EFFECT OF A WEB-BASED LEARNING TOOL ON STUDENT LEARNING IN SCIENCE EDUCATION: A CASE STUDY

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Approval of the Graduate School of Natural and Applied Sciences.

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ABSTRACT

EFFECT OF A WEB BASED LEARNING TOOL ON STUDENT LEARNING IN SCIENCE EDUCATION: A CASE STUDY

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This exploratory study provides a qualitative and quantitative report on the integration of a specific online information system into the science curriculum using authentic tasks in a class setting. It investigates how they use an online information database and tools to create meaning. An in-depth analysis was done to understand students' perceptions about the usability of a web-based learning tool used in science course, properties of a web-based learning tool, the quality of the content, and the structure of web-based instruction. It also aimed to explore the effects of the Web-based learning in a science course on students' achievement and attitudes toward science learning.

The subjects of this study were 51 Özel Bilim Okulları students in secondary school (6^{th}, 7^{th} and 8^{th} grades) classes. It was conducted throughout the academic year of 2004-2005.

The Science Achievement Test and attitude scales for science learning were given as pre-tests at the begging of academic year. They were given as post-tests and the students were interviewed in groups of five at the end of the academic year. The total time of using the web site of the course was kept by Web log-system.

The quantitative findings of the study indicated that there were significant differences between the pre-tests and post-tests of the science achievement test and attitude scale. In addition, there were a positive relationship between the site usage time and achievement and attitude of the students towards science learning.

The qualitative findings of this study showed that the amount of information supplied in the web site of the course, access to the Internet, doing assignments and taking online exams played important roles in students' science learning. However, the students did not prefer to use e-mails and chat rooms to collaborate with their fiends. They preferred to communicate face to face with their friends, and they preferred SMS because of ease of use.

The results and the discussion set out in this study have some important implications for teachers and instructional designers. The study contributes to an understanding of online learning and provides a basis for empirical study of learners performing real educational tasks. The insights gained in this small-scale study will help teachers construct better online learning environments with regard to pedagogy and technological innovation.

Keywords: web-based learning, instructional technology, interactivity in web-based instruction, attitude toward science learning

ÖZ

FEN BİLGİSİ EĞİTİMİNDE WEB TABANLI ÖĞRENME ARAÇLARININ ÖĞRENCİLERİN ÖĞRENMELERİNE ETKİSİ BİR DURUM ÇALIŞMASI

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Bu araştırma çalışması, sınıf ortamında geleneksel biçimde kullanılan kendine özgü bir çevrimiçi bilgi sisteminin Fen Bilgisi müfredatına entegrasyonuna ilişkin nitel ve nicel bir rapor niteliğini taşımaktadır. Öğrencilerin bir konuyu anlamak için, çevrimiçi bilgi veritabanını ve araçlarını nasıl kullandıkları incelenmektedir. Öğrencilerin, Fen Bilgisi dersinde kullanılan ağ tabanlı öğrenme aracının kullanılabilirliğini, özelliklerini, içeriğinin niteliğini, ağ-tabanlı öğretimin yapısını nasıl kavradıklarını anlamak için derinlemesine bir analiz yapılmıştır. Araştırma ayrıca Fen Bilgisi dersini ağ-tabanlı öğrenimin, öğrencilerin fen bilgisi öğrenimindeki başarı ve tutumları üzerindeki etkilerini ortaya çıkarmasını amaçlamaktadır.

Bu çalışmanın örneklemi, Özel Bilim Okullarının 6., 7., ve 8. sınıflarının 51 öğrencisidir. Çalışma 2004 – 2005 öğretim yılında yürütülmüştür.

Fen Başarı Testi (FBT) ve Tutum Ölçeği (TÖ) öğretim yılının başlangıcında ön-test olarak uygulanmıştır. Öğretim yılının sonunda da son-test olarak uygulanmış ve öğrencilerle beşerli gruplar halinde görüşme yapılmıştır. Fen Bilgisi dersi web sitesinin kullanımının toplam süresi, ağ kayıt sistemi aracılığı ile tutulmuştur.

Çalışmanın nitel sonuçları, FBT ve TÖ'nin ön-test, son-test uygulamaları arasında anlamlı farklılıklara işaret etmektedir. Buna ek olarak sitenin kullanım süresi ile fen bilgisi dersi öğrenimindeki başarı arasında olumlu bir bağlantı ortaya çıkmıştır.

Çalışmanın nicel sonuçları, öğrencilerin fen bilgisini öğrenmesi için ağ sitesinde verilen bilgi miktarının, İnternete girişin, ödevlerin ve sınavların çevirimiçi yapılmasının önemli bir rol oynadığını göstermektedir. Buna karşın öğrenciler arkadaşları ile iletişim kurmak adına elektronik posta ve sohbet odalarını kullanmak yerine, yüz yüze iletişim kurmayı yeğlemişlerdir ve ayrıca kullanım kolaylığı açısından cep telefonu ile SMS göndermeyi yeğlemişlerdir.

Çalışmanın sonuçları ve tartışılması, öğretmenler ve eğitim tasarımcılarının ağ destekli öğretimde kullanılabileceği bazı ipuçlarını ortaya çıkarmıştır. Aynı zamanda çevirimiçi öğrenmenin anlaşılmsına katkıda bulunmakta, gerçek eğitimsel etkinlikleri gerçekleştiren öğrenciler üzerinde deneysel çalışma yapılmasına temel oluşturmaktadır. Bu küçük çaplı çalışmadan elde edilen içgörüler öğretmenlere eğitsel ve teknolojik yenilikleri

göz önünde bulunduran daha iyi çevrimiçi öğrenim ortamları oluşturma konusunda yardımcı olacaktır.

Anahtar Kelimeler: web tabanlı öğrenme, öğrenim teknolojisi, Fenbilgisi öğrenimine yönelik tutum, web tabanlı eğitimde etkileşim.

To my wife Seher and my sons Mustafa & Engin

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SYMBOLS	
WWW	World Wide Web
WBI	World-based Instruction
DE	Distance Education
SAT	Science Achievement Test
PRESAT	Pre-test of Science Achievement Test
POSTSAT	Post-test of Science Achievement Test
PRETATTIT	Pre-test of Attitude Scale
POSTATTIT	Post-test of Attitude Scale
CAA	Computer Assisted Assessment
ISTE	International Society for Technology in Education
NETC	Northwest Educational Technology Consortium
DL	Distance Learning
VET	Vocational education and training
CEIT	Computer Education and Instructional Technology
METU	Middle East Technical University
ASP	Active Server Pages
CSS	Cascading Style Sheets

CHAPTER 1

INTRODUCTION

> *So that we may say the door is now opened for the first time to a new method fraught with numerous and wonderful results which in future years will be able to use command the attention of other minds.*
>
> Galileo

Perhaps the most powerful indicator of the rapidity of change in our society is the explosion of technology. This may be most obvious in the increasing presence of computers in the home, school, and workplace. Computers are providing individuals with a powerful means to transmit, access, and interpret an immense and growing body of information worldwide. In doing so, it is changing the way people live and work.

Inherent in this explosion of the capability to manipulate information is a corresponding need for education and experience in this new domain. The general acceptance of the use of information technology in industrialized societies, coupled with tremendous amount of information about technology and calls for technology standards, places greater responsibility on schools and families to help children become more efficient at accessing, transmitting, and using large pieces of information. The National Association for the Education

of Young Children has developed a position statement that professionals have a responsibility to use technology, particularly computers and software to benefit children (Parette, Hourcade & Heiple, 2000).

1.1 Distance Education

Personal computers are being used increasingly in distance education, and they have the potential to change the nature of education radically. For the student learning at a distance or using self-instructional material, computers can be powerful study tools, whether providing general “clerical” support, e.g. word processing facilities, spreadsheets, databases, or contributing to the subject area, e.g. via simulations in Physics, calculation and statistical packages in Mathematics, programming environments in Computer Science (Federico, 2000).

Keegan (1998 as cited in Federico, 2000) indicates that distance learning typically implies instruction via nontraditional means, i.e., courses via correspondence, radio, television, satellite, and, more recently, Internet with its associated software, hardware, multimedia, digital links, and supplementary audio and videotapes or CD-ROMs. Also, it implies on-campus classes, seminars, and workshops where the instructor is not physically present, and communicates with students at several sites simultaneously via electronic media (Laws, 1999).

Two types of distance education are frequently mentioned: (1) ``Synchronous instruction requires the simultaneous participation of all students and instructors, interaction is done in `real time'," e.g. video tele-

training, computer conferencing; and (2) ``Asynchronous instruction does not require the simultaneous participation of all students and instructors. Students do not need to be gathered together in the same location at the same time" (Lynch, 1999; Vrasidas and McIsaac, 1999).

“The `Internet' is a physical collection of interconnected computers: a network of networks for transferring data among computers and providing online services to users on a global scale, using phone lines, coaxial cables, data links, wireless communications, switching devices, and other conduits” (Federico, 2000).

Internet-based information and communication technologies are changing how instruction and assessment are being conducted in innovative schools, colleges, and universities throughout the world. Training and testing are experiencing a noticeable transition ``from the traditional centralized, local, classroom-teacher focused approach, to a de-centralized, global, network based, student focused one" (“Internet Based”, 2001). With the widespread use of personal computers in the classroom, on the job, and at home, and the connectivity to the internet increasing exponentially, many individuals have immediate access on their desktop to remote educational resources, and even instruction itself.

Consequently, education and training do not have to be confined to classrooms and campuses, and students and teachers do not have to be present at the same place and time for instruction. Teaching can occur on local or global networks, and distributing educational materials can occur electronically, or on CD-ROMs, thus capitalizing on multimedia formats. These yield several advantages, specifically: (1) access to a potential

worldwide student body; (2) access to better teaching materials prepared by experts; (3) rapid update of course materials; (4) enable instant access to these resources for students and teachers; and (5) tailoring instruction for self study ("Distance Education", 2002).

The Internet can provide video, but not as rapidly as videotape, television, or CD-ROM. It can support personal communication in real time, but not as efficiently as telephone or video conferencing. It can display textual and graphic materials, but not as easily as books and magazines. However, the Internet appears to have two primary advantages when compared to other educational media: (1) it enables the combined use of other media in an interactive manner to connect remote people inexpensively; and (2) it is not only an instructional delivery vehicle, but also a content provider enabling access to what is arguably the largest and most diverse resource for information, which can be incorporated into instructional design and development. In addition, the Internet has several aspects that appear to give it a number of other advantages for distance education, specially: it can (1) transmit text, graphics, audio, video, and data; (2) support real-time interaction among many individuals over considerable distances; (3) connect effectively and efficiently people throughout the world; and (4) be used relatively inexpensively as a substrate for online instruction ("Internet & Distance Education", 2001).

1.2 Web Based Learning

Tergan (1997) states:

> Contrariwise, Web-based education organizes subject matter as hypertext documents on the Internet, display of not only text, but also, for example, graphics, videos, or audios, which have many pedagogical advantages. This multimedia capability permits much more flexibility in the delivery of instruction by individuals selecting hypertext links, thus allowing the nonlinear interaction with information. This innovative technology can be used to complement customary instruction, or to provide complete courses over the Internet, especially the sciences and mathematics, which employ many symbols, simulations, and graphics (p.71).

The Web is a collection of cross-linked, usually graphical `pages' stored on computers around the globe, for providing friendly direct-manipulation interfaces for, or `point-and-click' access to, worldwide sites discovered via browsing programs, e.g. Netscape's Navigator, and search engines, e.g. Yahoo! (PC Novice, as cited in Frederico, 2000). With its implicit hypermedia design (Federico, 1999; Jonassen, 1989, 1993; Kommers, Grabinger & Dunlap, 1996), the Web represents an innovative means of structuring and presenting online instruction, because it can simultaneously serve as delivery medium, content provider, and subject matter (Nix & Spiro, 1990).

Hypermedia refers to online settings where networks of multimedia nodes connected by links are used to present information and manage retrieval. Nodes containing texts, graphics, videos, audios, animations, models, simulations, visualizations, are accessed and viewed by interactive browsers, e.g. Microsoft's Internet Explorer. Although connectivity among nodes is constrained by the design of the specific network-based educational environment, the student ultimately determines navigational paths through the

nodes, by freely controlling the movement among nodes, according to intrinsic interests and present goals (Milheim & Martin, 1991).

Large (1996) states:

> Educational environments employing hypermedia attracted the attention of instructional designers, chiefly because of the adaptability or flexibility they afford individual learners. Students are able to follow links or paths through the online content within the context created by the developer, or chart their own routes according to individually prescribed requirements, changing dynamically during the process of acquisition.
> (p. 97).

By using a seemingly ``ever expanding network of nodes and links'', courseware developers can create representational maps, i.e. Web pages, to guide students through customary knowledge domains (Federico, 1997, 1998, 1999). The fanciest Web site can be entirely ineffective for facilitating learning, if it is not based on sound design principles extrapolated from well-substantiated instructional theory (Jacobson, 1994; “Web Based Education”, 2000).

Possible links to Web pages, not produced by developers themselves, enable almost an infinite expansion of instruction; however, they are out of teacher control, and under direct learner control. By employing the Cognitive Exibility Theory (Spiro, Coulton, Feltovich & Anderson, 1988; Spiro, Vispoel, Schmitz, Samarapungavan & Boerger, 1987) and hypermedia of the Web, the instructional designer is in control, by creating nonlinear multidimensional paths traversing the subject matter, to provide multiple perspectives of the content, in order to guide student acquisition. Nevertheless, because of this hypermedia environment, individual learners are able to control their own

paths through complex subject matter, independently of the guidance provided by the courseware designer ("Hypermedia ", 2001).

Research and development in the field of hypermedia have made rapid progress in the past decade, moving from system development to application of these systems to such complex issues as augmenting teaching and learning, computer-supported collaborative learning, supporting information retrieval and browsing, as well as incorporating experiential simulation and virtual realities (Yang, 2000). A growing body of research and discussion on the use of hypertext systems as a writing, learning, research and problem-solving tool for educational purposes can be found in the literature in such diverse fields as business, medicine, chemistry, literacy, and the humanities (Garvin & Carrington, 1997; Sanne, 1994; Yang, 1997). However, much of the available literature on hypermedia consists of descriptive essays explaining the learning opportunities which may lend themselves to actual learning in various hypermedia systems (Dillon & Gabbard, 1998). The majority of the literature on the use of hypermedia as a tool for mediating learning in context is generally more promotional and assumptive than investigative and research based as Yang (2000) points out:

> The extensive use of large-scale hypermedia databases in actual class settings has not yet been thoroughly explored and there is a need for these systems be examined through observations of the ways in which students approach them in an ecologically valid learning situation (p. 452).

Any technological artifact is problematic in accurately describing the nature of the interaction between users or learners. Inherently a communicative

act, it is suggested that using constructive, phenomenological and naturalistic alternatives to the traditional empirical paradigm could provide richer, context-specific information necessary to understanding the effectiveness of this interactive media (Neuman, 1991). Furthermore, as a result of a meta-analytical study, Yang (2000) found that the perception of and attitudes toward hypermedia are functionally important to promote effective learning. Therefore, there is a need for a systematic exploration of the learners' interface with hypermedia in order to reveal their interactions with hypermedia learning systems.

1.3 Online Learning

An online learning model is proposed in which an instructor and learners are separated by physical distance, and online delivery media are used to bridge the instructional gap. Moving into the information technology era, a wide range of instructional technologies facilitates online educators (Huang, 2000). In general, an online computer–mediated environment includes synchronous and/or asynchronous communication, Web–based instruction, Web search, online resources, and technical support (Huang, as cited in Huang, 2002). One of the most salient features of online learning is that it allows learning to be place and time independent (Vrasidas and McIsaac, 2000). Adult learners can arrange their learning around their everyday lives without being constrained by time and place. Moreover, online learning allows learners to take courses not available on campus resulting in cost effective learning environments, and utilizes some appropriate delivery and instruction methods.

Therefore, it becomes quite clear that a lot of people can benefit from this second chance to educate themselves.

Distance education has different settings from the conventional classroom due not only to the physical distance between an instructor and learners but also to the difference in designs of instruction in distance learning (Moore, 1991). Since distance education cannot offer face–to–face instruction as the traditional classroom does, many researchers (Comeaux, 1995; McHenry and Bozik, 1995) focused on the study of interaction in distance education. Moore (1991) also noted that the interaction of the individual or group is determined by the educational philosophy in distance learning. Constructivists view knowledge as constructed by learners through social interaction with others (Huang, 2002). Recently, Moller (1998) and Petraglia (1998) proposed that constructivism should be applied in distance education and educational technology. However, Petraglia (1998, 53) argued for "the attempt to make learning materials and environments correspond to the real world prior to the learner's interaction with them".

For Bruner, technology is a powerful tool for instruction. As Bruner (as cited in Huang, 2002) stated, "Principal emphasis in education should be placed upon skills – skills in handling, in seeing and imaging, and in symbolic operations, particularly as these are related to the technologies that have made them so powerful in their human expression" (p. 72).

Technologies are cognitive tools which help learners to elaborate on what they are thinking and to engage in meaningful learning (Jonassen, 2000). In addition, Jonassen (2000) summarized that learners use technologies as intellectual partners in order to:

1. Articulate what they know;
2. Reflect on what they have learned;
3. Support the internal negotiation of meaning making;
4. Construct personal representations of meaning; and
5. Support intentional, mindful thinking (p.334).

Many commonly used technologies can provide support for online learning such as the Web, online discussion groups, online resources, and online courseware (Huang, 2000). The World Wide Web (Web) provides hypertext links and hypermedia ability to facilitate educational instruction. Hypermedia and Web publishing are knowledge construction environments which often incorporate information search engines for better understanding of information and video for visualizing the range of ideas that students generate (Jonassen, 2000). The Web provides immense resources for adult learners. Through Web mechanisms, the learner can search actively and discover rich resources to solve problems or construct his or her own knowledge. Thus, the Web becomes a common tool for learner – centered or constructivist learning. Jonassen (2000) says that:

> Email (voice mail), listservs, chat rooms, newsgroup and Bulletin Board System (BBS) via Internet can keep all learners of a learning group up to date to be formed and maintained by group teams online. Synchronous and asynchronous discussion focuses the development of knowledge-building communities where participants share information in pursuit of a meaning, and reflect on the knowledge that they have constructed, and the processes that they used (p.22).

1.4 Statement of the Problem

Whenever one asks a science teacher to answer the question "Do your students have some problem about remembering the prerequisite information?", S/he will respond as "YES". Korkmaz and Urulbay

(conversation, 3 September 2002) state that "I get surprised when they can not explain the things that I had explained last year. If I do not know the student or the student is a new-comer to our school, I will say that their ex-teacher did not give enough information. But I know that I had explained in detail." But, they do not know exactly who has a problem in remembering a specific concept. If they do know, they do not have time to teach the same concept (that was taught in the previous year) again because of the loaded curriculum and because of time. One of the aims of this study is to find out which concept is lacking for each specific student and to give him/her a chance to the students to repeat the same concept without taking up the school time.

1.5 Purpose of the Study

When the research conducted to investigate the effectiveness of online hypermedia studies in science education and when the problems existent in science classes in Turkey are considered, it is observed that there is a need to investigate how a hypermedia program should be designed for use in an online information system. This exploratory study provides a qualitative report on the integration of a specific information system into the curriculum using authentic tasks in a class setting. It investigates how students use an online information database and the tools to create meaning.

In this research study, the main problems are as follows:

1. to investigate whether science courses enhanced with a web-based learning tool affect students' academic success and attitudes toward online science learning or not.

2. to investigate students' perceptions about the effective dimensions of science courses enhanced with a web-based learning tool.

The research questions for this study are listed below:

Question 1: Do science courses enhanced with a web-based learning tool have affect students' academic success?

The sub-questions are as follows:

Sub Questions:

1.1 Is there a significant difference between the pre-test and the pos-test achievement scores in FBTS of the 6th grade science course at the end of the experiment?

1.2 Is there a significant difference between the pre-test and the pos-test achievement scores in FBTS of the 7th grade science course at the end of the experiment?

1.3 Is there a significant difference between the pre-test and the pos-test achievement scores in FBTS of the 8th grade science course at the end of the experiment?

1.4 Is there any relation between time to site time of the 6th grade students and their academic success in the science course at the end of the experiment?

1.5 Is there any relation between time to site time of the 7th grade students and their academic success in the science course at the end of the experiment?

1.6 Is there any relation between time to site time of the 8th grade students and their academic success in the science course at the end of the experiment?

Question 2: Do science courses enhanced with a web-based learning tool have affect students' attitudes towards science learning?

The sub-problems are as follows:

2.1 Is there a significant difference in attitudes of the 6th grade students toward science learning at the end of the experiment?

2.2 Is there a significant difference in attitudes of the 7th grade students toward science learning at the end of the experiment?

2.3 Is there a significant difference in attitudes of the 8th grade students toward science learning at the end of the experiment?

2.4 Is there any relation between site time of the 6th grade students' and their attitudes toward science learning?

2.5 Is there any relation between site time of the 7th grade students' and their attitudes toward science learning?

2.6 Is there any relation between site time of the 8th grade students' and their attitudes toward science learning?

Question 3: What are students' perceptions about a science course enhanced with a web-based learning tool at the end of the experiment?

The sub-questions are as follows:

3.1 What are students' perceptions about the usability of a web-based learning tool used in a science course?

3.2 What are students' perceptions about the quality of the content in web-based instruction?

3.3 What are students' perceptions about the structure of web-based instruction?

3.4 What are students' perceptions about the interactive tools like dictionaries, chat rooms, e-mail, videos, etc. in web-based instruction?

1.6 Significance of the Study

The study examines how the learners structure their activities and what their effective attitude and cognitive perceptions are towards online learning in general. The results and the discussion set out in this study, have some important implications for teachers and instructional designers. The study is expected to contribute to an understanding of online learning and provides a basis for empirical study of learners performing real educational tasks. The insights gained in this small-scale study will help teachers construct better online learning environments with regard to pedagogy and technological innovation.

1.7 Definition of Terms

In this section , some explanations about the terms used throughout the study will be supplied in order to asist the reader in understanding the study.

Online: “Online” means being in a live connection and able to send information. If you “go” online you are making that live connection and are able to send and receive information across the Internet. Sometimes the term is also used to describe having access to electronic media in generall. An online archive may be a collection of digital information stored in one place or on a CD-ROM.

Online Learning: A fundamental difference between learning online and tradional learning lies in the type of tools that are used. Traditionally students have pens, paper, books, dictionaries, seminars, lectures, tutorials and libraries at their disposal. However, an online learner has access to a computer (a hand drive, a monitor, a keyboard, a mouse and a printer), an Internet connection (via a modem and a telephone line) and software. Thus, the hardware available to the two types of learners appears at first glance to be radically different. Unlike the traditional model, in online learning there is no need for the student to be at the same place as the teacher. Both the teacher’s and the learner’s roles change in online education. In online education teachers behave as facilitators instead of presenting the knowledge in a traditional classroom. There is no or little face-to-face interaction between the learner and the teacher.

