,00	92,00	19,00	33,00	98,00
1	1,00	1,00	15,00	33,00	108,00	15,00	36,50	101,00
1	1,00	1,00	11,00	38,00	82,00	13,00	36,50	89,12
2	1,00	1,00	15,00	31,50	93,00	18,00	35,50	95,00
2	1,00	1,00	11,00	38,00	90,34	18,00	39,00	95,00
1	1,00	1,00	9,00	38,00	96,00	23,00	39,00	95,00

1	1,00	1,00	9,00	37,00	77,00	15,00	40,00	82,00
2	1,00	1,00	20,00	40,00	88,00	22,00	39,00	93,00
1	1,00	1,00	16,00	33,50	88,78	19,00	36,50	93,00
2	1,00	1,00	16,00	34,00	84,00	19,00	37,00	81,00
2	1,00	1,00	16,00	37,00	82,00	19,00	37,00	90,00
2	1,00	1,00	9,00	39,00	88,00	17,00	35,00	78,00
1	1,00	1,00	12,00	39,00	71,22	16,00	39,00	102,81
1	1,00	1,00	8,00	33,00	64,00	17,00	37,00	61,46
1	1,00	1,00	16,00	39,00	95,00	13,00	37,00	90,00
2	1,00	1,00	15,00	33,50	83,00	19,00	38,50	80,00
2	1,00	1,00	13,00	37,50	100,00	12,00	24,50	91,22
2	1,00	1,00	15,00	36,00	81,24	18,00	35,50	82,00
1	1,00	1,00	9,00	24,00	86,00	17,00	37,00	74,00
2	1,00	1,00	10,00	37,00	61,22	17,00	31,50	59,00
2	1,00	1,00	15,00	37,00	60,06	16,00	37,00	57,00
2	1,00	1,00	16,00	26,50	79,00	17,00	33,50	85,12
2	1,00	1,00	20,00	37,00	60,00	8,00	39,00	66,00
1	1,00	1,00	3,00	33,00	57,00	17,00	30,50	40,00
2	,00	1,00	10,00	40,00	92,24	14,00	40,00	97,00
2	,00	1,00	10,00	38,00	74,00	18,00	36,00	66,00
2	,00	1,00	10,00	33,00	83,00	18,00	34,50	85,00
1	,00	1,00	9,00	40,00	99,00	17,00	40,00	81,00
1	,00	1,00	12,00	35,00	62,72	15,00	35,00	64,24
1	,00	1,00	13,00	28,50	99,22	23,00	35,50	103,00
1	,00	1,00	12,68	38,00	102,00	14,00	38,50	90,00
1	,00	1,00	10,00	30,00	85,00	22,00	35,50	68,00
2	,00	1,00	11,00	40,00	84,00	20,00	38,00	74,00
1	,00	1,00	12,00	34,50	98,00	16,00	39,50	109,00
2	,00	1,00	10,00	38,50	83,00	18,00	38,50	75,00
1	,00	1,00	9,00	30,00	97,87	20,00	39,00	99,00
2	,00	1,00	10,00	32,00	88,00	14,00	39,00	86,00
2	,00	1,00	8,00	35,50	86,00	22,00	33,00	68,00
2	,00	1,00	15,00	40,00	97,00	21,00	40,00	88,00
2	,00	1,00	11,00	38,50	83,00	10,00	38,00	71,00
1	,00	1,00	11,00	38,50	106,00	19,00	38,00	114,00
2	,00	1,00	19,00	39,00	92,00	17,00	39,00	93,00
2	,00	1,00	13,00	32,50	82,00	21,00	35,00	78,33
2	,00	1,00	11,00	29,00	88,00	21,00	34,50	75,00
1	,00	1,00	16,00	19,00	113,00	19,00	26,00	112,00
1	,00	1,00	14,00	39,00	101,00	19,00	39,00	95,00
1	,00	1,00	2,00	38,00	99,22	14,00	31,00	94,12
2	,00	1,00	13,00	37,50	91,00	19,00	35,00	80,00
2	,00	1,00	12,00	37,00	89,00	16,00	35,00	83,00
1	,00	1,00	8,00	40,00	96,24	14,00	27,50	109,00