Internet: The Internet describes a global network of computers. The computers on the Internet can be located anywhere all around the world and wired together by telephone lines, undersea cables, satellite up-links or down-links and fiber optic cables. This network has evolved rapidly in most sectors though it was originally established by the military in the USA and then by

educational institutions. Business and domestic users have added to the rapid expansion of this communications network.

The Internet can be used in many ways to transfer information. The most popular applications for the Internet are the World Wide Web, Electronic Mail, Telnet and File Transfer.

World Wide Web: The World Wide Web (also referred to asWWW and "The Web") is part of the Internet. It can be accessed with browsers, and it is made up of web pages, which are in format called Hypertext. Web sites of the Internet present these web pages.

Since WWW browsers have the ability to handle text, picture, animation, audio and video, WWW is one of the most used services of the Internet. These web sites can offer links to other web sites as well.

Computer Attitude: Computer attitude is defined as learned predispositions to respond negatively or positively to computers.

Computer Literacy: In the relevant literature, there does not seem to be a consensus about how the computer literacy should be defined. In this study, computer literacy is considered as the basic knowledge and skills necessary for using computers and common applications for accessing, organizing, and presenting data and communication.

Computer Literacy Course: This is a course which is designed to provide necessary knowledge and skills for becoming computer literate. In this

study it is considered as the course designed to teach basic computer skills and introduce student to several commonly used computer applications such as word processing, spreadsheet, databases, telecommunications, presentation programs, and integration of these applications into the classroom.

Distance learning is an education program (course, certificate, degree, or other) that allows students to complete all or most of the program from a remote location (his or her living room, for example), while receiving the same credit as a student that completes the program onsite.

Constructivism: In the early 18th century, an Italian psychologist named Giambattista Vico claimed that humans can only understand what they have constructed themselves. This was the first definition of constructivism. Many years later, we now recognize constructivism as the theory that humans, in particular children, can learn better from discovering and modeling their own knowledge, rather than having it instilled into them.

Synchronous communication: This kind of communication requires the students and instructors to participate simultaneously. The advantage of synchronous communication is that the exchange of information is done in "real-time", and the feedback among all participants is spontaneous.

Asynchronous communication: This form communication does not require the simultaneous participation of the students and instructors. The advantage of asynchronous communication is that it allows students to pace their learning process to fit their personal and professional schedules. It also

allows them to get a handle on the content because it allows them to repeat the material that they do not understand.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Technology and Education

Technology has an enormous effect on different fields like industry, business and education. Education has experienced many challenges in the methods of presenting information. Technologies used in instruction such as books, written materials, films, radio, television, overhead projectors, and computers have all affected the educational system. The integration of technologies into our daily life has changed the way we live, the way we work, and the way we learn. Therefore, the progression in instructional technology (IT) has changed rapidly through many forms of presentation over the years.

Technologies have taken many different definitions. While some definitions are based on only hardware, others are added the use of this hardware to solve problems. Gentry (1987) defined technology as a systematic and systemic application of behavior and physical sciences concepts and other knowledge to the solution of problems.

Norton and Wiburg (1998) presented a traditional view of technology as, "… it is the machines or tools that we use to extend our physical and sensor capabilities" (p.2). They presented their future concern for technologies as:

> Technology does indeed have a role in learning, but that role is not to replace schools or teachers. Instead, we believe, the electronic technologies should become an integral part of the teaching and learning process just as they are increasingly integrated throughout the non-school learning experiences of today's students (p.9).

Technology offers all students opportunities for learning never before imagined. Factors encouraging—or discouraging—technology use can range from the level of teacher enthusiasm and expertise to principal and parental support to quality software and hardware availability and its selection (Burgess & Trinidad, 1997, p.16). How does one define the application of this multipurpose, multifaceted tool integration? The International Society for Technology in Education (ISTE) (2000) defines curriculum integration as follows:

> Curriculum integration with the use of technology involves the infusion of technology as a tool to enhance the learning in a content area or multidisciplinary setting. Technology enables students to learn in ways not previously possible. Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should become an integral part of how the classroom functions—as accessible as all other classroom tools (p. 6)

Clearly, technology cannot be a goal in itself. Without a systemic integration of content and quality into professional development for teachers, it is likely to only cause frustration. Technology is useful "insofar as it is handled competently by teachers and it is integrated into the teaching program as a whole" (Hoven, 1992, p.19). One of the reasons for this holistic integration of technology is the fact that there are always new technology tools entering classrooms. Therefore, the potential of such tools needs to be routinely

redefined and evaluated with all students in mind. Thoughtfully selected technology tools can offer so much more than just productivity to the learner.

Researchers are now beginning to examine the more complicated research task of investigating the impact of technology use in meeting these new expectations for what students should learn. They are examining students' ability to understand complex phenomena, analyze and synthesize multiple sources of information, and build representations of their own knowledge. This model of integrated technology-supported learning emphasizes the ability to access, interpret, and synthesize information instead of rote memorization and the acquisition of isolated skills.

Central to this change in expectations for student learning has been an acknowledgment of the complexity of three key factors that must be considered in evaluating the impact of technology on student achievement (Hoven, 1992):

- The term *technology* refers not to simply one type of technology but to a wide range of electronic materials and methods for learning. It can apply to the use of computers in education, but it also can apply to video production and distance learning classes. Each type of technology has different uses and fulfills different learning goals.

- Assessing the effect of technology on student achievement is a complex process.

- Changes in the classroom correlate with changes in other educational factors as well.

Educators become aware that many different types of technology can be used to support and enhance learning. Various technologies deliver different kinds of content and serve different purposes in the classroom. For example, word processing and e-mail promote communication skills; database and spreadsheet programs promote organizational skills; modeling software promotes the understanding of science and math concepts. It is important to consider how these electronic technologies differ and what characteristics make them important as vehicles for education (Becker, 1994). Technologies available in classrooms today range from simple tool-based applications (such as word processors) to online repositories of scientific data and primary historical documents, to closed-circuit television channels and two-way distance learning classrooms. Each one is likely to play a different role in students' learning. Rather than trying to describe the impact of all technologies as if they were the same, researchers need to think about what kind of technologies are being used in the classroom and for what purposes.

Some researchers define technology use on the basis of its application--how it is used for learning. Means (1994), for example, describes four major functions of technology used to support learning: Technology can be used as (1) a tutor (examples are drill-and-practice software, tutoring systems, instructional television, computer-assisted instruction, and intelligent computer-assisted instruction); (2) a means to explore (examples are CD-ROM encyclopedias, simulations, hypermedia stacks, network search tools, and microcomputer-based laboratories); (3) a tool to create, compose, store, and analyze data (examples are word processing and spreadsheet software, database management programs, graphic software, desktop publishing systems,

hypermedia, network search tools, and videotape recording and editing equipment); and (4) a means to communicate with others (examples are e-mail, interactive distance learning through satellite systems, computer and modem, and cable links).

Over the years, research has highlighted many benefits of using instructional technology with students. Competent use of computers prevents learners from "academic and social marginalization" (Murray & Kouritzin, as cited in *International Society for Technology in Education*, 2000). It allows them to have the most control over the direction of their learning by controlling their time, speed of learning, autonomy, choice of topics or even their own identity (Hoven, 1992). To many students, technology is motivational and nonjudgemental. It gives them prompt feedback, individualizes their learning, and tailors the instructional sequence. Technology can meet specific student needs, increase their autonomy, allow for more responsibility, promote equal opportunities in an early nonsexist environment, encourage student cooperation with peers, and encourage them to make decisions (Burgess & Trinidad, 1997). Through technology, students can learn in a rich linguistic environment and find opportunities to interact with the multicultural world, extend their language skills, and not be embarrassed for not knowing answers (Padrón & Waxman, 1996, p. 344; Lee, 2000). In other words, technology greatly helps studentsbuild on their confidence.

Our educational system must produce technology-capable kids. To live, learn, and work successfully in an increasingly complex and information-rich

society, students must be able to use technology effectively. Within an effective educational setting, technology can enable students to become:

- Capable information technology users
- Information seekers, analyzers, and evaluators
- Problem solvers and decision makers
- Creative and effective users of productivity tools
- Communicators, collaborators, publishers, and producers
- Informed, responsible, and contributing citizens.

Successful learning activities depend on more than just the technology. Certain conditions are necessary for schools to effectively use technology for learning, teaching, and educational management. Physical, human, financial, and policy dimensions greatly affect the success of technology use in schools.

A combination of essential conditions is required to create learning environments conducive to powerful uses of technology, including:

- Vision with support and proactive leadership from the education system
- Educators skilled in the use of technology for learning
- Content standards and curriculum resources
- Student-centered approaches to learning
- Assessment of the effectiveness of technology for learning
- Access to contemporary technologies, software, and telecommunications networks
- Technical assistance for maintaining and using technology resources
- Community partners who provide expertise, support, and real-life interactions
- Ongoing financial support for sustained technology use
- Policies and standards supporting new learning environments (*International Society for Technology in Education*, 2000).

Technology has evolved from its support function to play a role in initiating learning processes. It can provide a flexible learning environment where students can really explore and be engaged. Hypermedia, for example,

individually addresses levels of fluency, content knowledge, student motivation, and interest (Bermudez & Palumbo, 1994).

Technology integration defined by Reilly (as cited in Svedkauskaite, A., Hernandez, Clifford, & Durian, 2004) is curriculum development. It is one way to move teaching from teacher-centered to learner-centered. School reformers, such as Mehlinger (1995), believe that technology can support learner-centered instruction as practice. The relationship between students and teachers will be modified because in the past, schools were places in which the authority decided what and when content was covered; new technology provides students access to information that was once under the control of teachers (Mehlinger, 1995). To allow for greater success rates for students, teachers need to integrate technology to advance student learning because technology activities, such as using the Internet or working as a team on a project, provide students with opportunities in order to enhance and extend the regular learning to higher levels of cognitive involvement.

Today's engaged classroom is more student-oriented and individualized, which allows for more social interaction, learner communication, and cooperation (Padrón & Waxman, 1996), skills of especially high value to students. The teacher is not the only expert because students have their own experiences that are part of the learning dynamics. With technology, students can control and self-direct their learning and get immediate feedback. They no longer depend on direct teacher instruction, which often limits the student to passive listening and watching the teacher. While the direct teacher control is evidently lower in technology-based classrooms (e.g., a computer lab), the

instruction is ever more demanding on the teacher. The teacher becomes a facilitator, rather than a "deliverer or transmitter of knowledge" (Padrón & Waxman, 1996, p. 348). Teachers scaffold their students' learning experiences to build high-quality instruction. In a recent case study by Tiene and Luft (as cited in Svedkauskaite, Hernandez, Clifford, & Durian, 2004), it was found that this type of environment creates a shift from "sage on the stage" to "guide on the side". One teacher in the study wrote, "I spent more time with my students learning than I did teaching them".

Those who value technology as a resource to improve learning, and not just increase productivity, see the importance of changing the role of teachers, learners, and even the learning process itself. The transformation to student-centered classrooms in education marks a new role for the teacher as a facilitator. As both teachers and facilitators, they help students construct their own meaning; technology provides them with new ways of teaching and enhancing learning opportunities for students (Padrón & Waxman, 1996). The following are some activities which make use of technology intended to support learner knowledge construction:

1. Online collaboration with classrooms around the world.
2. Education applications of the Web such as e-mail exchanges, online bulletin board, and information searching.
3. The use of multimedia to create projects (Hartley & Bendixen, 2001).

When students are engaged in activities like these, they are constructing their own knowledge, with the teacher as the facilitator of the process.

Although technology integration can be pivotal in and positively impact students' learning process—in both the academic and workplace scenarios—arguments still emerge against the use of technology.

Some critics of the use of technology in schools raise a question about technology's physical and developmental effects upon students (such as posture and eye problems). According to Northwest Educational Technology Consortium (NETC), "As technology becomes a bigger part of children's lives, so does the need to pay attention to the health issues of using computers. Children need to be taught simple safety principles from the time they begin using computers" (NETC, 2002, p. 1).

The high equipment expenses associated with technology use have long been an issue of contention among educators and parents. Members of some communities question the focus of expenditures on technology at the expense of other student needs. They view financial support being reallocated from traditional materials and programs to buy new technologies. Those school districts that do have sufficient access to technology should make the most of it. Quality software with bilingual support is a great way to supplement skill development activities for students. Most textbooks today come with CD-ROMs attached to them in the form of an electronic book or workbook, or the actual textbook content; there is also individual software that parallels texts in more than one language. Having curriculum knowledge in digital form allows teachers and their students to modify information as needed to meet individual learning needs.

Some educators view additional teacher preparation for technology use as unnecessary because of their opposition to using technology to support student learning as a means to improve their learning. Or they may feel that technology can only be effective in some academic areas, but not in others.

2.2 Distance Education

What are the elements of secondary school education? First, there is the teacher. He or she leads the class, sometimes writing, sometimes showing slides and sometimes responding to questions. A second element is the course material. Sometimes this is available in the form of a textbook and sometimes you just listen and take notes. A third element is classmates. They help both in and out of class. They provide an element of shared experience, and they are the people to whom what the course content and the teacher mean can be discussed. They also provide emotional support.

Today, it is possible to provide education without campus, without a classroom, and without the necessity for the learner to be at some fixed place or time when a lecture is being delivered. This can be realized through “Distance Education” or “Distance Learning”.

Distance learning traditionally has provided access to instructional programs for students who are separated by time and/or physical location from an instructor. Distance learning has been thought of as prepackaged text, audio, and/or video courses taken by an isolated learner with limited interaction with an instructor or other students. This perspective is changing. Today information

technologies can allow a rich interactive distance learning experience that may surpass the interactivity of a traditional classroom (Moore & Kearsley, 1996).

Learning is defined as "the act, process, or experience of gaining knowledge or skill" (Willis, 1993, p.5). Learning is the preferred term rather than education that is generally defined as the knowledge or skill obtained or developed by the learning process. However, educators often use the terms interchangeably.

Distance learning is conventionally defined by Moore & Kearsley (1996) as:

> Broadly, any educational or learning process or system in which the teacher and instructor are separated geographically or in time from his or her students; or in which students are separated from other students or educational resources. Contemporary distance learning is affected through the implementation of computer and electronics technology to connect teacher and student in either real or delayed time or on an as-needed basis. Content delivery may be achieved through a variety of technologies, including satellites, computers, cable television, interactive video, electronic transmissions via telephone lines, and others. Distance learning does not preclude traditional learning processes; frequently it is used in conjunction with in-person classroom or professional training procedures and practices. It is also called distributed learning (p.2).

The California Distance Learning Project (CDLP) uses the following definition:

> Distance Learning (DL) is an instructional delivery system that connects learners with educational resources. DL provides educational access to learners not enrolled in educational institutions and can augment the learning opportunities of current students. The implementation of DL is a process that uses available resources and will evolve to incorporate emerging technologies.

Another formal definition of distance education made by American

Council on Education (1996) is as follows:

> Distance Education is a system and a process that connects learners with distributed learning resources. While distance education takes a wide variety of forms, all distance education is characterized by: (1) separation of place and/or time between the instructor and the learner, among learners, and/or between learners and learning resources, and (2) interaction between the learner and the instructor, among learners, and/or between learners and learning resources conducted through one or more media; use of electronic media is not necessarily required (p.10).

The definition of distance education has been refined and redefined over the years. This is seen in the evolution of Moore's distance education definitions. In 1990, Moore described distance education as "all arrangements for providing instruction through print or electronic communications media to persons engaged in planned learning in a place or time different from that of the instructor or instructors" (p. xv). Later, Moore (1996) defined distance education as:

> Distance education is planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements (p.3).

In 1997 Moore and Kearsley refine the definition to specify that the learning is planned and includes "organizational and administrative arrangements" (p. 2). Most definitions specify that distance education is teaching and learning that occurs when the learner(s) and the instructor are separated by time and space using a variety of technical media to support the teaching and learning (Keegan, 1996; Eastmond, 1998; Maguire, 2005).

Several key features define distance learning. (Porter, Barras, Barttlet, Rogers, & Porter, 2003)

- the separation of teacher and learner during at least a majority of each instructional process,
- separation of teacher and learner in space and/or time,
- the use of educational media to unite teacher and learner and carry course content,
- the provision of two-way communication between teacher, tutor, or educational agency and learner, and
- volitional control of learning by student rather than distance instructor.

These definitions apply equally to high tech and low tech approaches to distance learning.

There are two distance education delivery system categories - synchronous and asynchronous. There are advantages to both forms and in the end, personal learning styles and the larger educational context determine what is most appropriate.

Collis (as cited in Mason, 2004) identifies four basic patterns of communication in the learning environment:

- telling, which in the asynchronous mode has traditionally been the printed text, but increasingly is taking on a new form in hypertext Web pages, although many conventional linear texts, articles, reports and original works are also available on the Internet

- asking, which can take place through text messages via email or computer conference, through real time text chat systems, or through any of the audio systems
- responding, which is also supported in delayed time through asynchronous systems, and much more immediately through synchronous systems
- discussion, or collaborative work amongst small groups of students, which can take place over an extended time period through computer conferencing, or for much shorter periods via audio graphics.

The following list details the major benefits of each mode in an educational context.

Synchronous instruction requires the simultaneous participation of all students and instructors. The advantage of synchronous instruction is that interaction is done in "real time" and has an immediacy. Examples include interactive TV, teleconferencing and computer conferencing, and Internet chats.

There are four equally compelling advantages to synchronous systems,

- motivation - synchronous systems focus the energy of the group, providing motivation to distance learners to keep up with their peers and continue with their studies
- telepresence - real time interaction with its opportunity to convey tone and nuance helps to develop group cohesion and the sense of being part of a learning community

- good feedback - synchronous systems provide quick feedback on ideas and support consensus and decision making in group activities, both of which enliven distance education

- pacing - synchronous events encourage students to keep up-to-date with the course and provide a discipline to learning which helps people to prioritize their studies (Collis (as cited in Mason, 2004)).

Asynchronous instruction does not require the simultaneous participation of all students and instructors. Students do not need to be gathered together in the same location at the same time. Rather, students may choose their own instructional time frame and gather learning materials according to their schedules. Asynchronous instruction is more flexible than synchronous instruction. The self-paced format accommodates multiple learning levels and schedules. Examples of asynchronous delivery include e-mail, listservs, audiocassette courses, videotaped courses, correspondence courses, and WWW-based courses.

There are four crucial advantages to the asynchronous media which have been arranged below in descending order of significance:

- flexibility - access to the teaching material (e.g. on the Web, or computer conference discussions) can take place at any time (24 hours of the day, 7 days a week) and from many locations (e.g. oil rigs)

- time to reflect - rather than having to react 'on one's feet', asynchronous systems allow the learner time to mull over ideas, check references,

refer back to previous messages and take any amount of time to prepare a comment

- situated learning - because the technology allows access from home and work, the learner can easily integrate the ideas being discussed on the course with the working environment, or access resources on the Internet as required on the job (Porter, Barras, Barttlet, Rogers, & Porter, 2003).

- cost-effective technology - text based asynchronous systems require little bandwidth and low end computers to operate, thus access, particularly global access is more equable.

The advantages of asynchronous delivery include student choice of location and time, and (in the case of telecommunications such as email) interaction opportunities for all students. A disadvantage to consider with email-based interaction is the considerable written exchange, which could really pile up.

Three elements are of paramount importance to any successful distance education program.

- instructional design
- technology
- support

Support is often undervalued in design and implementation. Technology implementation studies show that teacher preparation and ongoing support are undervalued (Porter, Barras, Barttlet, Rogers, & Porter, 2003).

Due to demands for educational programs that are time and place independent, distance education availability, course offerings, and enrollment increased rapidly during the 1990's. To illustrate this trend, the National Center for Education Statistics (1999) reported 91% of public four-year institutions and approximately 50% of all private institutions, representing a total of 1.6 million students, were currently offering, or planned to offer, distance education programs. Many of these programs are, or will be, delivered via an online learning environment.

There are numerous pieces of research to show that distance education has been an effective way to achieve learning. A meta-analysis of the comparative distance education (DE) literature between 1985 and 2002 was conducted by Bernard, Abrami & Lou (2004). In total, 232 studies containing 688 independent achievement, attitude and retention outcomes were analyzed. This suggests that many applications of distance education outperform their classroom counterparts.

Verduin and Clark (1991) reviewed 56 studies comparing academic achievement of students in conventional classrooms with that of students in a variety of distance learning programs (e.g., television, computer-based, videodisk, and correspondence courses) and found that students using "DE methods achieve similar, if not superior, results when compared with conventional methods of teaching" (Verduin & Clark, 1991, p. 213).

Arbaugh (2000) found that though there were no significant learner outcome differences among students taking Web-based courses, women participated more than men in discussions. Finally, in a review of 248 research reports, summaries, and papers, Russell (1999) identified no significant difference in grades or final evaluations between students in conventional classrooms and those enrolled in correspondence and distance learning classes. The study was done by Russell, included over 300 studies which were comparing the effectiveness of distance learning to traditional learning. The study was covering the studies starting from 1982 and going up to 1998. It covers studies on variety of distance education media including mail, radio, audio and video tapes, television and telephone. It also includes more recent studies on two way online communication and student-teacher interaction related to Computer Mediated Communication. The study does not report any evaluation criteria on how those pieces of research were evaluated but it gives brief description or each. The important point of the study was that all studies examined were reporting that the students' performance in distance courses was not significantly difference than those in traditional courses. This result included online and distance course in old fashion with mail, radio and television.

2.3 Web-Based Learing

Over recent years, there has been a considerable growth in the use of educational materials over the World Wide Web (WWW). While remaining as a super database of information by connecting the world together with the aid

of a user-friendly WWW interface, the Internet is being transformed into a brand new educational model for almost every business sectors. This trend was even leading toward the changes of humans' way of life. The growth of information and communication technology, especially Internet-related technology, has changed how, what, who, when, where and why we learn (Chan *et al.*, 2001). Internet is not only full of rich media in text, images, animation, video, audio, etc. formats, but it also provides various tools to assist communication among users. These tools include File Transfer Protocol, Electronic Mail, ARCHIE, WAIS, TELNET, SNNP, Online Chat, Bulletin Board, Discussion Group, Digital White Board, Online Meeting, Web Phone, Web Fax, Web Radio, Chat Room, Virtual Reality, etc. Most of these tools can be further integrated with the Internet to become an efficient instruction environment. This development also encourages more educators to dive into these emerging markets. Due to the popularity of the Internet use, most instructors apply the network to host their teaching materials. During the process, in order to gain further advantage of digitalization, most lecturing processes such as web-based exams, Web-based registration, Web-based learning evaluation, etc. are further incorporated with the WWW. Therefore, lots of Internet oriented instruction tools were developed (Yen & Li, 2003). These developments also provide boundless space for most education reforms. Some of these tools were further integrated into Web-based instruction systems. These systems are usually named WBI (Web Based Instruction), IBT (Internet-Based Training), or WBT (Web-Based Training). Since 1996 a lot of similar systems were created among academic and business incorporation parties.

There are many definitions of Web Based Instruction but the definition made by Khan (1997) in his book *Web Based Instruction* is clear and applicable for years on. WBI is defined as:

> … a hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported (p.6).

In another definition WBI was defined as (Relan & Gilliani, 1997),

> … is the application of repertoire of cognitively oriented instructional strategies implemented within a constructivist and collaborative environment, utilizing the attributes and resources of the World Wide Web (p.43).

WBI has several advantages. These advantages can be grouped as logistical, instructional and economic. The idea behind WBI is to give the freedom to user for selecting the time, place, computer platform and operating system for learning (Hannum, 2001). Crossman (1997) states the advantages of web-based environments as "the ability to carry a vast amount of information and a variety of media from anywhere to anywhere" (p.19). This ability makes it possible for a person to communicate with a single person or with the entire world. This structure, being able to communicate with any other person and to access many resources independent of time and distance, has been related to constructivism because it is based on collaboration and social interactions from which a person builds his own knowledge (Miller & Miller, 1997).

Computer-based training (CBT) has been widely applied in learning after the burgeoning popularity of personal computer in the eighties. According to the survey of Whitehouse and Pellegrin (1995), utilizing personal computer and software to raise the knowledge of students can save up to 70% of training time. Recent popularity of Internet has brought more benefits into traditional CBT learning, such as the 24/7 availability, better interactions between students and instructors, and virtual classroom space. Accordingly, an asynchronous web-based CBT system can serve as an after-hour teaching assistant to traditional classroom learning.

Khan (1997) listed major components of the WBI system as follows:

- Content development (Instructional theory, design and development)
- Multımedia component (Tex, animation, graphics, sounds, etc.)
- Internet tools (Communication tools, remote access tools, navigation tools, search tools, etc.)
- Computers and storage devices (Platforms and operating systems, hardware)
- Connections and service providers (Modems, connection services, Internet service providers, etc.)
- Authoring programs (Programming languages, authoring tools, HTML coding and converting tools, etc.)
- Servers (HTTP servers, server software, server-side and client side scripts). Browsers and other applications (Text-based or graphical browsers, hyperlinks, plug-ins, etc.) (p.25)

Birmingham, Drabenstott, Frost, Warner, and Willis (2000) reported that the advantages of "WBI" are as follows:

> • They reduce geographic, organizational, and time barriers of distance.
> • They enhance collaborative and groupbased activities.
> • They provide access to collections of information in multimedia formats that
> are not available to off-campus students.
> • They allow users to personalize or customize information access and representation.
> • They provide information at any time and in any place (p. 21).

In general, there are three components in Internet-based learning environments—i.e. the person (learner), the machine/system and the activity. In this sense, Internet-based learning environments may involve two relationships, those of the person–machine and the person–activity (Lee & Tsai, 2005). In their study, the person–machine relationship is perceived as the exterior dimension of Internet-based learning environments, which mainly deals with the interaction between the person (learner) and the system or content provided by the machine. The relationship of person–activity is defined as the interior dimension of Internet-based learning environments, which focuses on how the person engages in the activity. In summary, the Internet-based learning environment contains exterior and interior dimensions, which involve the relationships of the person–machine and person–activity, and the learner, clearly, plays a central role in both environments.

Wen *et al.* (2004) have categorized the features of Internet-based learning environments into the technical-content aspect and the cognitive-metacognitive aspect. In addition, Tsai (2004) has argued that Internet-based instruction should not only be perceived as a cognitive tool or a metacognitive tool, it could also be regarded as an epistemological tool. Tsai (2004) has suggested that epistemology deals with the nature of knowledge and beliefs, and as learners will acquire large amounts of information and knowledge provided by the Internet, they need to reflectively evaluate the merits of the information and knowledge provided. Therefore, as Tsai (2004) has asserted, Internet-based learning environments provide adequate opportunities for students to deeply explore the nature or the merits of knowledge. For this

reason, Internet-based instruction can be considered as an epistemological tool. Thus, the aforementioned dimensions of Internet-based learning environments (i.e. exterior versus interior) could be further categorized into certain aspects. In this study, we integrate the suggestions made by Wen *et al.* (2004) and Tsai (2004), and assert that the features or perceptions regarding Internet-based learning environments should be further categorized into five aspects, namely the technical aspect, the content aspect, the cognitive aspect, the metacognitive aspect and the epistemological aspect. The technical aspect measures the ease of use for Internet learning systems; the content aspect explores the features of the information or learning materials contained in Internet environments; the cognitive aspect investigates the cognitive activities and strategies involved in Internet-based learning environments; the metacognitive aspect assesses the possibility of promoting metacognitive thinking by Internet-based learning environments; and, finally, the epistemological aspect examines the opportunities of exploring the nature of knowledge as provided by the environments. Moreover, the exterior dimension of Internet-based learning environments, described previously, covers the technical and content aspects, as these aspects mainly cope with the interaction between the user and the machine/system per se. The interior dimension of Internet-based learning environments includes the cognitive, metacognitive and epistemological aspects, because the interior dimension focuses on the interaction between the user and the involved activity as provided by the system; thus it deals with the user's cognitive activity, metacognitive process and epistemological thinking as promoted by the environments. To summarize, a framework illustrating the

features of Internet-based learning environments is proposed, and it contains two dimensions and five aspects.

There are numerous pieces of researches to show that WBI has been a truly effective way to achieve learning. Some of the studies are listed below:

The effectiveness of World Wide Web-based flexible learning practices in Australia was examined by McKavanagh, Kanes, Beven, Cunningham, Choy (2003). Online vocational education and training (VET) offerings were reviewed, and two Web-based VET modules were examined in case studies that involved observations and semi-structured interviews with teachers and students. According to the survey, approximately 120 modules were offered in a Web-based flexible mode in Australia in 1998. In addition, the modules served about 2300 students, with a median of 31 students involved in each module. The findings suggested that Web-based programs have the potential to support and enhance lifelong learning with an emphasis on learner-directed learning and adaptability. It was concluded that designers of Web-based programs should take advantage of the capabilities offered by technology in ensuring that content materials encourage rich "conversational" interactions and that student self-directedness and reflection are encouraged. The research led to development of data collection and data analysis tools for evaluating Web-based flexible learning in VET.

Research, theorizing and practice in the development and use of technologies such as the Internet for educational purposes seem to emanate from two different contexts in higher education around the world. The first is where technology is deployed in the service of on-campus classroom teaching, often supplementing face-to-face teaching. The second is where technology

supports the learning experience of off-campus students for courses that are online-dependent or fully online. Such disparate worlds of e-learning activity might rarely acknowledge the theorizing and good practice of the other. Dual mode institutions, however, must concurrently engage with the challenges of designing learning environments used by both on- and off-campus students. The central question is to what extent can learning environments, incorporating significant e-learning components, can be generically designed to help achieve the desired learning outcomes of such courses, while at the same time catering to the diverse needs of the students. This question requires deeper examination of the profiles of various cohorts of students who undertake the courses. Geographic location alone may not be the sole differentiator of what these students bring to the learning experience, how they engage in it, and what they might learn. If student cohorts differ in more than their mode of study, then this has implications to the extent to which learning environments can be standardized for all learners as opposed to containing points of customization catering for particular learner cohort needs. This, in turn, raises the question to the extent to which corporate learning management systems can sustain appropriate customized learning experiences within an environment of common overarching elements.

In their study Yıldırım and Özden (2001) assessed distinctive characteristics of a hierarchically designed hypermedia-learning environment through students' perceptions. The authors emphasized that hypermedia environment promoted a feeling of empowerment and this environment resulted in increased student motivation. They also asserted that hypermedia-

learning environments should be used along with a traditional learning environment.

Cereijo, Young, and Wilhelm (2001) conducted a research study, using qualitative method, to find out the factors facilitating student participation in asynchronous web-based courses. The authors collected data through surveys, observations, interviews, e-mail correspondence, chat room and bulletin board transcripts. Their analysis of data revealed that factors such as classroom preference, learning style and personality type influenced how students value a web-based course.

Although online learning has many advantanges when used for educational purposes, researchers should deal with design and implementation issues of the web. Many researchers stated that poor design in a web site fails to improve the quality of instruction. Based on their experience, Palloff and Pratt (2001) stated: "...a well-constructed course is one that is logical in its design, easy to navigate, and inviting to the users" (p.10). The authors underlined the effectiveness of asynchronous discussion for promoting learning. They also added that a course site, which is simple and easy to follow, would be better perceived by students than a complex one which comprises many elements such as audio, video and chat.

In their study, Whipp and Schweizer (2000) underlined the importance of online experience from the learners' point of view, and suggested some strategies to meet learners' psychological needs in the web-based courses. Some of the strategies offered by the authors for fostering a sense of community on the web-based courses can be summarized as follows: personal web page for each student, individual e-mail, personalized responses to student

posting, public and personal acknowledgements and celebrations, meeting, the need for freedom, clear but flexible deadlines for discussion, internet links, technical support, and course bulletin board.

Armatas, Holt & Rice (2003) examined in relation to a first year, a multi-modal psychology course offered at Deakin University. In 2001, the course, which was offered to over 1,000 students studying on three campuses in three Victorian cities, and off-campus nationally and internationally, adopted an online-supported, resource-based learning (RBL) approach. Research on the impact of the online RBL approach on various aspects of student learning was conducted to investigate whether learner characteristics are related to self-reported use of online learning materials, and examinations on whether differences could be discerned between student cohorts by mode of study were specifically conducted. Measures of learning goals (mastery and performance) and study strategies (rehearsal, elaboration, lack of strategy) were obtained from a large group of students studying the course. Their self-reported use of the resources (both prescribed and optional) provided electronically and in print form was examined with respect to their learning goals and preferred learning strategies, attitudes to computers and interest in psychology. The amount of time spent working with the material, the perceived value of the materials for helping students meet the assessment requirements of the course, and the extent to which students reported their use of they used various resources as part of their normal study routine were examined. These data formed the basis of analysis around issues of similarities and differences in the on- and off-campus cohorts who undertook the course. Unlike the on-campus students who were less positive about working with computers and reported

confusion about how and what to study for the unit, the off-campus students reported feeling confident that they had a good study strategy and were more positive about computers. The off-campus students also reported that they spent more time working with electronic resources and attached greater value to them. While all students valued the prescribed resources, the off-campus students found some of the optional, electronic resources valuable because they added to the learning experience. These students also reported greater use of the computer-mediated communication available as part of the online learning environment, and valued this functionality more highly than did the on-campus students. These findings highlight the need to take into account learner characteristics when designing learning environments that cater for individual differences and preferences. While online supported RBL approaches have the potential to cater to the diverse needs of students, learning environments need to be designed, structured and delivered so the learning experience can be customized to the needs of different student cohorts, while preserving the overarching, pedagogical goals.

2.4 Computer Assisted Assessment (CAA)

Computer-assisted assessment (CAA) is a common term for the use of computers in the assessment of student learning. Various other terms are used, such as computer-aided assessment, computerized assessment, computer-based assessment (CBA) and computer-based testing. These terms are largely interchangeable (Bull, 1999).

CAA encompasses the use of computers to:

- Deliver, mark and analyze assignments or examinations
- Collate and analyze data gathered from paper forms, using an optical mark reader (OMR) with hard copy question paper and an OMR-readable answer form
- Record, analyze and report on achievement
- Collate, analyze and transfer assessment information through network (p. 34).

While summative assessment has been one of the features most widely recognized among teachers as a benefit of CAA (Bull, 1999), formative CAA has much to recommend it for improving learning. Students value the opportunity to test their own knowledge prior to formal exams (Dalziel & Gazzard, 1999). A careful integration of formative and summative CAA has much to recommend it as a general strategy for many educational contexts.

The results of a survey conducted in 1991 by the CAA Centre into the use of CAA in the UK higher education sector show that the majority of the CAA tests are used for summative and formative assessment (McKenna & Bull, 1999).

Research studies have shown that Computer Assisted Assessment that is properly used can make a significant difference in students' academic performance. Gibbs (1992) provides several examples of how small changes in assessment strategy can dramatically transform the way students learn. He has applied some assessment techniques that led to an improvement in the average exam score from 45% to 75%. Thomas and Taylor (1999), with the study of Tutor Marked Assignments (TMAs) which are the major mechanism by which Open University (OU) students receive feedback on their academic progress, have found out that there has been significant improvement in the teaching and learning process.

The results of a study (Pollock, Whittinghton & Doughty, 1999) where Computer Assisted Assessment (CAA) was used for a Mathematics course that was already being delivered using Computer Aided Learning (CAL), displayed that most of the students preferred CAA to traditional exams. They found it more organized, felt less pressure, were able to work at their own pace, and found it simple, much easier and less stressful to use.

There are several advantages in the use of CAA compared with paper tests. CAA can reduce marking time and improve the accuracy of the assessment. It will also remove any bias (good or otherwise) towards particular students. The results are stored in a format, which is amenable to rapid production of statistical information. The advantages of CAA are as follows:

Cheaper and Faster: The computer does the marking, saving large amounts of trainer or teacher time. The research studies (Kleeman, 1998) related to Computer Assisted Assessment showed that marking by computer was resource efficient and efficiency gains increase with the increasing class size. As there is little or no time spent in marking, students can be given their results either immediately upon completion or after a very short period (Kleeman, 1998).

Fairer: Computers are objective. They do not make mistakes. In addition, they do not suffer from personal bias. It's very important to get the questions right, and to set up the marking criteria, but once you've done this; the computer will do the marking with precise accuracy (Kleeman, 1998).

Helps learning – Immediate Feedback: One of the strengths of CAA is that students can receive feedback quickly as they progress through the

assessment. Most of the survey results (McKenna & Bull, 1999) show that this is among the main advantages of CAA.

Feedback is the information given to students about the correctness of their answers. Providing feedback to students is vital if they are to benefit from self assessment activities. It serves the purpose of "assisting learners in monitoring their understanding, leading students to re-study or seek help on points where feedback has identified errors. Feedback may also provide helpful explanations" (Jonassen, 1998).

It is easy to get the computer to give helpful feedback to people taking tests. As well as simply working out a score, you can give diagnostic information to people about which topics they are strong or weak on, or why their answer to a question was wrong and perhaps direct them to relevant course materials (Kleeman, 1998; Winship, 2000). Technology allows complex analysis of student responses, and the tailoring of feedback according to that response (Jonassen, 1998). Thus testing can help learning, as well as measure its effectiveness (Kleeman, 1998).

Easy analysis: The primary purpose of CAA is the information and results it provides. Also, more meaningful from the results can be obtained to be used to improve teaching and learning (Kleeman, 1998).

CAA facilitates a detailed analysis of the test results with minimal effort. Once the data are the computer, it is easy to analyze the results on a computer. This can be used to identify areas within the course where the students have difficulty, thus alerting staff to the possible need to adapt their teaching. Or perhaps it could be used to identify trends and patterns within the student group. Question which are not successful at discriminating between

students can readily be identified and improved for future years (Kleeman, 1998).

When a test is delivered on paper, the only analysis that you are likely to do is that which can be done easily without further calculation or data entry. However, when CAA is used, the full results from the assessment are on mputer automatically, without any extra work needed. This gives us the ability to think of new kinds of analyses, that would never have been considered when most tests were on paper, but which is worth considering now they are on computer (Kleeman, 1998).

Also when conducting CAA, information that is simply impossible to know when conducting paper tests can often be gathered.

Looks different every time it runs: By using computers, you can randomize tests, to make each test different. You can choose questions at random from different topics, and with some question types (e.g. multiple choice), you can also shuffle the order of the options. You can also make adaptive tests, where the computer jumps to different places depending on the answers. This means that each time someone takes a test, it is different. So you can have a single test that people are allowed to re-take, because if they do, there is not much chance of seeing the same questions again (Kleeman, 1998).

Testing on demand: It is easy to arrange for people to take tests at the place and time that is convenient for them. In the business environment, people can be assessed at their desks or from their portables over a mobile phone line. It is not necessary to drag people into the training office just to assess them, which means less wasted time, and less travel costs. Especially for medium or

low stakes testing, where invigilation or proctoring is not required, the assessment can be available at all times (Kleeman, 1998).

Use graphics or multimedia – Powerful Learning Environment: It is easy to include color graphics, a screenshot from a computer application or a color photograph on a computer, whereas this is expensive on paper. Furthermore you can include sound, video or other multimedia, which is impossible on paper. In some fields graphics or multimedia may open new opportunities altogether. Consider for example, a medical assessment on irregular heartbeats – how much better to play a recording of a heartbeat in a question than to describe it (Kleeman, 1998).

Easy to update: Whereas re-printing paper tests is time consuming and can be costly, changing a computer test is just a matter of simple editing. Therefore, it is easy and cheap to change questions and keep a test up to date. Furthermore if you are testing at a distance, you can update the questions centrally, and the updates can happen remotely at once (Kleeman, 1998).

Besides many advantages of CAA there are also some limitations which must be taken into consideration and tried to overcome carefully.

Limited Question Types: Ultimately CAA is suited to those question types which require a limited response from the user. Typical examples of traditional CAA questions include multiple choice questions, multiple response questions, gap filling, matching pairs, list ordering, and those questions requiring numerical input, e.g. complex math problems. So it is not well suited to subjects such as the humanities (Oliver, 2000). However, the result of a survey made in 1991 by the CAA Centre in UK, suggest that there is evidence of some use of CAA in social and humanity courses (McKenna & Bull, 1999).

Recent research has produced an improvement in CAA's ability to test higher order skills such as comprehension, application and reasoning, and allowed for its implementation of the tools on the web. Areas for development include graphical hotspot questions, which involve selecting an area of the screen by moving a marker to the required position. Text assessment is also being developed (O'Keefe, 2000).

Security: There are also security aspects to consider. It is very difficult to stop one student from glancing at the display of their adjacent companion, (either voluntary or involuntary!). But this can also occur in paper-based examinations. One proposed solution in CAA is to vary the sequence in which the questions are presented. Another solution suggests having each alternative machine presenting a different bank of questions, which measure the same educational objectives. Also, use of random factors within the question itself can be a solution. For example angles, heights or widths can be varied. This would also solve the problem of the lecturer having to rewrite the questions every year. However this requires a considerable degree of programming expertise and time investment that CAA is trying to avoid!

There is also the issue of passwords. If CAA is to be used for coursework assessment, what is to stop one student from using another's password? There are recorded instances of students logging on under a different name, completing the assessment and then re-logging on under their own name to "successfully" complete the task (Oliver, 2000). But by the rapid improvement of biometrics technology new identification and authentication methods can be used such as smart cards, identifying from finger print, eye

retinas etc. Many research studies are being done about this subject (Fröhlich, 2000).

Security issues can be a problem in Web based CAA, but with adequate computer support, institutions have found that it is possible for exams and tests to be password protected, encrypted and loaded onto the server just prior to the test being taken. Questions and options can be randomized to reduce cheating and variety of mechanisms can ensure that students only have access to permitted online material during an exam (Warren, 2000).

Attitudes towards CAA: Although some studies suggest that students are positive towards the use of CAA one must bear in mind that it takes the user longer to read a piece of text from the computer screen in comparison to that of its paper-based equivalent. Students can be tired after computer based exercises. Thus, the use of CAA may increase the actual time period of the examination (Oliver, 2000).

As mentioned above, fear of technology and the lack of recognition for innovative teaching practice are among the potential obstacles for successful implementation of CAA (McKenna & Bull, 1999).

Research to date suggests that if students are given adequate training in the use of assessment software prior to the actual test, no groups are disadvantaged by CAA (Winship, 2000).

Question Selection order during an exam: One of the main obstacles CAA must overcome in the exam environment is that of duplicating of the advantages of the paper based equivalent. For instance students using the traditional method can flick from question to question and can answer in a random order if they so choose. Thus the CAA system must also offer a similar

degree of freedom. In addition many students throughout the exam may change their answer – this is easily achievable with paper based situations but not so with CAA. Many systems simply record the user's last entry (Oliver, 2000).

Reliability of Hardware and Software: Reliability of hardware and software was found among the main disadvantages of CAA in the survey conducted by CAA Center in UK in 1999 (McKenna & Bull, 1999).

There are many delivery mechanisms for CAA. There are closed computer networks, web based systems, OMR-delivered systems and stand – alone machines. Among these, by the improvement in Internet technology, web based testing became an important assessment method. In the survey conducted by CAA Center in UK in 1991, it was found that the predominantly used delivery mechanisms were closed computer networks and web-based systems. However, a little delivery on stand-alone machines also exists (McKenna & Bull, 1999).

Web-based assessment allows great flexibility in the presentation of computer assisted assessment (CAA), particularly in terms of time, place and pace. For this reason, existing Web-based assessment systems can be expected to be of growing importance in education. The Web-based assessment program runs entirely within the Web browser, as is currently exemplified by Web-based email. These systems allow for the creation, delivery and monitoring of all aspects of educational assessment over the Web, and bring with them a range of advantages in terms of ease of use, ease of editing and efficiency (Dalziel & Gazzard, 1999).

In this study, a web-based testing program was developed. Users (both students and teachers) required no special software or hardware apart from an

Internet- accessible computer and Web browser. It was designed for summative assessment and also had instructor modules to define students, to prepare questions, and to send results to the students just after the exam.

The Web will change many aspects of education (in any society), but Web-based assessment is one of the most promising innovations in education and training. The flexibility in time, place and pace that Web-based assessment can afford for practice questions and other formative assessment methods is a major advance over previous CAA methods. In addition, the intuitive nature of the Web and its platform independence give it special advantages over "stand alone" CAA. Further, it is possible to design Web-based assessment systems which require no software installation or downloading, nor the use of any special plug-in, allowing the web-based assessment to become as simple as using a Web browser (Dalziel & Gazzard, 1999). Due to the server id, software need only be hosted on a single computer (rather than separately on each test computer), and questions can be hosted centrally, meaning that changes need only be made to a single computer, and these can then be distributed to all users. Monitoring exams and collecting response data are also greatly improved by using the standardized network of the Internet (Dalziel, 2000).

2.5 Student Attitudes towards Science Courses

Many studies that have been implemented about the influences of web-based learning on students' attitudes hold different opinions about whether it makes positive changes in attitudes towards science and science lessons. (Francisa, Katzb, Susan, & Jonesc, 2000; Mitra, 1998; Federico, 2000) For

example, Choi, Lim, & Leem (2002), and Ertepınar, Demircioğlu, Geban, and Yavuz (1998) reported that computer assisted instruction develops a positive attitude towards science education. Choi, Lim, & Leem (2002), Beard, Harper, & Riley (2003) reported that web-based learning develops a positive attitude towards science education. In contrast to this, Shaw and Marlow (1999), Çepni, Taş, & Köse (2004) stated that computer assisted instruction does not show a positive effect on students' attitudes. Besides, students' attitudes towards science are quite negative if traditional teaching methods are used in science classes (Colletta & Chiappetta, 1989).