1	,00	1,00	13,00	24,00	84,00	15,00	31,00	91,00
1	,00	1,00	13,00	27,50	107,22	20,00	38,00	99,00
1	,00	,00	12,00	36,50	63,00	17,00	35,00	55,00
1	,00	,00	13,00	35,50	63,00	19,00	38,50	55,00
1	,00	,00	5,00	36,00	64,00	20,00	37,00	120,00
1	,00	,00	12,00	38,00	80,44	18,00	39,00	76,00
1	,00	,00	13,00	39,50	104,00	17,00	35,00	88,00
2	,00	,00	12,00	36,50	49,00	18,00	39,00	60,00
2	,00	,00	9,00	36,00	52,00	15,00	37,00	52,00
2	,00	,00	17,00	39,00	109,00	20,00	33,50	119,00
2	,00	,00	14,00	35,50	82,11	18,00	39,00	81,00
2	,00	,00	12,00	38,50	50,00	7,00	40,00	50,00
2	,00	,00	16,00	30,00	84,00	22,00	37,00	85,00
2	,00	,00	14,00	28,00	52,00	19,00	34,00	53,00
1	,00	,00	14,00	38,50	81,00	21,00	37,50	75,00
1	,00	,00	13,00	33,00	88,00	21,00	38,00	89,00
2	,00	,00	15,00	37,00	81,00	22,00	39,00	72,00
2	,00	,00	15,00	40,00	81,00	21,00	38,50	83,00
1	,00	,00	15,00	39,00	79,44	20,00	37,00	80,00
1	,00	,00	12,00	34,50	95,00	4,00	28,00	100,00
1	,00	,00	17,00	37,50	88,00	15,00	38,00	87,00
1	,00	,00	16,00	38,00	59,00	20,00	32,50	64,00
2	,00	,00	12,00	35,50	46,00	21,00	40,00	70,00
1	,00	,00	20,00	36,50	120,00	20,00	40,00	120,00
1	,00	,00	20,00	40,00	115,00	21,00	39,50	115,00
2	,00	,00	5,00	38,00	88,26	16,00	21,00	99,00
2	,00	,00	14,00	36,00	111,00	18,00	38,50	81,42
1	,00	,00	5,00	28,00	105,22	17,00	39,00	107,42
2	,00	,00	5,00	33,00	81,00	21,00	30,50	85,00
1	1,00	1,00	10,00	37,00	81,00	19,00	35,00	79,00
2	1,00	1,00	10,00	30,00	88,00	18,00	33,50	94,00
1	1,00	1,00	10,00	12,00	52,00	20,00	22,00	64,00
2	1,00	1,00	5,00	23,00	72,44	17,00	20,00	74,00
1	1,00	1,00	11,00	33,00	71,00	19,00	34,50	80,00
1	1,00	1,00	11,00	38,50	82,00	15,00	36,00	87,00
2	1,00	1,00	13,00	21,00	82,00	18,00	36,00	92,33
1	1,00	1,00	3,00	33,50	93,00	21,00	38,00	100,00
2	1,00	1,00	7,00	20,50	59,00	9,00	21,00	83,00
1	1,00	1,00	1,00	26,00	91,00	15,00	15,50	111,00
2	1,00	1,00	3,00	15,50	40,00	15,00	24,00	60,00
2	1,00	1,00	12,68	31,69	80,98	20,00	40,00	60,00
1	1,00	1,00	12,68	31,69	80,98	20,00	22,50	97,00
1	1,00	1,00	12,68	31,69	80,98	19,00	35,00	95,89
2	1,00	1,00	12,68	31,69	80,98	19,00	37,00	83,00

1	1,00	,00	3,00	17,00	78,00	19,00	39,50	79,00
1	1,00	,00	4,00	6,00	116,00	16,00	18,00	90,00
1	1,00	,00	10,00	5,00	116,00	15,00	16,00	100,00
1	1,00	,00	7,00	16,50	63,00	17,00	18,00	74,00
2	1,00	,00	11,00	13,50	72,00	12,00	13,00	81,00
1	1,00	,00	12,00	10,50	68,00	15,00	21,00	71,89
2	1,00	,00	14,00	25,00	60,00	14,00	28,50	56,00
1	1,00	,00	9,00	4,00	78,00	22,00	13,00	109,00
1	1,00	,00	8,00	9,00	90,34	14,00	21,50	91,00
2	1,00	,00	14,00	25,00	63,00	22,00	34,50	70,00
2	1,00	,00	14,00	29,50	79,45	18,00	26,00	114,00
2	1,00	,00	10,00	28,00	76,00	21,00	34,00	78,00
2	1,00	,00	10,00	28,50	67,00	20,00	35,00	62,00
2	1,00	,00	12,00	28,00	68,79	17,00	27,00	62,00
1	1,00	,00	8,00	28,50	111,00	18,00	25,50	108,00
1	1,00	1,00	2,00	11,00	28,00	14,00	13,00	47,22
2	1,00	1,00	11,00	28,00	52,00	18,00	28,50	70,00
1	1,00	1,00	10,00	31,00	93,00	12,00	30,50	83,00
1	1,00	1,00	14,00	26,00	79,00	18,00	31,50	106,00
1	1,00	1,00	13,00	17,00	82,00	16,00	23,50	87,89
2	1,00	1,00	13,00	30,00	45,00	6,00	29,50	52,00
2	1,00	1,00	12,00	26,50	83,00	20,00	27,50	82,00
2	1,00	1,00	2,00	11,00	68,00	7,00	16,00	78,00
1	1,00	1,00	16,00	27,50	96,00	21,00	25,00	110,00
2	1,00	1,00	7,00	8,00	58,00	10,00	13,50	71,00
2	1,00	1,00	8,00	5,00	58,00	14,00	14,50	50,00
1	1,00	1,00	11,00	17,00	98,00	16,00	30,00	93,00
1	1,00	1,00	9,00	16,00	86,00	13,00	18,50	100,00
1	1,00	1,00	9,00	17,00	98,00	4,00	14,00	58,34
1	1,00	1,00	5,00	17,50	66,00	13,00	14,50	82,00
2	1,00	,00	8,00	20,50	86,00	4,00	31,00	78,00
1	1,00	,00	11,00	17,00	71,48	13,00	29,00	84,00
2	1,00	,00	15,00	17,00	70,00	23,00	21,00	50,00

CURRICULUM VITAE

PERSONAL INFORMATION

Surname, Name : Çetin, Ali
Nationality : Turkish (TC)
Date and Place of Birth : Nowenber 25, 1980, Ankara
Marital Status : Married
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EDUCATION

Degree	Institution	Year of Graduation
Ph.D.	METU, SSME, Physics Education	2012
MS	METU, SSME, Physics Education	2004
High School	Ankara High School	1997

WORK EXPERIENCES

2011- present	Ankara Karacan Dershanesi – Head of Physics Department
2010-2011	Mersin Mehmetçik Dershanesi (Military Service)- Physics Teacher
2005-2010	Büyük College – Physics Teacher
2002- 2005	Yorum Dershanesi – Physics Teacher

FOREIGN LANGUAGES

English

INTERESTS

Blended Learning
Distance Education
Java Simulations
Web based education
Inquiry and 5E