Another aspect of computer or web-assisted instruction that was researched was the attitude of students towards using computer animations and graphics compared with text-based or mental models (Szabo and Pookay, 1996). In this study, animations and slide-presentations using PowerPoint TM for example were utilized in the classroom and/or posted on a web site to teach geometry and trigonometry. One group was taught using animations, another with graphics, and the third was instructed using text only. Pre- and post-tests were administered. The research findings were as follows: the animation group score was 21.3% higher than the graphics group and 34.8% higher than the text-only group. Still another study reported on student attitudes toward and evaluation of Internet assisted instruction (Truell, 2001). The research consisted of student responses to questions, with answer options ranging from (1) strongly agree, (2) agree, (3) disagree, and (4) strongly disagree. The participants' overall attitude toward internet-assisted instruction was 1.93, which is slightly lower than an "agree" response since "strongly agree" is rated at 1.00. An interesting internal-comparison of the results of Truell's study was

also obtained in this study because a Group Embedded Figures Test (GEFT) was administered to determine the learning styles of the participants. The neutral learning style category produced the most positive attitude towards internet-assisted instruction illustrated by a mean score of 1.65. Furthermore, attitudes based on gender were computed with female students with a slightly more positive attitude towards internet-assisted instruction than males, although the difference in gender group attitudes was not considered significant at alpha = .05

2.6 Case Study

Case study is an ideal method when a holistic, in-depth investigation is needed. Case studies have been used in varied investigations, particularly in sociological studies, but increasingly, in instruction. As cited in Tellis (1997), Yin, Stake, and others who have wide experience in this method have developed robust procedures. When these procedures are followed, the researcher will be following methods as well developed and tested as any in the scientific field. Whether the study is experimental or quasi-experimental, the data collection and analysis methods are known to hide some details. Case studies, on the other hand, are designed to bring out the details from the viewpoint of the participants by using multiple sources of data.

There are several examples of the use of case study method in the literature. Yin (1993) listed several examples along with the appropriate research design in each case. There were suggestions for a general approach to designing case studies, and also recommendations for exploratory, explanatory,

and descriptive case studies. Each of these three approaches can be either single or multiple-case studies, where multiple-case studies are replicatory, not sampled cases. There were also specific examples in education, and management information systems. Education has embraced the case study method for instructional use. Some of the applications are reviewed in this study.

In exploratory case studies, fieldwork, and data collection may be undertaken prior to definition of the research questions and hypotheses. This type of study has been considered as a prelude to some social research. However, the framework of the study must be created ahead of time. Pilot projects are very useful in determining the final protocols that will be used. Survey questions may be eliminated or added based on the outcome of the pilot study. Selecting cases is a difficult process, but the literature provides guidance in this area. Yin (1993) recommended that the selection offers the opportunity to maximize what can be learned, knowing that time is limited. Hence, the cases that are selected should be easy and subjects should be willing. A good instrumental case does not have to defend its typicality. Explanatory cases are suitable for carrying out causal studies. In very complex and multivariate cases, the analysis can make use of pattern-matching techniques. (Tellis, 1997, September)

Knowledge-driven theory means that ideas and discoveries from basic research eventually become commercial products. Problem-solving theory follows the same path, but originates not with a researcher, but with an external source identifying a problem. The social-interaction theory claims that

researchers and users belong to overlapping professional networks and are in frequent communication.

Descriptive cases require that the investigator begin with a descriptive theory, or face the possibility that problems will occur during the project. Several states were studied and the data about each state's activities were compared to another, with idealized theoretic patterns. Thus what is implied in this type of study is the formation of hypotheses of cause-effect relationships. Hence the descriptive theory must cover the depth and scope of the case under study. The selection of cases and the unit of analysis are developed in the same manner as the other types of case studies.

Case study research is not sampling research; that is a fact asserted by all the major researchers in the field. However, selecting cases must be carried out so as to maximize what can be learned in the period of time available for the study (Tellis, 1997).

The unit of analysis is a critical factor in the case study. It is typically a system of action rather than an individual or group of individuals. Case studies tend to be selective, focusing on one or two issues that are fundamental to understanding the system being examined.

Case studies are multi-perspectival analyses. This means that the researcher considers not just the voice and perspective of the actors, but also of the relevant groups of actors and the interaction between them. This one aspect is a salient point in the characteristic that case studies possess. They give a voice to the powerless and voiceless. When sociological investigations present many studies of the homeless and powerless, they do so from the viewpoint of the "elite" (Tellis, 1997, September).

Yang (2000) conducted a study to examine how the learners use Perseus to create their projects, what their affective attitude and cognitive perceptions are towards hypermedia in general and the Perseus system in particular. The Perseus Project is an ambitious, highly visible hypermedia research project that is creating a large-scale, heterogeneous corpus of material, textual and visual, relating to the ancient Greek world. Perseus moves beyond simple information delivery, as it allows the users to share and personalize the knowledge base with the system. The Path-making tools of CD-ROM applications give its users the power to extract, annotate and reorganize information through the collection based on their specific research direction.

The subjects in the Perseus project were six volunteers from a mid-western university. Their majors were Psychology, Computer Science, Political Science, Journalism and one was Undeclared. All took the introductory course about Greek culture for elective credit. At the outset, they were inexperienced in both the Perseus hypermedia and the content domain of Greek culture. The subjects participated individually, and were later interviewed on a one-to-one basis. Data were collected using audio-visual tapes, observations, and interviews. Think-aloud protocols involved asking the problem solvers to verbalize their thoughts while working on a problem. The verbal data gathered from the subjects' problem-solving procedures and interviews were recorded and analyzed to find the particular responses related to the issues addressed in the study. After each participant's verbal data had been transcribed, the author began the segmentation of protocols by reading each learner's transcript several times. A set of symbols for identifying aspects of the verbal protocols was developed.

The study focused on learners' attitudes and perceptions in their construction of discourse synthesis in the Perseus hypermedia environment. Several themes that were distilled and emerged from the learners' online protocols and interviews related to the learners' interaction with Perseus were outlined.

The results focused on from interviews show that students spent between 4 and 12 hours using Perseus to complete their assignments. Users found the materials and interactive learning experiences worthwhile, valued the Perseus hypermedia features, and believed that the Perseus resources were more meaningful than traditional forms of instruction involving textbooks. Yang (2000) remarked that one of his subjects had mixed feelings about using Perseus. He felt a balance between the requirement to use it, and his desire to use it. He expressed only moderate enjoyment about his experience of using Perseus. He stated that one positive aspect about Perseus was that it provided lots of visual information. On the other hand, he did have complaints about Perseus in respect to the uneven depth of the material, and in particular, he felt that the site plans were less helpful than pictures for visualizing the architectural ruins. Another said that her attitude towards working on assignments in Perseus was balanced equally between the fact that she ``had to'' and that she ``wanted to''. She felt comfortable reading and working in the computer environment.. However, she complained that it was sometimes hard to locate the information she wanted, especially without an index.

The study found that the subjects reported their experience of three types of dis-orientation to varying degrees, such as: (1) required information was not available in the database; (2) some subjects had diffculty in locating

specific information – it was in the database, but they were unable to fnd it; (3) some subjects had problems using the application functions - either they did not know how to initiate the appropriate commands, or the system produced unanticipated or undesirable results.

However, not every learner enjoyed these free-form information traversals. For example, one appeared to be less receptive to this constructive pedagogy and to the hypermedia application. He was not comfortable using Perseus exclusively for the assignment. He felt that this reading, linking, and writing by extracting information from Perseus with its excessive links gave him a fragmented learning experience. He remarked that he would learn more from the traditional lecture and reading format, as he was more oriented to paper-based books, and missed having a book in hand and flipping pages. However, he did like the multiple representations in Perseus, especially the images, which gave him a contextualized way of learning.

Given the small size of the class, these results cannot be generalized, but they do illustrate that the central Reading-Linking-to-Writing experience in Classical Grek Studies could not have been achieved in itself simply by the introduction of the learner to the Perseus hypermedia application. Perseus hypermedia is by no means a stand-alone system; it does not dictate meaning, nor does it guarantee pluralistic thinking, rather it merely facilitates it. As Salomon (1985) argued intellectual partnership which the technology can establish with the students can promote and sustain learners' mindfulness, but it is the learners' desire as to how mindful they will be while interacting with the computer, which in turn is partly determined by the materials encountered and by personal, perceptual, and attitudinal factors. In other words, hypermedia

itself will not teach students advanced-level thinking skills. But, the concept of constructive hypermedia, which consists of authoring and scripting, can indeed augment sound pedagogy given attentive learners. The teacher is a facilitator in a dialectical community of learning, and forms a triadic relationship with the learners and the computer tools. Optimizing the effectiveness of constructive hypermedia depends, on one hand, on the instructor's ability to communicate and engender commitment to the constructive messages and, on the other hand, on the learners' willingness to play an active role by taking their own initiative. The learners are the central agents in their own knowledge construction. They deliberately create their unique intellectual outcomes by assimilating, considering then restructuring, repacking or re-connecting the relevant information while critically reflecting on their new constructions, connections and linkages.

However, compared with the successful learners, some learners approached their path assignment with less of a sense of synthesis and integration than other subjects. They seemed to have only impoverished strategies for synthesizing data into patterns. Given this, the capability to access and collect information rapidly did not ensure a clear and persuasive presentation. Perseus is a tool that allows students to be intellectually lazy if they choose to be. To use it well requires initiative and effort, if the effort is missing, the results will be minimal. Therefore, making students aware that the personal construction of knowledge is dependent on meticulous scrutiny of primary materials and deeper level of integrating and evaluating of those materials is critical in research-based learning. The study showed the positive value of well-designed constructive hypermedia (Perseus) and constructive

pedagogy, when effectively integrated into a humanities curriculum. As students bring differing perspectives to their courses, those learners with a passive or maladjusted orientation toward Perseus need careful guidance and support from the pedagogical and technological applications of this self-directed curriculum. Therefore, providing scafolding, both in using hypermedia applications and in orienting the learners to the task, is vital to the successful implementation and integration of hypermedia into the curriculum.

This exploratory study provides a qualitative report on the integration of a specific hypermedia information system into the curriculum using authentic tasks in a class setting. It investigates how they use a hypermedia information database and tools to create meaning. The study examines how the learners structure their activities and what their affective attitude and cognitive perceptions are towards hypermedia in general.

2.7 Summary of Literature Review

A growing body of research and discussion on the use of hypertext systems as a writing, learning, research and problem-solving tool for educational purposes can be found in the literature in such diverse fields as business, medicine, chemistry, literacy, and the humanities (Castelli, Colazzo & Molinari, 1998; Lidstone & Lucas, 1998; Yang, 1996, 1999). However, much of the available literature on hypermedia consists of descriptive essays explaining the learning opportunities which may lend themselves to actual learning in various hypermedia systems (Dillon & Gabbard, 1998). The majority of the literature on the use of hypermedia as a tool for mediating

learning in context is generally more promotional and assumative than investigative and research based. As Knuth (as cited in Yang, 2000) points out, the extensive use of large-scale hypermedia databases in actual class settings has not yet been thoroughly explored and there is a need for these systems to be examined through observations of the ways in which students approach them in an ecologically valid learning situation.

Accurately describing the nature of the interaction between users or learners and any technological artifact is problematic. Inherently a communicative act, as several researchers and authors have suggested that using constructive, phenomenological and naturalistic alternatives to the traditional empirical paradigm, could provide richer, context-specific information necessary to understanding the effectiveness of this interactive media (e.g. Driscoll, 1984; Neuman, 1991). Furthermore, from the results of a meta-analytical study, Ayersman (1996) found that the perception and attitudes toward hypermedia are functionally important to promote effective learning. Therefore, there is a need for a systematic exploration of the learners' interface with hypermedia in order to reveal their interactions with hypermedia learning systems. According to Borsook and Higginbotham-Wheat (as cited in Yang, 2000), ``Knowledge of new technologies offers us new opportunities for understanding how we learn as they provide new capabilities. In turn, knowledge of how we learn feeds back to guide the development of new technologies, creating a wonderful cycle of progress" (p. 16). Given this, investigating how learners integrate their ideas and information selected from multiple source texts within a program to compose new texts will support

better understanding of the users' perspective and thus afford some insight into instructional design.

Federico (2000) investigated to determine student attitudes toward various aspects of network based instruction: cognitive, affective, and behavioral tendencies that are likely to facilitate, or interfere with, interacting and learning from this innovative technology. Also, analyses of student attitudes and learning styles will help design, develop, and deliver more effective and effcient network-based educational environments, for distributed individuals who will eventually be taking online courses. His study focused on student attitudes among individuals disclosing dissimilar learning and cognitive styles.

234 individuals voluntarily participated in his research to ascertain their tendencies that will likely facilitate, or interfere with, interacting and learning from this innovative technology. Participants were requested to respond anonymously to 60 items of a survey, designed to assess their attitudes toward distinct facets of network-based instruction, as well as two separate forms developed to ascertain their learning and cognitive styles. Student responses to survey items, and measures of learning and cognitive styles, were analyzed using a number of multivariate and univariate statistical techniques. The alpha reliability coefficient for the 60 items of this attitude survey, using the total sample of 234 participants, was computed to be 0.91. This index implies that the created attitude survey has high reliability.

As mentioned above, much of the available literature on hypermedia consists of descriptive essays explaining the learning opportunities which may lend themselves to actual learning in various hypermedia systems. The

extensive use of large-scale hypermedia databases in actual class settings has not yet been thoroughly explored and there is a need for these systems to be examined through observations of the ways in which students approach them in an ecologically valid learning situation. The study carried out by Yang (2000) looked at learners' attitudes and perceptions in their construction of discourse synthesis in the Perseus hypermedia environment. The reaction of students to the Perseus-augmented assignments was varied. The overall results indicated that most students were positive about learning through interactive multimedia case studies.

In our education system, the curricula of the secondary school and high school are very heavy. For teachers, it is sometimes impossible to repeat any subject even though it is difficult to achieve the desired objectives. Because of this, the students pass to upper classes without reaching the desired targets. Almost all high school teachers complain that students could not learn what they had to in the secondary school. As a science teacher and as the chairman of the science department of a private school, the researcher of this study would like to diagnose the problems of the students (e.g., the misconceptions, underachieved topics not covered properly,...). To do this, a test called Science Achievement Test (SAT) which contains multiple choice, true/false, matching and fill in the blanks types of questions was designed. One objective can be checked in more than one type of question. After diagnosing the problems, we would like to repeat the concept again if the number of students who can not solve the related question is more. If the number is less, homework will be given to restudy the concepts and solve problems. However, this is impossible to achieve due to limited time. Then, it is better to design a hypertext and offer

distance education. This exploratory study provides a qualitative report on the integration of a speciffic online information system into the curriculum using authentic tasks in a class setting. It investigates how students use an online information database and tools to create meaning. The study examines how the learners structure their activities and what their effective attitude and cognitive perceptions are towards online learning in general. Drawing from the study, the results and a discussion are provided, which highlight some implications for teachers and designers. The study contributes to an understanding of online learning and provides a basis for empirical study of learners performing real educational tasks. The insights gained in this small-scale study will help teachers construct better online learning environments with regard to pedagogy and technological innovation.

CHAPTER 3

METHOD

In the previous chapter, the need for the present study was investigated through the evaluation of the related literature. In this section, the research questions and sub-questions, design, procedure, subjects, instruments and analyses procedures of the study will be explained. To investigate the effectiveness of online hypermedia studies in science education, quantitative and qualitative research methodologies have been used together.

3.1 Design of the Study

This is a exploratory case study to investigate the effect of a web-based learning tool on student learning in science education.

Case study is known as a triangulated research strategy. Tellis (1997) asserted that triangulation can occur with data, investigators, theories, and even methodologies. It is stated that the protocols that are used to ensure accuracy and alternative explanations are called triangulation. The need for triangulation arises from the ethical need to confirm the validity of the processes. In case studies, this can be done by using multiple sources of data (Yin, 1984). The problem in case studies is to establish meaning rather than location.

For the purpose of the study, a science course enhanced with a web-based learning tool was developed. In the beginning of the semester, achievement and attitude tests were implemented as a pre-test to 6^{th}, 7^{th} and 8^{th} grade students. During the treatment period, the activities of students' were observed. At the end of the year, the same achievement and attitude tests were given to all grades as post-tests. Just after the post-tests, all students were interviewed about the effectiveness of the course. During the treatment, students' activities were recorded with a web site log system. The data in the log system was also used to triangulate student perceptions.

Table 3.1 Design of the Study

Grades	Pre-test	Treatment	Post-test	Interview
6^{th} 7^{th} 8^{th}	SAT Attitude scale	Web-based Instruction (WBI)	SAT Attitude scale	Interview guide

3.2 Research Questions

The study examines how the learners structure their activities and what their affective attitude and cognitive perceptions are towards online learning in general. The research questions are aiming to understand two major purposes:

1. to investigate whether science courses enhanced with a web-based learning tool affect on students' academic success and attitudes toward online science learning or not.

2.to investigate students' perceptions about the effective dimensions of science courses enhanced with a web-based learning tool.

The research questions for this study are listed below:

Question 1: Do science courses enhanced with a web-based learning tool have effects on students' academic success?

The sub-questions are as follows:

1.1 Is there a significant difference between the pre-test and the post-test of Science Achievement Test (SAT) scores of the 6th grade students?

1.2 Is there a significant difference between the pre-test and the post-test of Science Achievement Test (SAT) scores of the 7th grade students?

1.3 Is there a significant difference between the pre-test and the post-test of Science Achievement Test (SAT) scores of the 8th grade students?

1.4 Is there any relation between site time of the 6th grade students' and their academic success on the science course?

1.5 Is there any relation between site time of the 7th grade students' and their academic success on the science course?

1.7 Is there any relation between site time of the 8th grade students' and their academic success on the science course?

Question 2: Do science courses enhanced with a web-based learning tool affect on students' attitudes toward science learning?

The sub-questions of the study are as follows;

2.1. Is there a significant difference in attitudes of the 6th grade students toward science learning?

2.2. Is there a significant difference in attitudes of the 7th grade students toward science learning?

2.3. Is there a significant difference in attitudes of the 8th grade students toward science learning?

2.4. Is there any relation between site time of the 6th grade students' and their attitudes toward science learning?

2.5. Is there any relation between site time of the 7th grade students' and their attitudes toward science learning?

2.6. Is there any relation between site time of the 8th grade students' and their attitudes toward science learning?

Question 3: What are students' perceptions about a science course enhanced with a web-based learning tool at the end of the experiment?

The sub-questions are as follows:

3.1. What are students' perceptions about the usability of a web-based learning tool used in science courses?

3.2. What are students' perceptions about the quality of the content in web-based instruction?

3.3. What are students' perceptions about the structure of web-based instruction?

3.4. What are students' perceptions about the interactive tools like dictionaries, chat rooms, e-mail, videos, etc. in web-based instruction?

3.3 Subjects of the Study

The subjects of the study were 67 Özel Bilim Okulları students in secondary school (6^{th}, 7^{th} and 8^{th} grades) classes. The number of students in each grade can be seen in Table 3.1. At the beginning of the semester 67 students who participated in the study took a Computer literacy course. The number of students in 6^{th}, 7^{th}, and 8^{th} grades were 16, 25 and 26 respectively. The age level of students were between 12 and 14. There were no repeating students. There were 31 femail and 36 mail students.

In the 2002-2003 academic year, the Science Achievement Test (SAT) was applied to the students to get use to take exams in this form. At the beginning of the study, students were asked whether they had Internet connection or not. 25 % of the students responded that they did not have an Internet connection but they will do so in a short period of time. However, some of the students, which correspond to 16 % of the students, did not have any connection to the Internet at all. The students in the 8^{th} grade had taken the Lycée Entrance Exam this year, and 5 of these students had taken doctor's reports in order not to go to school. Therefore, some of them had not used the web site of the course, and the data of these students has not been taken into consideration. As a result, 51 students participated in this study.

Table 3.2 Subjects of the Study

Grade Level	Number of Students at the beginning of the study	Overall Initial %	Number of Students at the end of the study	Overall Final %
6th	16	23,88	13	25,49
7th	25	37,31	21	41,18
8th	26	38,81	17	33,33
Total	67		51	

3.4. Procedure of the Study

The researcher of the study was working in Özel Bilim Okulları as the chair of the Science Department at the time of the research. The researcher developed a Science Achievement Test (SAT)(Appendix-C). Since 2000, the SAT related to the previous year's content of science courses had been implemented to secondary classes (the 6th, 7th, and 8th grades) in order to find out the level of each student, the missing points in the content and concieved topics. The number of questions (depending on the level of classes) in the SAT ranged between 60-110. After the SAT was implemented, students' cards were produced. After the production of cards, some of the topics that were not understood well by almost all class members were re-taught and homework was given and then collected and checked. If the topics were not understood well by a small number of students, then only lecture notes and homework

were given. After that, the homworks were collected and checked. But, it was not able control whether the homework was done by himself/herself or s/he took a help from somebody else. In addition to this, the number of topics of the current year is really enormous and the contents are heavy for these age levels. If the previous year topics were being re-taught, the yearly plan could not be completed. In order to solve this problem, a web-based instruction tool was designed.

At the beginning of the2004-2005 academic year, for each level, in one class hour (40 minutes) a short orientation about how to use the web site and its components was given. In this orientation, students were informed about what the Internet address of the web site was, what was expected from them, how the web site was functioning, what their usernames are and how to choose their passwords. The SAT was going to be administered online and the students had not taken any online exams before. Because of this, again in one class hour, a short orientation about how to use online SAT was given. Moreover, the parents of the students were informed about the study, and they were asked to motivate their children to use the web-based learning tool. Then, before the treatment, online SAT on the topics that were covered in the previous year's science course were given to the students in the 6^{th} , 7^{th}, and 8^{th} grades to gain an understanding of the entry knowledge level of the students. To find out the initial attitudes of the students towards science learning, an attitude test was also given to all levels.

Students' logs were collected by the log system by Prof. Dr. M. Yaşar Özden. To increase the interactivity and the number of visit of the web site, Microsoft Class-Server© 3.0 packed program was used, and 19 Class-Server

examples (containing objectives, short description of the topic, tests) were produced by the researcher and they were given as homework. Deadlines were given to the students. The feedback about the assignments was immediately given to students. The activities of each student were controlled. During the academic year, the previous year's content was not explained. Lectures about new topics were offered by the same teacher.

At the end of the 2004-2005 academic year, the same SAT and attitude test were given to all levels as post-tests. After the post-tests, the students were interviewed in groups of 4 students to get their perceptions about science courses enhanced with a web learning tool. Each interview lasted for about one class hour (approximately 40-50 minutes). The interviews were recorded by using audio tapes after permission was taken from the students. The recorded data was transcribed and analyzed to find out students' perceptions about science courses enhanced with a web learning tool.

3.5 Instruments

The following instruments were used to obtain data for the study

3.5.1 Science Achievement Test (SAT)

Science Achievement Test (SAT) was used as both pre-test and post-test to measure students prior knowledge and knowledge acquisition after the treatment respectively. The SAT questions were developed by the researcher as the teacher of the subjects of the study. The questions were written in

compliance with the course objectives stated in different learning levels in the cognitive domain (such as knowledge, comprehension, application etc.) (Bloom, 1956). The initial form of the SAT contained multiple-choice and fill-in-the-blank type questions. The test prepared was examined by three subject matter experts for internal validity, and found to be valid. But in the first pilot application of the SAT, almost none of the students responded to the fill-in-the-blank type questions. Because of this, the SAT contained only multiple-choice questions. In order to be sure about the result of the SAT, more than one question was asked about the same objective of the topic. The second pilot application was conducted to 60 students in Özel Bilim Okulları in 2004. The result of the item analyses showed that some questions should have been eliminated. The number of questions for each grade and the reliability coefficient of the SAT for each grade are presented in Table 3.3.

Table 3.3 The number of questions in SATs and their reliability coefficients, alpha

Grade	**Number of questions in SAT**	**Alpha**
6^{th}	44	0.89
7^{th}	89	0.91
8^{th}	59	0.89

The SATs are given as Appendix-C

3.5.2 Attitude Scale

The Attitude Scale was developed to investigate the subjects' pre-attitudes and post-attitudes toward Science courses. Some of the questions in the scale were adapted from Delialioğlu's (2004) subjects' attitude scale about computer networks and communication topics, and some of the questions were developed by the researcher. There were at least 2 statements for each opinion. The initial form of the attitude scale that contained 35 questions was piloted to 30 students who were going to graduate from 8th grade in 2004. The results were investigated by the researcher and 4 questions were eliminated from the scale. The Attitude scale had 31 items in a 5 point Likert scale from Strongly Disagree to Strongly Agree. There were positive and negative statements on the scale. The positive items were coded from 5 to 1. But, the negative ones were coded from 1 to 5. The reliability coefficient of the attitude scale was measured as 0.81. The attitude scale is given as Appendix- A

3.5.3 Interview Form

The Interview form was developed by the researcher in order to investigate the perceptions of the students about science courses enhanced with a web based instruction tool. The initial form of the interview form was developed after some studies (Studies done by Delialioğlu and Topçu) were carried out. The initial form of the interview form contained 19 questions that included alternative questions. After the opinions of experts were taken, irrelevant and misleading questions were eliminated. Before using the form, it

was conducted on 5 students in the same school. The structure of three questions were changed in order to eliminate misunderstandings. The form was found valid by experts. The interview form is given as Appendix-B

3.5.4. The Web site of the Course

The web site of the course was developed by groups of students in the Department of Computer Education and Instructional Technology (CEIT) at Middle East Technical University (METU). The web site was developed as a term paper for the course CEIT-419 which is delivered by Prof. Dr. M. Yaşar Özden. The students at METU designed the instruction, adapted the content and developed all activities related with the course. Final form of the site was coded and implemented by Prof. Dr. M. Yaşar Özden. The side can be seen in http:\\guide.ceit.metu.edu.tr .

The designed web site was investigated and used by the researcher, a science teacher of Özel Bilim Okulları, in teaching some 8^{th} grade students who were going to graduate in 2003, and six prospective (pre-service) teachers from Science Education Department at METU. The whole content of the web site was analyzed. If there were any spelling errors and/or lack of information, they were edited. All of the links in the web site were checked, and if there were any missing connections in the links, they were connected. In the content of the web site, there were some links to videos related to the content to be taught. But, in some topics, there were not any links to videos. Desired videos were searched and the resources that were found were edited by using Microsoft Movie Maker® and Adobe Premier© packet programs.

Web-based instruction is an instructional delivery mode that has evolved from traditional instructional delivery environments; hence, many online materials have been derived from traditional instructional material, typically textbooks. Unfortunately, converting textbooks to Web pages can result in digital versions of textbooks that provide no incremental benefit for learners. In this project, considerable time was spent converting and redesigning original textbook content to produce a rich online learning experience. Special efforts were made in terms of content design, the activities necessary to support and reinforce student learning, developing ancillary learning materials and resources, and utilizing Web resources.

In many (if not most) programs of instruction, course and lesson objectives are not always clearly presented to students, either initially or throughout the progress of a course. Course objectives are essential because they help instructors plan the structure of a course and develop learning activities and assessment methodologies (Berge, Collins, & Dougherty, 2000). The online learning materials developed in this project were derived from textbooks in which learning objectives were not stressed or made obvious to learners. This deficiency in the online materials was addressed by presenting learning objectives at the beginning of each lesson together with basic/new concepts and definitions to support those objectives as shown in Figure 3.1. This was done continuously throughout the instruction to reinforce the learning of new concepts and to help students acquire and construct new meanings and principles in science.

The components of the page were topics, dictionary, news, e-mail, help, and homeworks. All of these components were designed in navigation buttons.

Length of the pages fixed into screen and there were no need to scroll up and down.

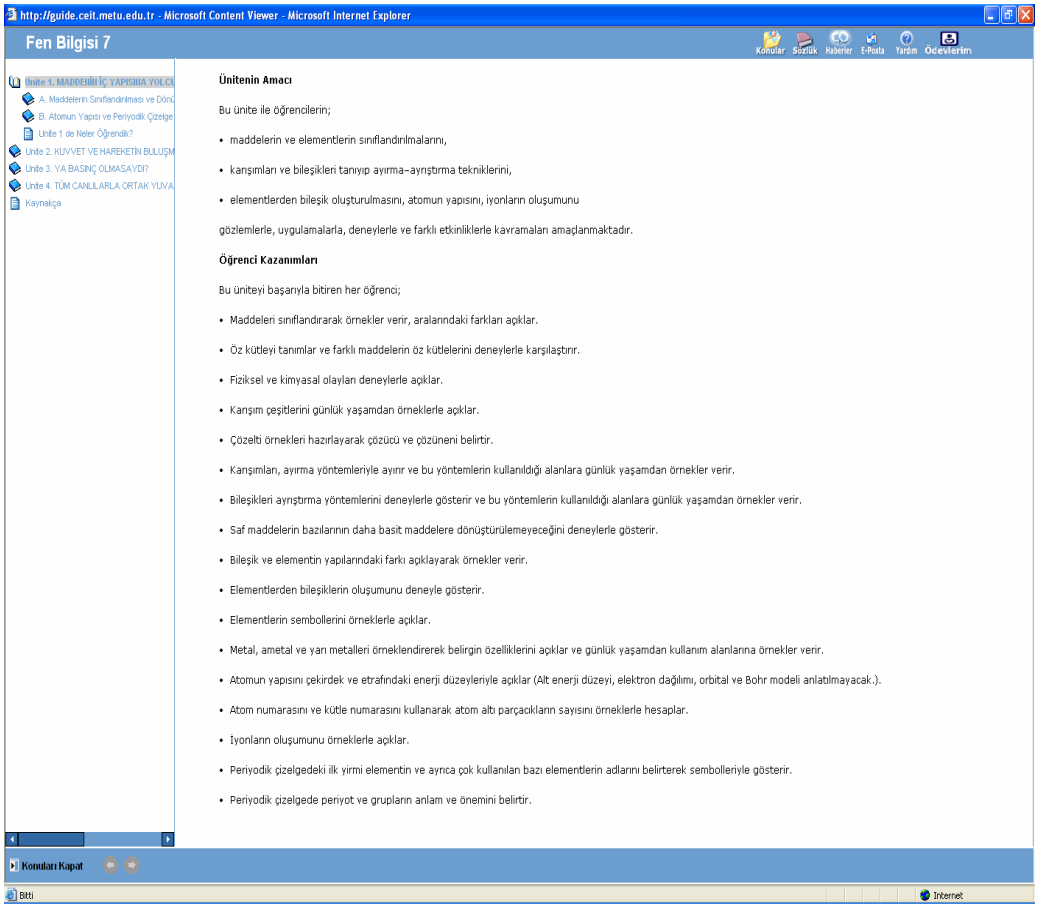

Figure 3.1 Introduction Page of a Unit

The content of units in science content is difficult for many students, particularly for those studying independently at a distance. Online content can provide learners with multiple forms of media (e.g., hypertext links, graphics, animation, real-time audio and video, etc) to involve them in active learning activities (Weston & Barker, 2001). Other online tools/effects that can be used are links to Web sites with authentic contexts or sites that afford access to primary source documents, and immediate automated assessment and feedback (Weston & Barker, 2001). Consistent with Sadik & Reisman (2004), this study

utilized such technologies to provide students with complete and up-to-date views of the subject matter, including main concepts, links to Web resources, examples, exercises, and so forth. The use of a variety of well-selected, real-life examples helped students focus on new concepts and understand difficult issues by applying them in new ways, especially when alone and with less access to instructor assistance than is common in face-to-face learning environments. Accordingly, more real-life examples were provided so that students could practice new concepts and skills in an independent and comprehensible manner.

Web-based learning platforms provide an ideal environment in which to implement the principles of constructivist learning. The web site of this study was implemented on such a basis. Constructivists assert that students construct their own learning in meaningful ways when they participate in individual and social activities, encounter and solve problems, interact with others, exchange information, and evaluate their understanding. Accordingly, different kinds of resource tools such as videos and situational problem solving exploration methodologies were provided to assist students in achieving high-order learning objectives.

Students were involved individually in many real-life problem-solving activities through self-tests, exercises, and discussions. Through social interaction, facilitated by e-mail and discussion boards, students could learn others' points of view and assess their own understanding.

Sadik & Reisman (2004) state that;

> Students do not like to scroll long pages; this implies that consideration should be given to optimizing the length of course pages when designing online material. Tradeoffs may need to be made regarding the relationship between optimal lengths of content display versus page download times (p 165).

In this study, the lengths of the pages in general were designed in such a way that the users do not need to scroll pages.

Some of the Internet technologies used in this web site are Active Server Pages (ASP), Cascading Style Sheets (CSS), and Microsoft SQL Server.

Usernames and passwords were given to the students to access the web site of the course. The username supplied in authentication initiated the log system, which was internally bound to a database, to keep track of activities of the students while going through the content and using the cognitive tools.

The screen design of the web site separated the web page into four main parts. One part was used for visual and graphical elements. The second part was used to show the table of contents. The third part was used to show all content and activities. The fourth part was used to open or close the table of contents and it was used to display the position of the student in the web site as shown in Figure 3.2.

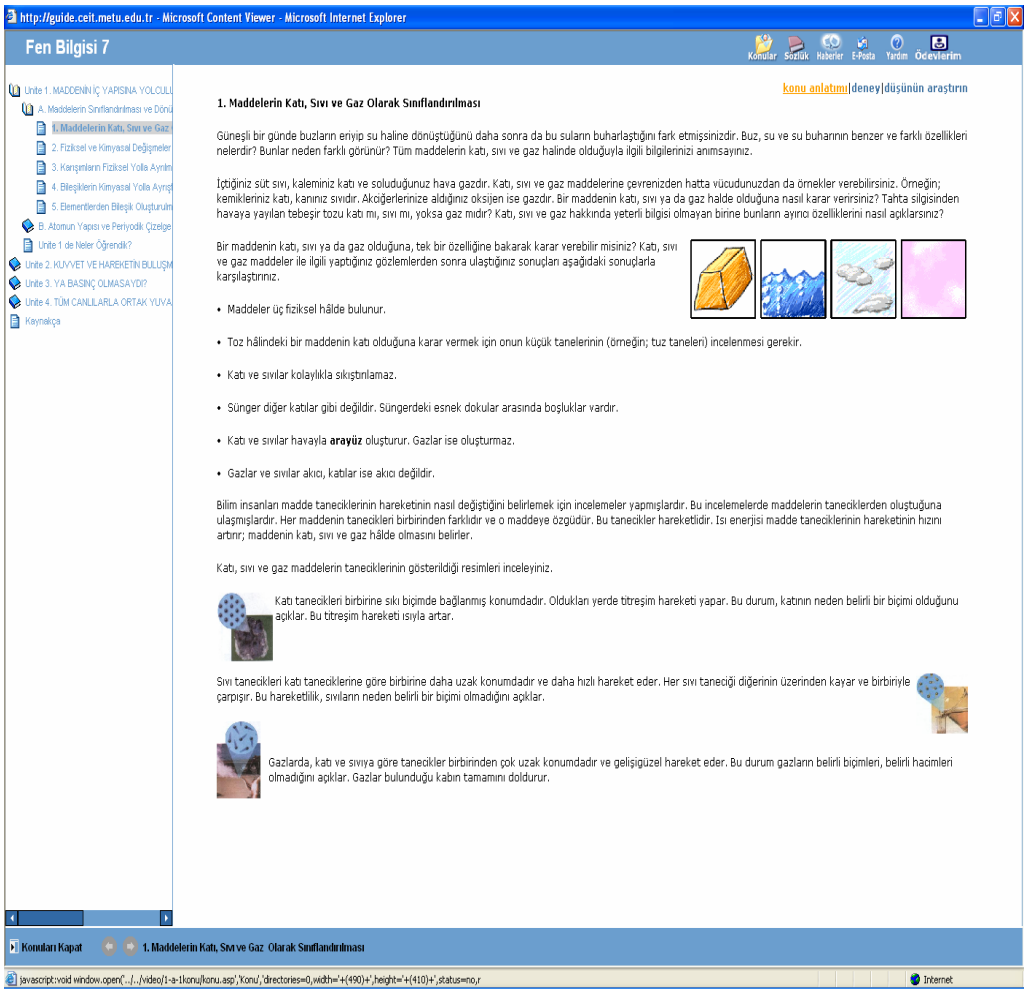

Figure 3.2 A sample for Screen Design of the Web site

3.5.5 Components of the Web site

The course content was labeled and numbered as shown in Figure 3.2. The students do not need to go back to the table of contents. They could study any topic they want at any time.

Konular 

: was used to reach the table of contents if the table of contents was closed by using the Close/Open button in the fourth part of the web site screen design.

Sözlük 

: was used to give definitions and some extra information about a term.

Haberler 

: was used to give news to the students about assignments and some changes in the web site.

E-Posta 

:was designed to link to Microsoft® Outlook Express to use asynchronous online communication.

Yardım 

: was designed to explain the meaning of visual elements (see Figure 3.3.)

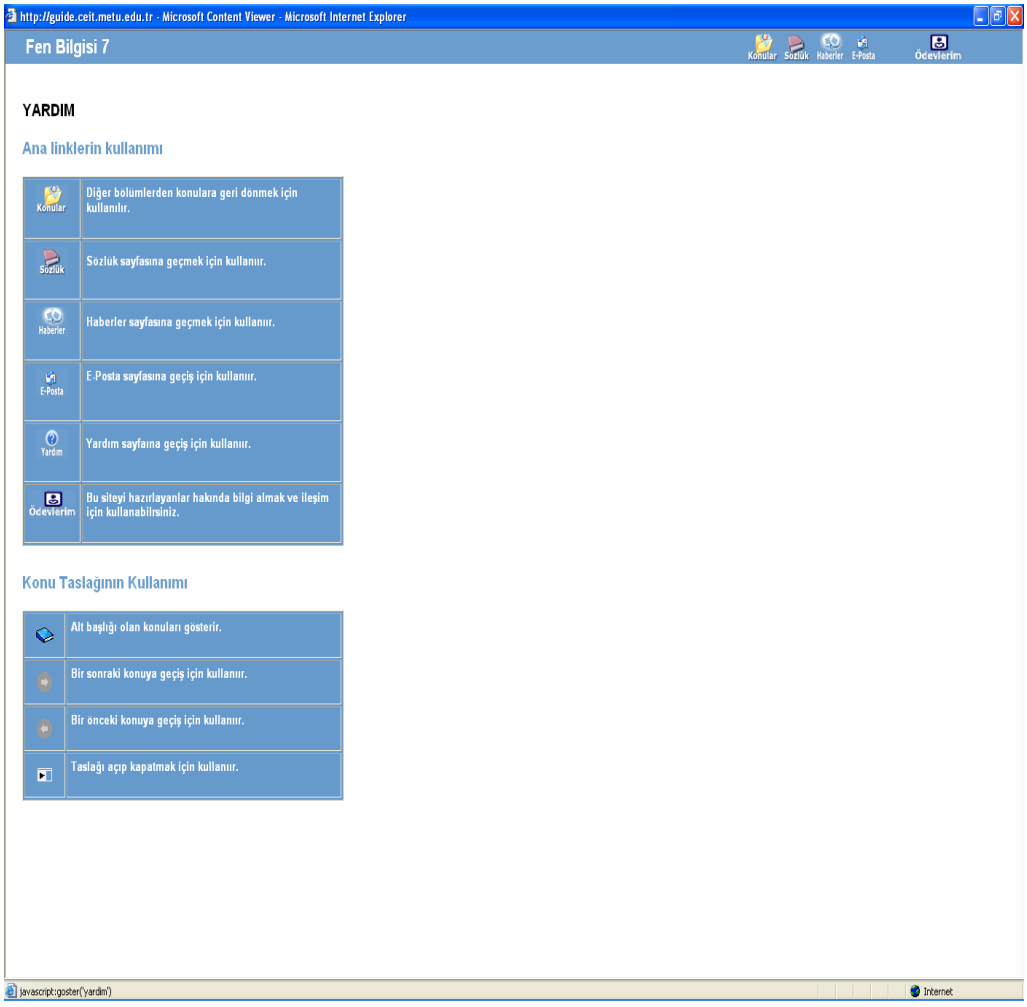

Figure 3.3 “Yardım” page of the Web site

Ödevlerim : was used to reach assignments given by using Microsoft® Class-Server package program. By using this program, objectives, short descriptions of the topic, tests and some useful links about the content to be taught could be provided to the students. A sample page of Microsoft® Class-Server is given in Figure 3.4.

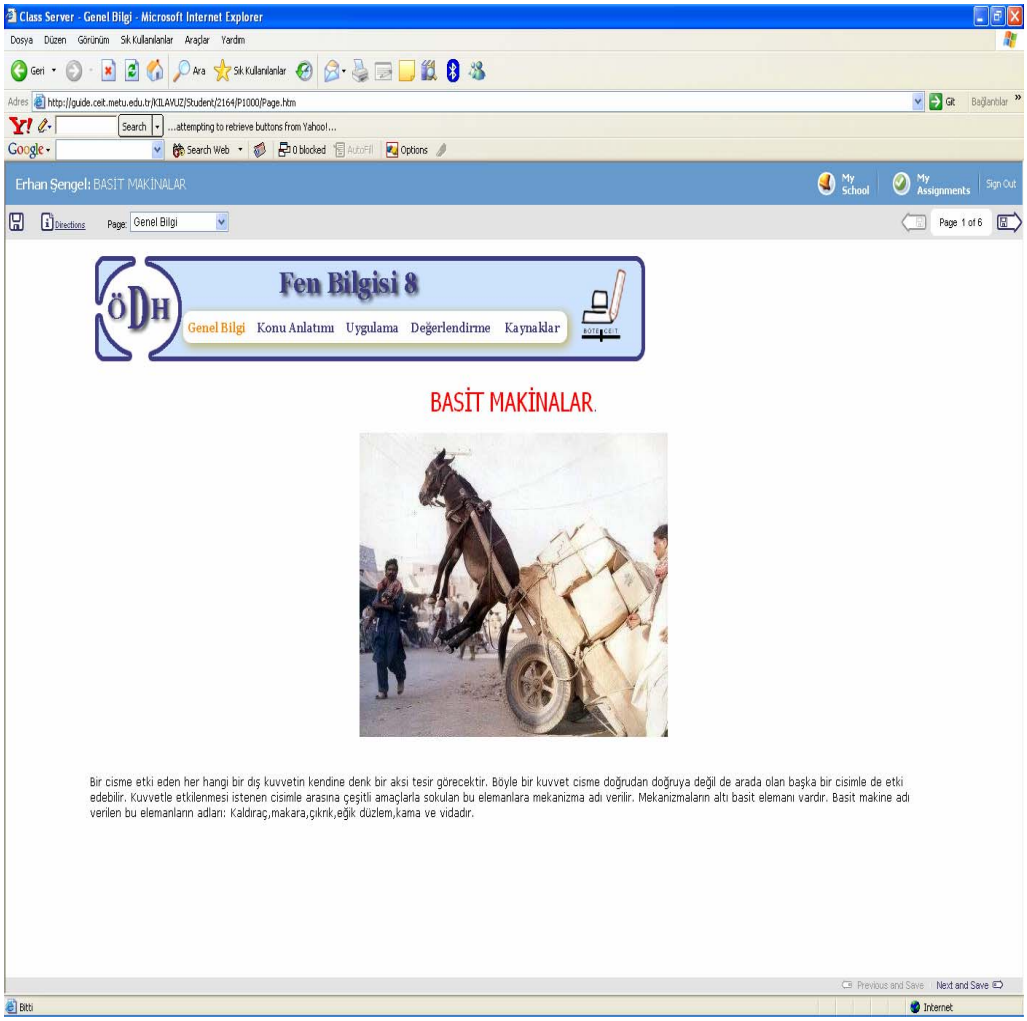

Figure 3.4 A sample page of Microsoft® Class-Server

The objectives and aims of the assignment were given in the “Genel Bilgi” part. Brief information about the topic to be taught was explained in the “Konu Anlatımı” part. In the “Uygulama” part, some daily life examples were

given or some open ended questions were asked to give the students an opportunity to think about the content. In the “Değerlendirme” part, tests were given. These tests could contain multiple choice, fill in the blank, True/False, and Matching types of questions. Feedback for the tests could immediately be provided or the teacher could give the feedback online at a later time by using e-mail. The tutor has the opportunity to rank the homework online and give back the rank results. A sample page for the “Değerlendirme” part is given in Figure 3.5

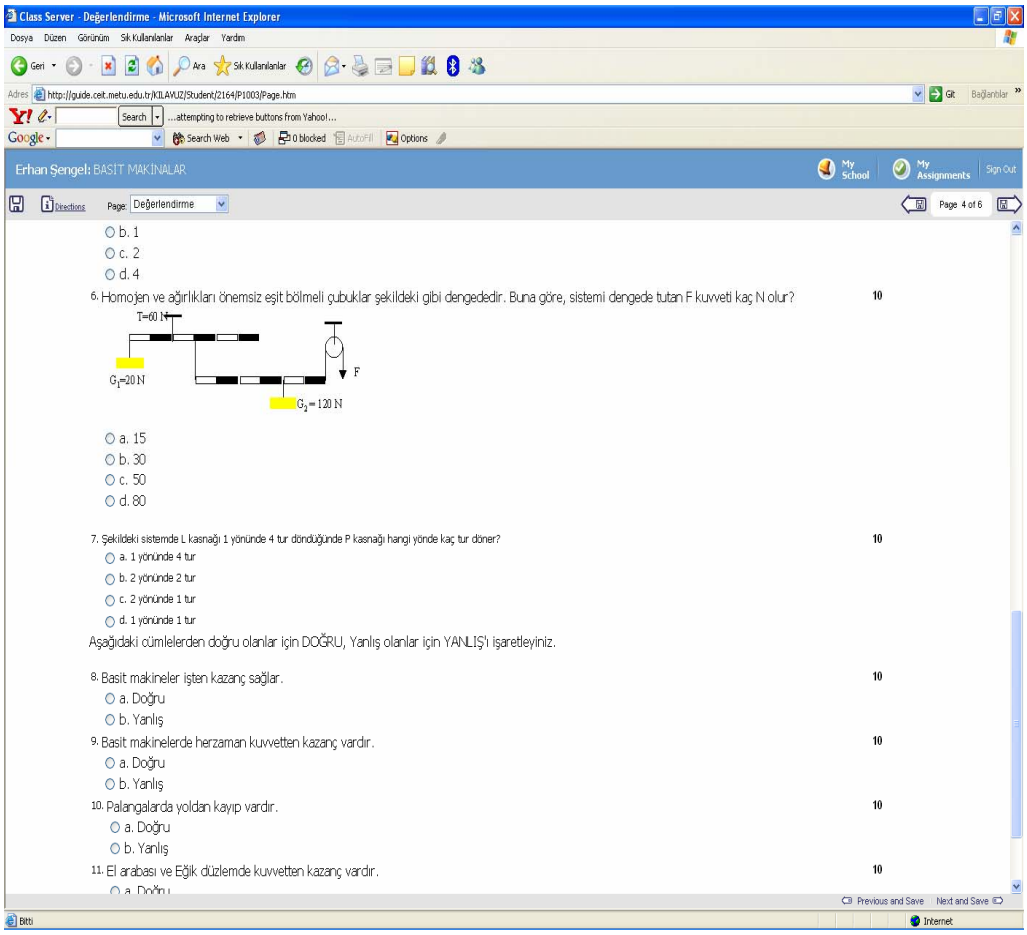

Figure 3.5 A sample page for the Değerlendirme part of Microsoft® Class-Server

The course Web site contains some links to videos and experiments that could be done easily, even at home. (See Figure 3.6)

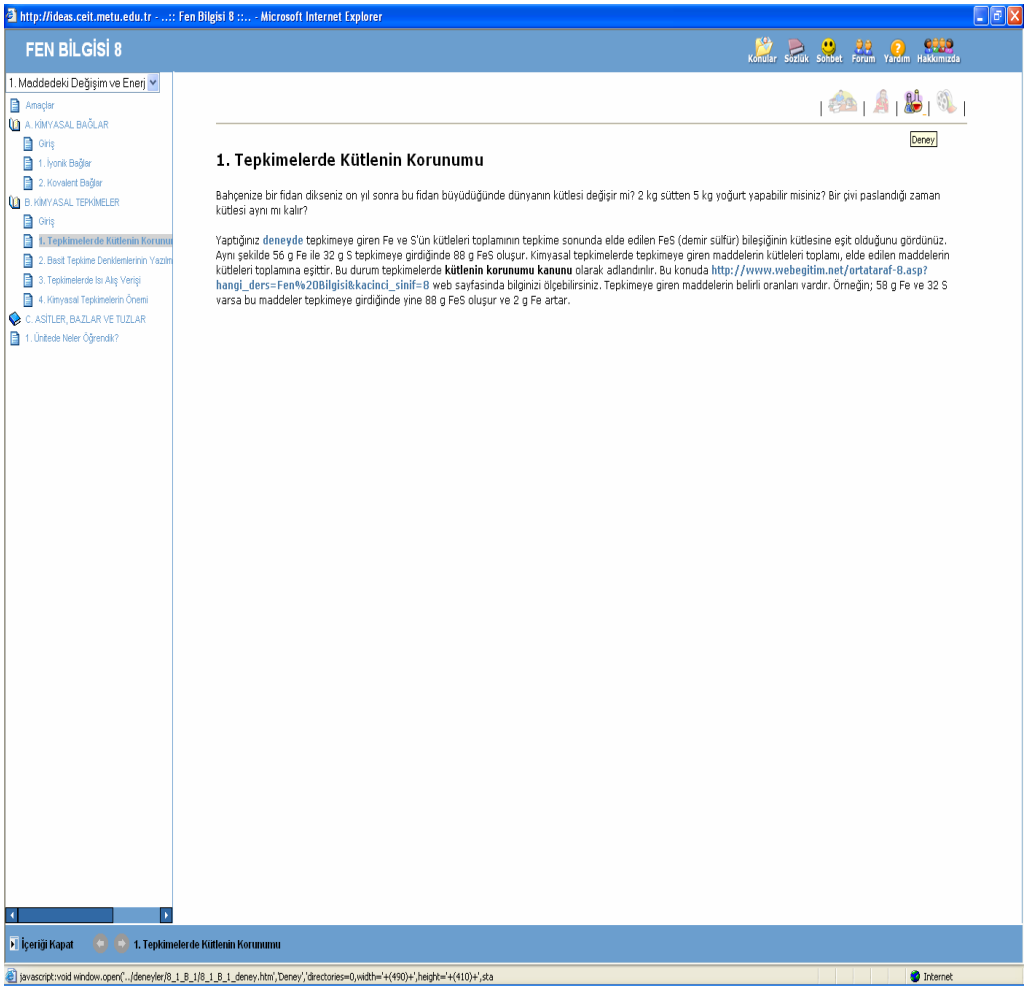

Figure 3.6 A sample page of the course web site

3.5.6 Web site Log System

A database was used in the web site of the course in order to keep log of the students. The Web site log system included the following information by Prof. Dr. M. Yaşar Özden: logging in, page navigation, time spent at each page, and total time spent for each user session. An example of the Web site log system output is given in Figure 3.7.

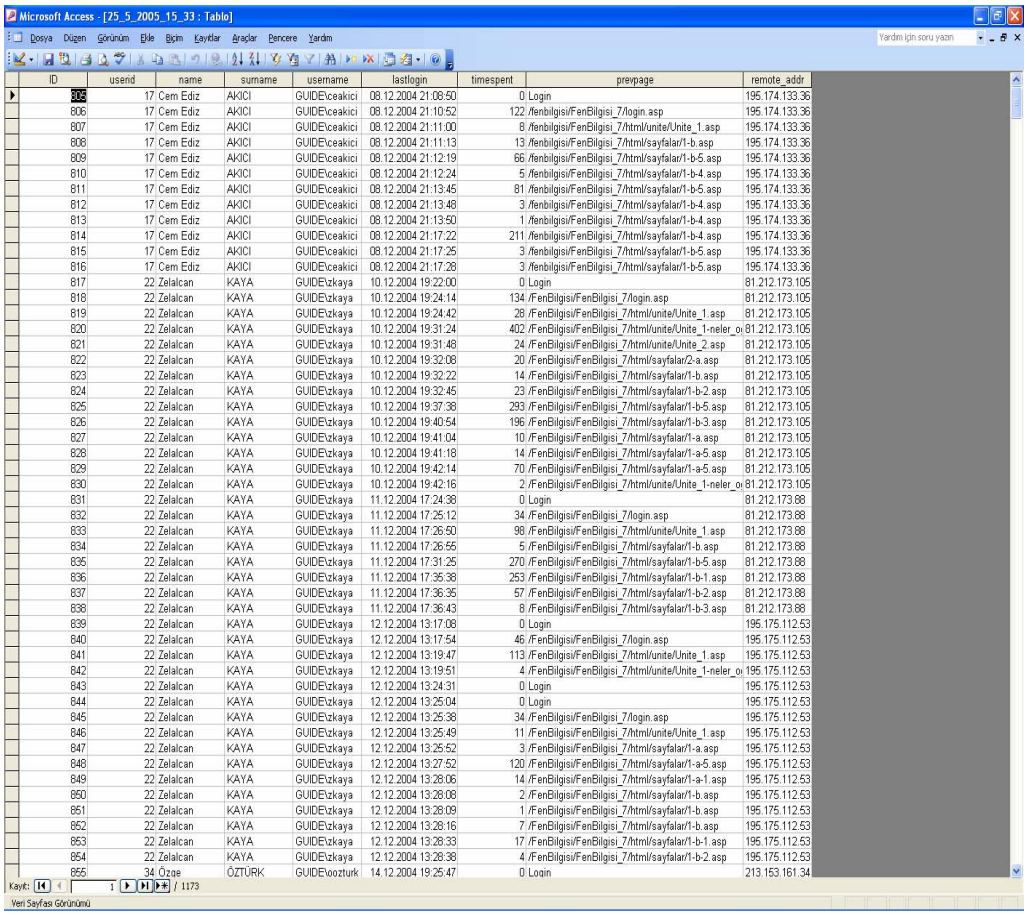

Figure 3.7 A sample of the Web site Log System Output

3.6 Analysis of Data

The quantitative analyses were conducted by using descriptive and inferential statistics. In analyzing the statistics, SPSS© 11 package program was used. The data collected by the SAT and attitude scale were compared by paired t-tests. The correlation between the user logs, attitude and the SAT scores were found by using simple r correlation.

The data obtained by interviews were analyzed by using qualitative methods. Students' responses were interpreted and categorized into the dimensions. Data reduction, data display and conclusion were carried out for

each interview result. In the data reduction, the interview results were categorized and simplified. Then results were organized for conclusion drawing in the data display. Finally, data conclusions were obtained.

3.7 Assumptions

1. All students could easily access to the Internet connection.
2. The administration of the instrument was under standard conditions.
3. All students answered the questions in the instruments accurately and sincerely.
4. The results taken from the SAT can be used as the measure of students' knowledge acquisition performance.
5. Subjects of the study were normally distributed.
6. The students and the teacher in the study were willing to attain the objectives of the study.

3.8. Limitations of the Study

1. This study is limited to a sample size of 51 students.
2. This study is limited to using students of Özel Bilim Okulları.
3. This study is limited by using science courses only.
4. The validity of the responses to the instruments used in this study was limited to the honesty of the students.
5. The qualitative results of this study were limited to the perceptions of the students.

6. Difficulties in gaining access to the Internet might have affected students' achievement and the attitude scale.
7. The personal characteristics of the course teacher might have affected students' achievement and the attitude scale.
8. Some of the students were taking special courses elsewhere. This might have affected students' achievement.
9. The number of students changed during experiment.

3.9. Delimitations

1. This study is limited to the sixth, seventh and eighth grade students who were enrolled in a science course which is enhanced with a web-based learning tool.
2. Generalizability of the study is limited to a science course.
3. This study was concerned only with students' perceptions at one school in the 2004-2005 academic year. Teachers, administrators and family members' opinions were not considered.

CHAPTER 4

RESULTS

This chapter is divided into two sections. In the first section, the result obtained from quantitative data analyses and in the second section, the results obtained from qualitative data analyses will be presented.

4.1 Quantitative Results

This section is divided into four sub-sections. In the first sub-section, missing data analysis will be presented. In the second, assumptions of the tests used will be presented. Then, the inferential statistics results will be discussed. In the last part, the findings of the quantitative results of the study will be presented.

4.1.1 Missing Data Analysis

The issue of missing data was addressed before examining the inferential tests used in this study. Initial data were gathered from 67 students in a secondary school. Six of the students had not used the web site of the course. Therefore, data obtained from these students on the pre & post tests of the SAT and attitude scale were also ignored. In addition, one student from the

8th grade did not take the post-test of the SAT. By considering all of these, missing data in the study were equal to 1.6 % of the whole data. Since the missing data constituted a range less than 5% of the whole data, it was directly replaced with the series mean of the entire subjects as suggested by Cohen and Cohen (1983).

4.1.2 Assumptions of the t-test and Correlations

For the normality assumption, skewness and kurtosis values of the scores should be checked (Fraenkel & Wallen, 1996), the values between -2 and +2 can be assumed as approximately normal for skewness and kurtosis (Tabachnick & Fidel, 1989). In the study, skewness and kurtosis values were in the acceptable range for a normal distribution.

Another assumption of t-test is that: the cases represent a random sample from the population and the difference scores are independent of each other. (Cohen, 1983, Green & Salkind, 2005, p.162)

There are two assumptions underlying the significance test associated with a Pearson correlation coefficient between two variables. The first one is: the variables are bivariately normally distributed. This means that each variable is normally distributed ignoring the other variable and each variable is normally distributed at all levels of the other variable. The second assumption is: the cases represent a random sample from the population and the scores on variables for one case are independent of scores on these variables for other cases (Cohen, 1977, Green & Salkind, 2005, p.255).

Independency of observation not being a statistical assumption, simply means that the observation obtained for one individual is not influenced by the observation obtained for another individual (Gravetter & Wallnau, 1996). However, in some instances, this assumption might be violated as a function of something, such as time or distance, associated with the order of cases (Tabachnick & Fidel, 1989). For example, the subjects of this study shared the computer laboratories in the applications of Science Achievement Test and attitude scale, and the response of each subject might be influenced by the responses of other subject in the same laboratories. On the other hand, this probability of non-independence was not higher than in the face to face case. Independency of the observation assumption was supplied by the observations of the researcher and the teacher of the course during the administration of all the tests. All the subjects did the exams by themselves.

4.1.3 Inferential Statistics

In this part, the findings of the analyses related to the research questions will be presented.

The study examines how the learners structure their activities and what their affective attitude and cognitive perceptions are towards online learning. The research questions aim to understand two major purposes:

1. to investigate whether science courses enhanced with a web-based learning tool affect students' academic success and attitudes toward online science learning or not.

2. to investigate students perceptions about the effective dimensions of science courses enhanced with a web-based learning tool.

4.1.3.1 Results of sub-question 1.1: The Difference between the Pre-test and the Post-test of the Science Achievement Test (SAT) Scores of the 6th Grade Students

To test the first sub-question, a t-test was carried out on the pre-test and the post-test achievement scores in the SAT scores of the 6th grade science course students at the end of the study. Mean scores on the pre-test and the post-test were compared using a t-test at a significance level of .05. As shown in Table 4.1, the post-test mean score on achievement (M=56.55) was slightly higher than that of the pre-test (M=42.85). The t-test result showed that this difference in the mean score is statistically significant at a significance level of .05. There was a significant difference between the pre-test and the post-test achievement scores in the SAT score of the 6th grade science course at the end of the study. These results also indicated that a significant correlation existed between these two variables ($r = .610$, $p<.05$), indicating that those who scored high on the pre-test tend to score high on the post-test.

Table 4.1 Comparison of the Pre-test and the Post-test of the Science Achievement Test (SAT) Scores of the 6th Grade Students

Test	N	Mean	SD	T value	df	2-tail prob
Pre-SAT	13	42.85	10.67	6.02	12	.00
Post-SAT	13	56.55	13.85			

Paired Samples Correlations

	N	Correlation	Sig.
Post-SAT & Pre-SAT	13	,610	,027

4.1.3.2 Results of sub-question 1.2: The Difference between the Pre-test and the Post-test of the Science Achievement Test (SAT) Scores of the 7th Grade Students

To test the second sub-question, a t-test was carried out on the pre-test and the post-test achievement scores in the SAT scores of the 7th grade science course at the end of the experiment. Mean scores on the pre-test and the post-test were compared using a t-test at a significance level of .05. As shown in Table 4.2, the post-test mean score on achievement (M=58.38) was slightly higher than that of the pre-test (M=46.81). The t-test result showed that this difference in the mean score is statistically significant. There was a significant difference between the pre-test and the post-test achievement scores in the SAT score of the 7th grade science course at the end of the study at a significance level of .05. These results also indicated that a significant correlation exists between these two variables ($r = .807$, $p<.05$) indicating that those who scored high on the pre-test tend to score high on the post-test.

Table 4.2 Comparison of the Pre-test and the Post-test of the Science Achievement Test (SAT) Scores of the 7th Grade Students

Test	N	Mean	SD	T value	df	2-tail prob
Pre-SAT	21	46.81	11.24	5.30	20	.00
Post-SAT	21	58.38	16.56			

Paired Samples Correlations

	N	Correlation	Sig.
Post-SAT & Pre-SAT	21	,807	,000

4.1.3.3 Results of sub-question 1.3: The Difference between the Pre-test and the Post-test of the Science Achievement Test (SAT) Scores of the 8th Grade Students

To test the third sub-question, a t-test was carried out on the pre-test and the post-test achievement scores in the SAT scores of the 8th grade science course at the end of the experiment. Mean scores on the pre-test and the post-test were compared using a t-test at a significance level of .05. As shown in Table 4.3, the post-test mean score on achievement (M=47.65) was slightly higher than that of the pre-test (M=37.24). The t-test result showed that this difference in the mean score is statistically significant at a significance level of .05. This result indicated that there was a significant difference between the pre-test and the post-test achievement scores in the SAT score of the 8th grade science course at the end of the study. These results also indicated that a significant correlation exists between these two variables ($r = .499$, $p<.05$) indicating that those who scored high on the pre-test tend to score high on the post-test.

Table 4.3 Comparison of the Pre-test and the Post-test of the Science Achievement Test (SAT) Scores of the 8th Grade Students

Test	N	Mean	SD	T value	df	2-tail prob
Pre-SAT	17	37.24	9.01	3.09	16	.007
Post-SAT	17	47.65	16.00			

Paired Samples Correlations

	N	Correlation	Sig.
Post-SAT & Pre-SAT	15	,499	,042

4.1.3.4 Results of sub-question 1.4: The relation, between Site Time of the 6th Grade Students and their Academic Success in the Science Course

Correlation coefficient was conducted between site usage time of 6th grade students and their academic success in the science course at the end of the study. A *p* value of less than .05 was required for significance. The results of the correlational analyses presented in Table 4.4 and Figure 4.1 show that the correlation between site time of the 6th grade students and their academic success in the science course was significant, $r(11) = .662$, $p<.05$.

Table 4.4 The Bivariate Correlations between Site Time of the 6th Grade Students and their Academic Success in the Science Course

		POST-SAT	SITE TIME
*POST-SAT	Pearson Correlation	1.000	.662*
	Sig. (2 tailed)	.	.036
	N	13	13
SITE TIME	Pearson Correlation	.662*	1.000
	Sig. (2 tailed)	.036	.
	N	13	13

* Correlation is significant at the 0.05 level (2-tailed).
*POST-SAT: Post-test of Science Achievement Test

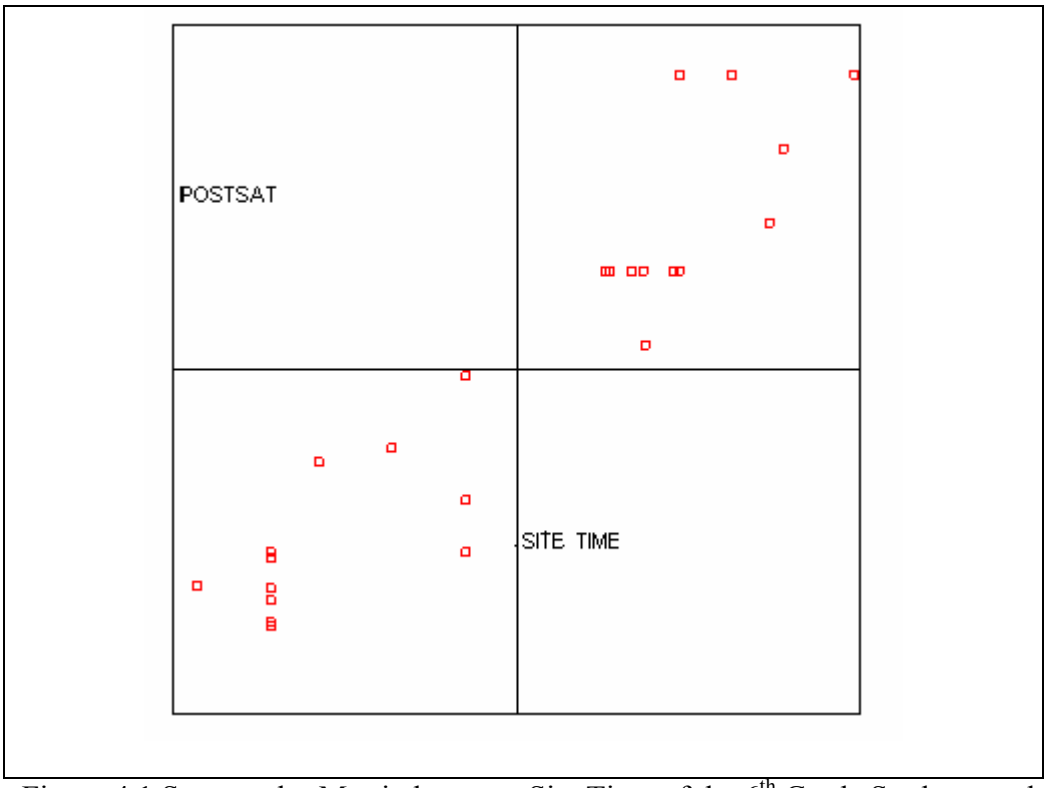

Figure 4.1 Scatter-plot Matrix between Site Time of the 6th Grade Students and their Academic Success on the Science Course

4.1.3.5 Results of sub-question 1.5: The relation between Site Time of the 7th Grade Students and their Academic Success in the Science Course

Correlation coefficient was conducted between site usage time of 7th grade students and their academic success in the science course at the end of the study. A *p* value of less than .01 was required for significance. The results of the correlational analyses presented in Table 4.5 and Figure 4.2 show that the correlation between site time of the 7th grade students and their academic success in the science course was significant, $r(19) = .554$, $p<.01$. These values indicate a strong positive relationship between site time of the 7th grade students and their academic success in the science course.

Table 4.5 The Bivariate Correlations between Site Time of the 7th Grade Students and their Academic Success in the Science Course

		POST-SAT	SITE TIME
*POST-SAT	Pearson Correlation	1.000	.554**
	Sig. (2 tailed)	.	.009
	N	21	21
SITE TIME	Pearson Correlation	.554**	1.000
	Sig. (2 tailed)	.009	.
	N	21	21

** Correlation is significant at the 0.01 level (2-tailed).
*POST-SAT: Post-test of Science Achievement Test

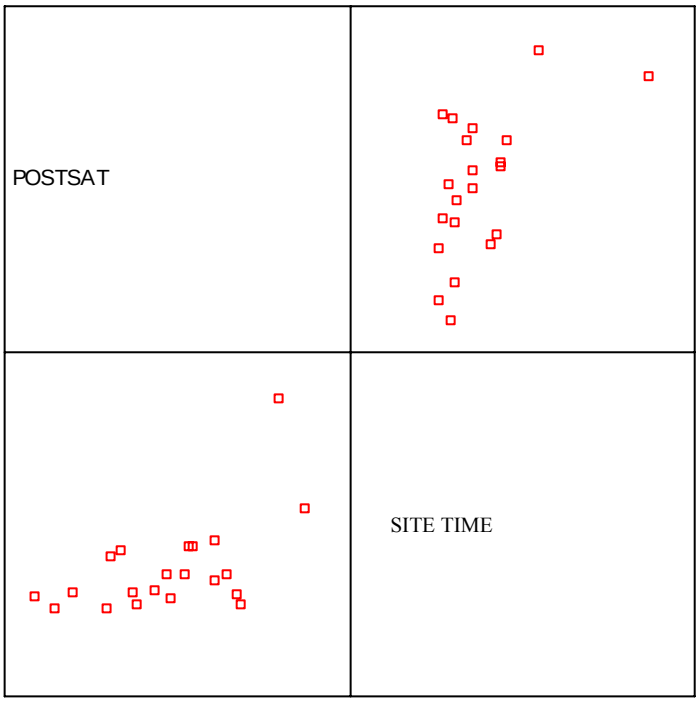

Figure 4.2 Scatter-plot Matrix between Site Time of the 7th Grade Students and their Academic Success on the Science Course

4.1.3.6 Results of sub-question 1.6: The relation between Site Time of the 8th Grade Students and their Academic Success in the Science Course

Correlation coefficient was conducted between site time of the 8th grade students and their academic success in the science course at the end of the study. A *p* value of less than .05 was required for significance. The results of the correlational analyses presented in Table 4.6 show that the correlation between site time of the 8th grade students and their academic success in the science course was not significant, $r(15) = .022$, $p<.05$.

Table 4.6 The Bivariate Correlations between Site Time of the 8th Grade Students and their Academic Success in the Science Course

		POST-SAT	SITE TIME
*POST-SAT	Pearson Correlation	1.000	.022
	Sig. (2 tailed)	.	.934
	N	17	17
SITE TIME	Pearson Correlation	.022	1.000
	Sig. (2 tailed)	.934	.
	N	17	17

*POST-SAT: Post-test of Science Achievement Test

4.1.3.7 Results of sub-question 2.1: The Difference in Attitudes of the 6th Grade Students toward Science Learning

To test this sub-question, a t-test was carried out on the pre-attitude and the post-attitude scores in the attitude scale of the 6th grade students. Mean scores on the pre pre-attitude and the post-attitude were compared using a t-test at a significance level of .05. As shown in Table 4.7, the post-attitude mean score (M=96.15) was slightly higher than that of the pre-attitude mean (M=93.34). The t-test result showed that this difference in the mean score is statistically significant at a significance level of .05. There was a significant difference between the pre-attitude and the pos-attitude scores in the attitude scale of the 6th grade students at the end of the study. These results also indicated that a significant correlation exists between these two variables (r = .905, p<.05) indicating that those who scored high on the pre-attitude tend to score high on the post-attitude.

Table 4.7 Comparison of the Pre-attitude and the Post-attitude Scores in the Attitude Scale of the 6th Grade Students

Test	N	Mean	SD	T value	df	2-tail prob
Pre-attitude	13	93.34	3.73	6.09	12	.000
Post-attitude	13	96.15	3.76			

Paired Samples Correlations

	N	Correlation	Sig.
Postattitude-Preattitude	13	,905	,000

4.1.3.8 Results of sub-question 2.2: The Difference in Attitudes of the 7th Grade Students toward Science Learning

To test this sub-question, a t-test was carried out on the pre-attitude and the post-attitude scores in the attitude scale of the 7th grade students. Mean scores on the pre-attitude and the pos-attitude were compared using a t-test at a significance level of .05. As shown in Table 4.8, the post-attitude mean score (M=94.81) was slightly higher than that of the pre-attitude mean score (M=87.67). The t-test result showed that this difference in the mean score is statistically significant at a significance level of .05. There was a significant difference between the pre-attitude and the post-attitude scores in the attitude scale of the 7th grade students at the end of the study. These results also indicated that a significant correlation exists between these two variables (r = .467, p<.05) indicating that those who scored high on the pre-attitude tend to score high on the post-attitude.

Table 4.8 Comparison of the Pre-attitude and the Post-attitude Scores in the Attitude Scale of the 7th Grade Students

Test	N	Mean	SD	T value	df	2-tail prob
Pre-attitude	13	87.67	3.26	6.99	20	.000
Post-attitude	13	94.81	5.21			

Paired Samples Correlations

	N	Correlation	Sig.
Postattitude-Preattitude	13	,467	,033

4.1.3.9 Results of sub-question 2.3: The Difference in Attitudes of 8th Grade Students toward Science Learning

To test this sub-question, a t-test was carried out on the pre-attitude and the post-attitude scores in the attitude scale of the 8th grade students. Mean scores on the pre-attitude and the pos-attitude were compared using a t-test at a significance level of .05. As shown in Table 4.9, the post-attitude mean score (M=91.94) was slightly higher than that of the pre-attitude mean score (M=87.24). The t-test result showed that this difference in the mean score is statistically significant at a significance level of .05. There was a significant difference between the pre-attitude and the post-attitude scores in the attitude scale of the 8th grade students at the end of the study. These results also indicated that no significant correlation existed between these two variables (r = .377, p<.05) indicating that those who scored high on the pre-attitude tend to score low on the post-attitude.

Table 4.9 Comparison of the Pre-attitude and the Post-attitude Scores in the Attitude Scale of the 8th Grade Students

Test	N	Mean	SD	T value	df	2-tail prob
Pre-attitude	17	87.24	3.17	4.58	16	.000
Post-attitude	17	91.94	4.25			

Paired Samples Correlations

	N	Correlation	Sig.
Postattitude-Preattitude	17	,377	,136

4.1.3.10 Results of sub-question 2.4: The Relation between Site Time of the 6th Grade Students and their Attitude towards the Science Course.

Correlation coefficient was conducted between site time of 6th grade students and their attitude toward the science course at the end of the experiment. A *p* value of less than .01 was required for significance. The results of the correlational analyses presented in table 4.10 and figure 4.3 show that the correlation between site time of 6th grade students and their attitude towards the science course was significant, $r(11) = .684$, $p<.01$.

Table 4.10 The Bivariate Correlations between Site Time of the 6th Grade Students and their Attitude towards the Science Course

		POST-ATTITUDE	SITE TIME
POST-ATTITUDE	Pearson Correlation	1.000	.684**
	Sig. (2 tailed)	.	.010
	N	13	13
SITE TIME	Pearson Correlation	.684**	1.000
	Sig. (2 tailed)	.010	.
	N	13	13

** Correlation is significant at the 0.01 level (2-tailed).

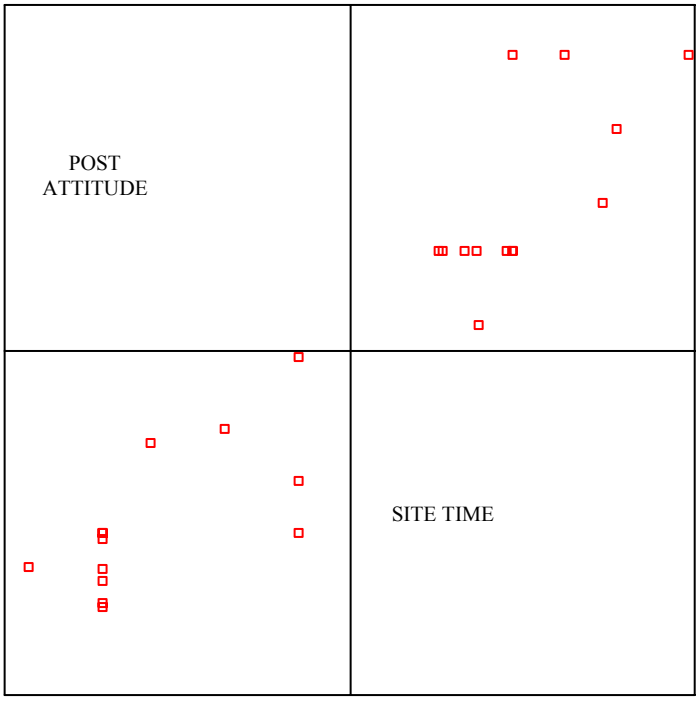

Figure 4.3 Scatter-plot Matrix between Site Time of the 6th Grade Students and their Attitude toward the Science Course

4.1.3.11 Results of sub-question 2.5: The relation between Site Time of the 7th Grade Students and their Attitude towards the Science Course

Correlation coefficient was conducted between site time of 7th grade students and their attitude towards the science course at the end of the experiment. A *p* value of less than .05 was required for significance. The results of the correlational analyses presented in Table 4.11 and Figure 4.4 show that the correlation between site time of the 7th grade students and their attitude towards the science course was significant, $r(19) = .697$, $p<.05$.

Table 4.11 The Bivariate Correlations between Site Time of the 7th Grade Students and their Attitude towards the Science Course

		POST-ATTITUDE	SITE TIME
POST-ATTITUDE	Pearson Correlation	1.000	.697**
	Sig. (2 tailed)	.	.038
	N	21	21
SITE TIME	Pearson Correlation	.697**	1.000
	Sig. (2 tailed)	.038	.
	N	21	21

* Correlation is significant at the 0.05 level (2-tailed).

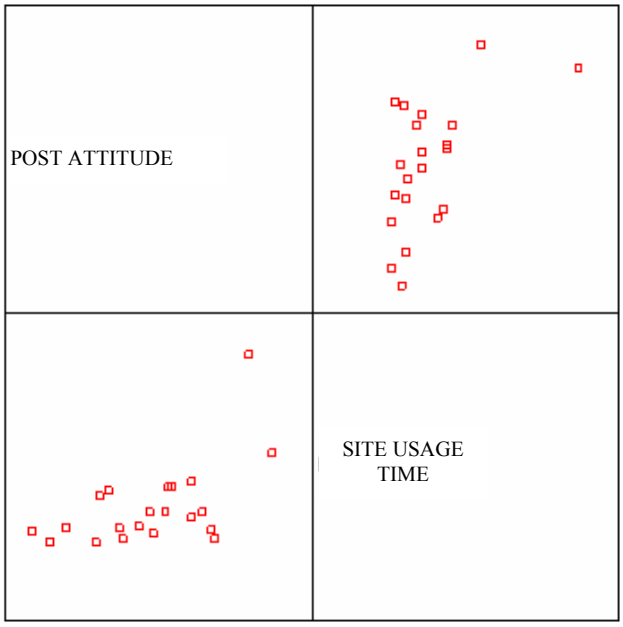

Figure 4.4 Scatter-plot Matrix between Site Time of the 7th Grade Students and their Attitude towards the Science Course

4.1.3.12 Results of sub-question 2.6: The Relation between Site Time of the 8th Grade Students and their Attitude towards the Science Course

Correlation coefficient was conducted between site time of the 8th grade students and their attitude towards the science course. A *p* value of less than .01 was required for significance. The results of the correlational analyses presented in Table 4.12 show that the correlation between site time of the 8th grade students and their attitude towards the science course was not significant, $r(15) = .303$, $p<.01$.

Table 4.12 The Bivariate Correlations between Site Time of the 8th Grade Students and their Attitude towards the Science Course

		POST-ATTITUDE	SITE TIME
POST-ATTITUDE	Pearson Correlation	1.000	.303
	Sig. (2 tailed)	.	.237
	N	17	17
SITE TIME	Pearson Correlation	.303	1.000
	Sig. (2 tailed)	.237	.
	N	17	17

4.1.4 Summary of the Quantitative Results

The findings of the quantitative data analyses can be summarized as follows;

1. There was a significant difference between the pre-test and the post-test of Science Achievement Test (SAT) scores of the 6th grade students. These results also indicated that a significant correlation exists between these two variables.
2. There was a significant difference between the pre-test and the post-test of Science Achievement Test (SAT) scores of the 7th grade students. These results also indicated that a significant correlation exists between these two variables.
3. There was a significant difference between the pre-test and the post-test of Science Achievement Test (SAT) scores of the 8th grade students. These results also indicated that a significant correlation exists between these two variables.
4. The correlation between site usage time of 6th grade students and their academic success in the science course was significant. These values indicate a strong positive relationship between site usage time of 6th grade students and their academic success in the science course.
5. The correlation between site usage time of 7th grade students and their academic success in the science course was significant. These values indicate a strong positive relationship between site usage time of 7th grade students and their academic success in the science course.

6. The correlation between site usage time of 8th grade students and their academic success in the science course was not significant.
7. There was a significant difference between the pre-attitude and the post-attitude scores in the attitude scale of the 6th grade students. These results also indicated that a significant correlation exists between these two variables.
8. There was a significant difference between the pre-attitude and the post-attitude scores in the attitude scale of the 7th grade. These results also indicated that a significant correlation exists between these two variables.
9. There was a significant difference between the pre-attitude and the pos-attitude scores in the attitude scale of the 8th grade students. These results also indicated that no significant correlation existed between these two variables.
10. The correlation between site usage time of 6th grade students and their attitude towards the science course was significant.
11. The correlation between site usage time of 7th grade students and their attitude towards the science course was significant.
12. The correlation between site usage time of 8th grade students and their attitude towards the science course was not significant.

4.2 Qualitative Results

To understand students' perceptions about the science course enhanced with a web-based learning tool, four dimensions to be investigated were

defined. An interview guide that included these dimensions was prepared and interviews were conducted with the groups that included four students. The questions in the interview were asked to reveal student perceptions about the science course enhanced with a web-based learning tool in terms of; (1) usability, (2) quality of the content, (3) structure, (4) interactivity. The results of the interviews are presented in detail, in accordance with the dimensions of interactive learning. Data analysis was conducted through three phases: data reduction, data display, and conclusion drawing (Yıldırım, Şimşek, 2004).

4.2.1 Students' Perceptions about the Usability of Web-based Learning Tool Used in the Science Course

The students were asked questions in the interview to understand their perceptions about the usability of web-based learning tool used in the science course in terms of the following aspects:

- How they used the web site throughout the academic year.
- What features of the web-based instruction they liked.
- Whether there were any factors hindering their success in the course.
- What problems they faced when they were using the web site of the course.
- Whether taking this type of course made any change in their learning habits.
- Whether they could easily get access to a topic they wanted to study in the web site.

- Which features of the web-based instruction aided their learning of the content.
- Whether accessing the course content from the web site had any advantages or limitations.
- What they think about the future of web-based learning.

The number of responses of the students to above questions is given in Table 4.13.

Table 4.13 Students' Perceptions about the Usability of Web-based Learning Tool Used in the Science Course

The responses of students about the Usability of Web-based Learning Tool Used in the Science Course	**Number of responses**
they used the web-site at random intervals, whenever they had time and wished.	28
they could relate what they learned in the course with what they knew.	17
they had a strong background in the science subjects and that they could build everything they learned from the web-site of the science course onto their knowledge background.	10
the assignments through the course web-site were the most effective activities supporting their learning.	38
they only used the supplied information on the course web-site.	20
They used both the course content and announcements.	11
they used the course content, assignments and additional links.	11
to be effective in supporting their learning was home works and additional web links on that topic.	26
Like to have online exams on computer.	45
The computer based environment in the web based component of the science course was stated as problems	10
Students' tired to use their learning habits obtained in traditional courses. They wanted the teacher to teach and explain the topic of the course in traditional courses.	14
They wanted to ask questions especially to the teacher immediately.	25
it was boring to study the previous year's topics	16
They could use many of the topics in their future live experiences related with science topics.	21
they needed extra practice to use the knowledge they learned from the course content.	14
they definitely benefited from their learned knowledge.	23
course had given them theoretical knowledge, rather than practical knowledge.	17
they would like to study the science course in this manner. But, it should contain the contents of this year.	22

Students were asked to describe how they used the course web site. The majority of the students (28 students) stated that they used the web site at random intervals, whenever they had time and wished. The above information

was triangulated with the log-system and it was seen that most of the students connected to the web site at weekends.

Seventeen students stated that they could relate what they learned in the course with what they knew. Ten students indicated that they had a strong background in the science subjects and that they could build everything they learned from the web site of the science course onto their knowledge background. One student in eight grade stated “My science grade in seventh grade class was five out of five. I knew the content before I studied it from the web site”.

The students’ answers showed that the science course enhanced with web-based learning tool was successful in relating previous knowledge to the newly acquired knowledge if the students had previous knowledge.

Interesting results were found in student interviews on the question related to the components of the science course enhanced with web-based learning. Students were asked to state which features of the science course enhanced with web-based learning tool. Almost all students (38 students) agreed that the assignments through the course web site were the most effective activities supporting their learning. One student’s comment reflecting the students’ perceptions: “While doing the assignments one had to re-study the related subject of the content. In addition to that we could also find additional information resources (web sites) related to the course content.”

To understand student preferences in terms of learning resources students were asked whether they used other information sources than those supplied on the course content, reading materials, assignments and additional links in the course web site. Twenty students said that they only used the

supplied information on the course web site. Eleven students used both the course content and announcements. Eleven students said that they used the course content, assignments and additional links. Related to this, one student said "I preferred to read the content of this year. Especially when there was an exam, I read the content before the classroom meetings, so my knowledge was fresh and I could succeed in exams."

An important feature on which 16 students agreed to be effective in supporting their learning was homework and additional web links on that topic. Students agreed that the pre-determined web sources enhanced their learning. In general they liked to have different information sources which they could choose to study from. They could either study directly from the provided content or they could choose to study from the source most appropriate for them.

Most of the students (45 students) liked to have online exams on computer. One of the students stated "Before the online exam, I was afraid. Because it was the first time I had an exam in this manner. When I sat in front of the computer and started to read the questions, I felt comfortable. The nice thing about it is this, you do not need to wait for exam results and mistakes. If one made a mistake, s/he could easily see his/her mistake and learn the exam grade. I wish I could take all exams in this way". Another student indicated "I agree with my friend, but in some questions I needed paper and pencil to solve questions that required mathematical calculations".

To understand what difficulties students faced they were asked what problems they had to deal with while studying the web-based instruction of the science course. The common criticisms of the students were on availability of

Internet access. One student said: “The only disadvantage of reading the course material from the computer screen was that one should use dial-up connection to the Internet.”

The computer-based environment in the web-based component of the science course was stated as problems by several students (indicated by 10 students). The interview results were investigated and the common problems were selected. One student stated: “The internet connection from home was too slow. I could not have watched videos prepared in the web site of the course because the Internet connections from home disconnected from time to time, it was not reliable”. Another student said: “I could not find a computer or the Internet access from anywhere. I have no Internet connection at home. I could sometimes study in my father’s office to do only my homework”. Among the stated problems the availability of the Internet access was the most frequently stated problem.

Students tired to use their learning habits obtained in traditional courses. They wanted the teacher to teach and explain the topic of the course in traditional courses as indicated by 14 students.

Another problem as indicated by the students was students’ communication habits with the teacher. They wanted to ask the teacher some questions immediately. The students did not prefer to use the e-mail for their questions but they wanted to ask their questions directly at the moment they had a problem. They stated their preference to ask questions while or just after they read the content. They did not want to wait until the message was replied. Related to this, one student said: “I would like to ask the teacher questions as

soon as possible after reading the content. I do not want to wait for the message."

The aim in using the web site of the course was to study the content of the previous year. Some of the students complained that it was boring to study the previous year's topics (indicated by 16 students). They stated that they could not devote that much time to these kinds of applications, since they had also other courses which should be studied for this year. This was also stated by some students as the reason for not visiting the web site as frequently as required. One student in the seventh grade stated: "If I had to study content of the seventh grade, I would visit the web site of the course more frequently than I did. Because, I had taken exams related with the topics of the seventh grade in school, but I had to study content of the sixth grade. It was boring". Almost all students (22) said that they would like to study the science course in this manner. But, it should contain the contents of this year. The students also said that they would like to study other courses (especially Mathematics) using web-based learning.

To understand how the general goal orientation had affected their learning they were asked if they could use the knowledge they obtained from the course in their future life. 21 students stated that they could use many of the topics in their future live experiences related with science topics. 14 students stated that they needed extra practice to use the knowledge they learned from the course content. Three students with previous knowledge on the content said that they definitely benefited from their learned knowledge. There were seven students to whom the course had given theoretical, rather than practical knowledge. Related to this a student said "I need to practice the things we

learned, after that I can relate the knowledge with real-life situations. Moreover, I am going to take High School Entrance Exam and I need to solve more problems instead of reading information in the web site".

Student interview results showed that one external factor which demotivated students in the web site of the course was the requirement to use username and password. One student in the sixth grade claimed: "I had some problems in using the password. My password had to be changed, but I could not use the new password to study. It was not functioning. Because of this, I sometimes did not want to use the web site"

Students were asked if studying a science course which includes a web-based learning tool made a change in their learning habits. 14 students said that it did not make any changes in their learning habits, but that they got aware of this structure of course delivery. They commented that an information source like the Internet should not be left outside the courses. One student stated that "taking the course as web-based had many advantages but it did not change my learning habits. I don't believe that learning habits can change by taking one course. It will take some time for us to get used to learning from the web without searching any other information source." Most of the students believed that the learning habits would not change quickly. One student from the eighth grade stated that "It could have changed if I had used the web site of the course. But, I had to solve hundreds of test questions for my special studies (Dershane)".

4.2.2 Students' Perceptions about the Quality of the Content in web-based Learning

The students were asked questions in the interview form to understand their perceptions about the quality of the content in a web-based learning tool used in the science course were related with;

- Which features of the web-assisted instruction aided their learning of the component.
- What advantages and disadvantages the content had.
- Whether the examples, practice questions and visuals provided in the web site were useful in relating the information with real-life.
- Which features of the web-assisted instruction aided their learning of the content.

The number of responses of the students to above questions is given in Table 4.14.

Table 4.14 Students' Perceptions about the Quality of the Content in web-based Learning

The responses of students about the the Quality of the Content in web-based Learning	**Number of responses**
materials helped them to relate their knowledge with real-life.	22
the case examples and practice questions helped them to understand the subject in detail.	24
not enough problem solutıon	18
the course content abstract and complained about not having enough real-life examples.	8
there were students who wanted even more assignments.	11

According to students' perceptions, the presentation structure of the course material on the web site was evaluated from a behavioural perspective. Students found the objectives given at the beginning of each unit useful in understanding what is expected of them. One student said: "From the written

objectives, I could determine how deeply I was expected to learn each topic." Students' perceptions about the learning theory of the science course with web-based learning were parallel to their perceptions about the pedagogical philosophy. Although there were written behavioural objectives, some of the features in the web site of the course, the assignments were based on constructivist epistemology and cognitive learning theory.

To understand which type of instructional elements in the course web site were more effective in students' learning, students were asked if and how the examples, practices, and visual materials given in the course web site helped them to relate their knowledge with real-life. The theoretical and academic learning/instruction through reading the course content was supported with case examples, pictures, graphics, and practice questions. Students' answers indicated that most of the students (22) stated that those materials helped them to relate their knowledge with real-life. Students said that the pictures, graphics and small animations were useful to visualize concepts like cells, organisms, electricity. A student said: "The pictures and animations supported the information in the text. We could see what was meant in the text." Some of the students stated that the case examples and practice questions helped them to understand the subject in detail. However, one student said: "The pictures and graphics were useful to understand the concept, but nothing can replace the place of a real experience, I would like to see a teacher in the class and ask him/her questions. S/he could also show the pictures by using an overhead projector".

Students indicated that they enjoyed some learning activities. Students did not enjoy reading the content from the web site, but they enjoyed the real-

life experiences. One stated that: “Before I had studied the content from the web site, I believed that some flowers given by some persons could solve some health problems. But I have learned that these could not”.

One of the students stated that: “The topics in the course were too theoretical. Reading the content in the web site was not enough to learn the topics. More practice would have been better for us to remember the lesson content when we need to use it in daily life. Generally I have problems in solving Physics questions. In the web site of the course, there are explanations about the topic, some daily-life examples and one or two solved questions. But, this is not enough for me to understand. When different types of questions are asked, I could not solve them. Hence, there should be more examples to be solved for physics content”.

Student comments on the course content revealed student perceptions pointing on academic task orientation. Some found the course content abstract and complained about not having enough real-life examples. The criticisms were that the content was based on theoretical learning. A few students said: “I would like to have more examples on some topics. Doing the assignments would be easier for me if I could see some more examples.” On the other hand, there were students who wanted even more assignments. Related with this one student pointed out: “I would like to do some more exercises, drills and practice on the content”.

4.2.3 Students' Perceptions about the Structure of Web-based Learning

The students were asked questions in the interview form to understand their perceptions about the structure of a web-based learning tool used in the science course were related with;

- Which of the cognitive tools in the course web site they made use of.
- How they used the web site throughout the academic year.
- Which features of the science course enhanced with a web-based learning tool they liked.
- What sources they used while studying.

The number of responses of the students to above questions is given in Table 4.15.

Table 4.15 Students' Perceptions about the Structure of Web-based Learning

The responses of students about the Structure of Web-based Learning	**Number of responses**
Students were happy with these pre-determined goals and objectives.	38
could easily find the topics that I need to study on	22
students first entered the course content pages then the students viewed the assignments and additional links.	31
The web-site was found to be very user-friendly, nice looking in terms of graphics and well organized in terms of access to information.	33
Students were happy with these pre-determined goals and objectives.	38

Students were happy with the list of pre-determined goals and objectives in the web site of the course. Most of them stated that knowing the goals and objectives they could answer the metacognition related question:

"What information do I need to know?" The hierarchic structure of the course web site to present information also pointed towards a focused goal orientation structure. One of the students indicated: "At the beginning of the education, an exam was given to us, and then the topics that we have some problems in were obtained and then we were told to study some units from the web site of the course. I could easily find the topics that I need to study on. And, I could see what I am going to learn at the end of the session. I think it was good".

To understand how the students made use of the sharply focused structure of the course contents, they were asked how they used the web site throughout the semester. The students' interviews showed that 31 students first entered the course content pages when they logged into the course web site. After that, the students viewed the assignments and additional links. Triangulating the students' statements with the web log-system records showed that most of the students first visited the main page (comes default after the login information is supplied by students) than visited the course content, assignments, text as indicated by the students. This could be interpreted as, first the students wanted to achieve the pre-defined goals of the course in terms of content knowledge. Then they wanted to see what is required of them.

The web site was found to be very user-friendly, nice looking in terms of graphics and well organized in terms of access to information. The students liked the navigation structure and information presentation structure. The interface features like buttons, icons and links were quite clear and distinguishable. They also stated that they liked the hierarchic structure of the web site. One student said that "All of the buttons in the web site was in the same place on all pages. Moreover, if there was a video related with the

content, the video button was highlighted, if there was not a video navigation, it was inactive in colour. So, it was easy to navigate from one page to another".

4.2.4 Students' Perceptions about the Interactive Tools like Dictionaries, Chat rooms, e-mail, Videos in Web-based Learning

The students were asked questions in the interview form to understand their perceptions about the interactive tools like dictionaries, chat rooms, e-mail, videos, etc. in web-based learning were related with;

- Which features of the web-assisted instruction aided their learning of the component.
- Which features of the course they liked.
- Which of the cognitive tools in the course web site they made use of.
- Whether the examples, practice questions and visuals provided in the web site were useful in relating the information with real-life.
- What they think about the future of web-based learning.

The number of responses of the students to above questions is given in Table 4.16.

Table 4.16 Students' Perceptions about the Interactive Tools like Dictionaries, Chat rooms, e-mail, Videos in Web-based Learning

The responses of students about the Interactive Tools like Dictionaries, Chat rooms, e-mail, Videos in Web-based Learning	**Number of responses**
they used the video navigations to support their learning.	13
they did the assignments to support their learning.	33
they did not use the chat room effectively for information exchange.	12
that they found the course structure interesting and useful.	18
they liked the cognitive tools,	21

A constructivist application in the course web site was the cognitive tools. The cognitive tools were applications within the general structure of the web site to support student learning. They were metacognitive support tools enabling the students to customize their web site usage according to their leaning habits. In the interviews students were asked which of these tools they used and which of them sported their learning in the web based component of the course. The findings from the students answers indicated that students ranked the most effective cognitive tools in terms of their support on their learning as videos, Class-server applications and assignments. Some students (13 students) indicated that they used the video navigations to support their learning. They added that not only by read the text, but also by watching videos in the web site, could they understand and remember the content because of the virtual property. However, one indicated that "it was not easy to watch videos. Because of the dial-up connection, it was not easy to download them. If the size of the video was long, it took a long time to see in the screen. I tried two or three times to connect to videos. But, I could not. Then, I did not use them any more".

A large group of students (33 students) said that they did the assignments to support their learning. The assignments were given by using Microsoft Class-Server program. The assignments contained five sections as follows: objectives, brief notes about the topic, applications, tests and references and related links. One of the students said: "while doing assignments, I could re-study the content in brief descriptions and read daily life examples. After that, I could easily solve the test given". Another student indicated that "in addition to these, one could study the same topic in different

pre-determined web sites. I could read different information from these pages". Five students indicated: "In fact, I could find the same topic by using search engines. But, all the search results are not worth using. I think it is time consuming".

Students' perceptions on the web-based learning tool for science course indicated that the chat room in the course-web site was viewed differently by only three of the students. Students agreed that they did not use the chat room effectively for information exchange. Some students (12 students) indicated: "we were all at school from 8:30 to 16:00. We were making live chat. We did not need to chat from the web. If we would like to do it, we used our cell phones". Another student added that "It was even more practical. We could send messages from our cell phones from anywhere and at any time we liked without having a computer with dial-up connection".

Students were asked which features of the course they liked the most. Students indicated that having a course given by an alternative method after so many traditional courses. It was something new for them. They stated that they found the course structure interesting and useful. Students stated that they prefer doing activities (watching films about content to be taught and experiments) rather than sitting silently and reading the text.

According to the student comments, the cognitive tools used in the site gave the course web site a professional look, making it different than standard, electronic page turning web sites. Related to this, one student said: "The tools in the web site were very user friendly. I used them for accessing to information quickly and easily".

The cognitive tools and the web site of the course were among the most liked features of the course as indicated by the students. While 21 students stated that they liked the cognitive tools, 17 students said that they liked the course web site.

CHAPTER 5

CONCLUSION AND IMPLICATIONS

In this chapter, the conclusions of the findings, implementations, recommendations for researchers and future research will be presented.

5.1 Summary

This study examines how the learners structure their activities and what their affective attitude and cognitive perceptions are towards online learning in general. The research questions aim to understand two major purposes: to investigate whether science courses enhanced with a web-based learning tool affect students' academic success and attitudes toward online science learning or not, and to investigate students perceptions about the effective dimensions of science courses enhanced with a web-based learning tool. This research study was designed as a mixed method case study. This mixed method design included quantitative analysis of the Science Achievement Test about the Web-based science course and attitude scale towards science courses, and qualitative student interviews, qualitative analysis of course and instructional materials.

5.1.1 Conclusion for Question–1: Do science courses enhanced with a web-based learning tool affect students' academic success?

The quantitative results of the study indicated that there was a significant difference between the pre-test and the post-test of the Science Achievement Test (SAT) scores of the sixth, seventh and eighth grade students at the end of the study. These results (of sub-questions 1.1, 1.2, 1.3) also indicated that a significant correlation exists between these two variables. This significant correlation indicated that those who scored high on the pre-test tend to score high on the post-test. Most of the past studies investigated the effectiveness of web-based learning by comparing with the traditional learning and/or with different types of media (Delialioğlu, 2004; Armatas, Hold, Rice, 2003; Persin, 2002; Sherry, Jesse, & Billig, 2002; Sorg, 2000, Barry and Runyan, 1995; Russell, 1999; Phipps & Merisotis, 1999; Hargis, 2001; Bernard, Abrami, & Lou, 2004, Topçu, 2005). In some studies, there was a significant difference in achievement scores of the learners between the two modes of instruction (Persin, 2002; Sherry, Jesse, & Billig, 2002, Sorg, 2000). However, many studies that employed media comparison methodologies have conceded that there is no significant difference in the learning outcomes of online students and students receiving the conventional face-to-face instruction (e.g., Barry and Runyan, 1995; Russell, 1999; Phipps & Merisotis, 1999; Hargis, 2001; Bernard, Abrami, & Lou, 2004, Topçu, 2005). The findings of Demirci (2004), Faul et al. (2004) agreed with the previous findings as "no significant difference…" However, in their study it was concluded that incorporating the web-based physics program into traditional lecturing did

have a significant effect on dispelling students' physics misconceptions about force and motion concepts. The finding of this case study agrees with the findings of Demirci's and Faul's (2004) studies.

The significant difference between the pre-test and the post-test of the Science Achievement Test (SAT) scores in this study was partly attributable to the constructivist view of learning about the web site about the course. The use of predetermined links requires critical thinking skills. The participants in this study were able to navigate through large pools of information and make appropriate and relevant selections on their own. They were then responsible for identifying the benefits and disadvantages of the selection.

The size of groups is an important factor on the effectiveness of interactive web-based learning (Owston, 1997; Trentin & Sciecen, 1999). The instructor must understand the cognitive strategies of their students and know how best to structure content, that is, what to do when to facilitate learning. Since the number of participants in this study was small, the instructor had the opportunity to solve problems that occurred throughout the academic year.

Another reason for the significant difference can be accounted for by the different findings for the exam performances in the study supported also by findings of previous studies (Chellman & Duchastel, 2000) which reported that the learning environment has a novice effect on the students if they take the web-based course for the first time. The students who participated in this case study had not taken a web-based course before.

Moreover, the science course enhanced with a web-based learning tool also provided students with more self-control over the when and where and how of learning, which can improve motivation (St. Clair, 1999). Research

points to motivation as an important factor on student achievement. There is also research evidence that shows that motivation is not only a determinant for student achievement but it has to be activated for each task (Weiner, 1990).

The correlation between site usage time of sixth and seventh grade students and their academic success in the science course was significant. These values indicate a strong positive relationship between site usage time of sixth and seventh grade students and their academic success in the science course. However, the correlation between site usage time of eight grade students and their academic success in the science course was not significant. The correlation coefficients for sixth and seventh grade were r = .662 and r = .554 respectively. These values indicate a strong positive relationship between site usage time of sixth and seventh grade students and their academic success in the science course. This indicated that those who used the web site of the course more often, tend to score high in the post-test of the Science Achievement Test (SAT). In 2002, Tello investigated the impact of instructional interaction on student persistence among adult students in online courses. Tello found that there was a significant correlation between the achievement of students and students' persistence. In his study, he investigated the factors affecting for students' persistence and dropout, the study also investigated the reasons for high/low student persistence. The literature on students' persistence at the undergraduate level indicates that interaction between faculty and students, as well as interaction among students, is an important factor in supporting student retention (Braxton, Milem & Sullivan, 2000). Attendance has often been related to better performance in class (e.g., Gatherer & Manning, 1998; Moore, 2003). A number of theorists and

researchers have studied student retention and persistence in classes among undergraduate students (Kuh & Hu, 2001, Woodley & Parlett, 1983). These studies suggest that formal and informal interactions with faculty are positively related to student achievement and student persistence. In this study, the sixth and seventh grade students' persistence was high compared to the eighth grade students' persistence. Because of this, the correlation between site usage time of sixth and seventh grade students and their academic success in the science course was significant. This result agrees with the literature. However, the findings of the study was different than those of past studies for the eighth grades, because it was found that the correlation between site time of the eighth grade students and their academic success in the science course was not significant. The site time of eighth grade students was less than the site time of the sixth and seventh grade students. Because of this, there was no correlation. Although the site time of eighth grade students was not enough, there was still a significant difference between the pre-test and the post-test of the SAT. There was an increase in the mean scores between the pre-test & the post-test of the SAT. Data were triangulated with site usage time and interview results. Most of the eighth grade students who did not use the web site enough stated that "I would like to study whole topics from the web site of the course. But, at the end of this year, I am going to take High School Entrance Exam, and I had to solve hundreds of test questions. I had not had time to sit in front of a computer and study. In fact, if I had used the web site, I would have perceived the topics better, I think. There were lots of information, daily life examples, assignments and problems. Now, it is too late. Next week, I am going to take this exam". Therefore, the results indicated that the reason for the increase in the mean of

SAT scores may be because of their extra study for Lycée Entrance Exam. As Riffel and Sibley (2005) indicated, attendance was not an important factor in predicting post-test scores. Any inference about the influence of attendance should be restricted to the set of students used in our analyses and the range of attendance rates. Teaching activities are an important pedagogical consideration for distance education because most studies have indicated that when students actively participate in the learning process they are likely to perform better and remember more (Hanafi, Zuraidah, & Rozhan 2004).

In summary, it can be concluded that science courses enhanced with a web-based learning tool have a positive effect on students' academic success for students if their achievement scores are interpreted as success in acquiring the knowledge in the course content. Moreover, science courses enhanced with a web-based learning tool may be used to minimize the lack of knowledge for previous year's content of science topics and to improve students' success in science education in secondary schools.

5.1.2 Conclusion for Question–2: Do science courses enhanced with a web-based learning tool affect students' attitudes toward science learning?

The quantitative results of the study indicated that there was a significant difference between the pre-attitude and the post-attitude scores in the attitude scale of sixth, seventh and eighth grade students at the end of the study. These results also indicated that a significant correlation exists between these two variables. This significant correlation indicated that those who scored high on the pre-test tend to score high on the post-test from the attitude scale. The correlation between site usage time of sixth and seventh grade students and

their attitude towards the science course was significant. However, the correlation between site usage time of eighth grade students and their attitude towards the science course was not significant.

Many studies that have been implemented about the influences of web-based learning on students' attitudes do not agree on the issue of whether it makes positive changes in attitudes towards science and science lessons. (Francisa, Katzb, Susan, & Jonesc, 2000; Mitra, 1998). For example, Choi, Lim, & Leem (2002), and Ertepınar, Demircioğlu, Geban, and Yavuz (1998) reported that computer assisted instruction develops a positive attitude towards science education. Choi, Lim, & Leem (2002), Beard, Harper, & Riley (2003) reported that web-based learning develops a positive attitude towards science education. In contrast, Shaw and Marlow (1999), Çepni, Taş, & Köse (2004) said that computer assisted instruction does not show a positive effect on students' attitudes. Besides, students' attitudes towards science are quite negative if traditional teaching methods are used in science classes (Colletta & Chiappetta, 1989). In this study, web-based learning changed students' attitudes towards science lessons.

Apparently, perceived benefits of taking a web-assisted course, and the actual value associated with the interactive and communication features of web-assisted instruction may have helped to shape students' attitudes towards science. Hoffman (2002) noted that since students are active learners and since they are responsible for their own learning, it is reasonable to expect a favorable attitude towards the medium of delivery. Similarly, students also expressed a positive attitude about web-based technology the more they used it,

and the more they become comfortable with the course and mode of interaction (McBride as cited in Hagir & Mohamed, 2003).

Although there was a significant difference between the pre-attitude and the post-attitude scores in the attitude scale of eighth grade students, the correlation between site usage time of eighth grade students and their attitude towards the science course was not significant. This result is merely because of the insufficient use of the web site of the course.

Findings of this study added an empirical support for the positive effect of web-based learning. Reaching to the content easly and less effort to obtain the knowledge can explain the difference in attitude toward science course. The web site of the course provided students with opportunities to read, and analyze the content. In the web site the students could use many links in which they could find related information. These conditions affected the progress in their attitude. As literature suggests, the development of positive attitudes is related to the easy involvement of the students in activities in the web site of the course (Manual, 2001; Matuga, 2001).

This result can still be understood as successful because the new course structure did not change students' attitudes negatively. It can be concluded that the hybrid course was successful in shifting the course structure from teacher centered to student centered without causing any decrease in students' attitudes towards the course.

5.1.3 Conclusion for Question–3: What are students' perceptions about the science course enhanced with a web-based learning tool?

The students' perceptions about the science course enhanced with a web-based learning tool inherent in the current study were important in understanding the effective dimensions of students' science learning. The students were interviewed in groups of 5 students after post-tests were administered. Students were asked questions that reveal their perceptions. The findings and conclusions on the students' perceptions are listed below:

Most students who used the Web site found the material interesting, easy to understand, and thought it was relevant to the learning objectives. Almost half of those who used it found it stimulating, helpful in understanding topics, and useful for exam preparation. Over a third of the sample found the companion Web site to the text easy to understand and felt it was relevant to the learning objectives. While some of the web components of the science course like course content structure and course objectives included more of traditional academic tasks, they were supported with authentic tasks in the assignments, films, and laboratory activities, "do you know" activities. The students' used both type of tasks. The majority of the students learned the content through the course content in the web site. Half of the class made use of the assignments as the primary learning source. One of the students stated: "the reason for me to use the web site was to learn what the assignment was and to review the content before assessment". The academic and authentic tasks went hand in hand as the instructional elements enabled students learning. The log-system showed that the most frequently used tools were assignments

that were created by using Microsoft Class-Server packed program. As stated by the students, the tools helped them in structuring their knowledge.

The course was a student centred with direct learning from the web site of the course. Students were required to do academic and authentic exercises. This caused to work too hard. The same overwork issue was also pointed out by Garnham & Kaleta (2002). Their findings were related to the overwork issue also applicable to the current study. Students were expected to read the content, to watch films, use additional web links for their learning, and do assignments. Previous research showed that in web-based learning environments the students were expected to access, organize, and analyze information (Yang, 2000).

The content of the web site had the topics of the previous year's content. The topics were not explained in the class hours while the study was in progress. In addition to that, the students were not geographically separated. They tried to communicate with the teacher and their peers only in classroom settings although they were able to use the chat room and e-mail in the web site.

Collaboration in the web component of the course was through e-mail and chat rooms. These tools were designed for communication and were necessary but not enough for accomplishing collaboration. The reason for this might be students' communication habits throughout their school life. Students preferred to communicate face to face with their peers and the teacher. One of the student stated "I like to ask my questions to my teacher when I had a question. I could easly understand when she explained. If I had used e-mail, I should wait for my teacher's respond. In this case, I would forget the topic".

The collaboration among students was in eachother's presence through verbal communications. Students preferred real time communications in the classroom. One student stated "When I am in the class, I could listen my teacher and ask question directly to her. I could consantrate her, and I could follow her". In supporting this finding, there are researchs showing that students do not prefer to communicate through chat or other communication tools if they are able to see eachother in the classroom (Driver, 2002; İnan, 2002). Six students stated that there was no need to use e-mail and the chat tools because of having a face-to-face communication chance. This result is very similar to the findings of Driver (2002) and Ersoy (2003), where the face-to-face interaction was preferred over the chat and the students did not use the chat rooms.

The lack of facilitation was cautioned by Eastmond (1997). Eastmond claimed that the self-directed learning can be accomplished by the individuals, but it did not rest on the individual only, the facilitator and institution needed to encourage it. In this study, the lack of a facilitator role might have affected the participation of online communication tools (e-mail and chat rooms) resulting in the low number of participation obtained. The findings of the students' perceptions about online collaborative learning can be interpreted in a way that the online collaborative tools (e-mail and chat) were not used in the science course enhanced with a web-based learning tool since there was a face-to-face communication chance in this study. This was the first time many of the students had taken a web-based course. Some expressed concern about the lack of teacher interaction (as did the teacher) and the inability to interact with other students. One student stated "I had a question to ask to my teacher, and I sent

an e-mail. But, she did not give answer to it". There were also the hardware and software concerns, as some students expressed their frustrations at trying to connect to the web site. However, all students stated that they would like to take a course with web-based instruction in the future. Similar results were obtained in literature (Beard, Harper, & Riley, 2003; Yang, 2000).

Almost all students agreed on the support of the classroom meetings to learn especially abstract content. This is understandable as they are accustomed to lecture courses from their primary and secondary school years with the same structure and students can not be blamed for their difficulties in getting used to new instructional contexts in the science courses.

There were differences in the preferences of students in using the cognitive tools and the frequency of using a tool. Overall, the student perceptions indicated that the course web site was integrated in terms of metacognitive support. The important finding of the study was how important the metacognitive skills of students in the science course were. In the current study the metacognition and time management skills of the students were supported through cognitive tools in the web site and recorded with a log-system. They were important factors for learning in open learning environments, which were described by Land & Hannafin (2000) as environments in which students need to process large amounts of information. Cognitive tools are required in these environments for providing help to the students in searching, accessing information (Land & Hannafin, 2000)

Closely related with structural flexibility of the hybrid course was the usability of the course web site. Usability refers to the factors in the web site that make the experience for the learner simpler and stress free. The usability

factors were especially important for the course web site. The download time was also important since most of the students stated that they preferred to connect to the internet from their homes with a modem. The usability and simplicity of design is given special attention to in the web based course design literature. One of the researchers in this area is Jacob Nielsen, who advocates web design not to include graphics and sounds unless they are absolutely essential (Palloff and Pratt, 2001, as cited in İnan, 2003). However, the web site in this study contained photographs, graphics, and films. Students were sometimes criticized for accessing some of the links in the web site. One of the students stated, "I could not watch films related with the topic I studied. I tried to browse the video page. Because of dial-up connection, I was disconnected from the server. I could only watch them in one of my friend's home. He has an ADSL modem to connect to the Internet."

The structural flexibility of the web site of the course was open rather than fixed. The students could access information anytime they wanted and there was no restriction with time or place, the web site was accessible 7 days a week, 24 hours a day. With the integration of the cognitive tools the students could easily search, access and organize knowledge. By using the different tools students could access the same information from different links. The course web site was stated as user-friendly and graphical and the navigational features of the web site like buttons, icons and links were clear, easy to understand and distinguishable.

The cognitive tools were implemented to increase the usability of the web site and provide flexibility in accessing information. The course web site is simple to use as indicated by the students. The design and development of

the course web site was carried out according to Özden (2002). Some of the findings in the literature that guided that design and development and positively affected the structural flexibility and usability of the course web site (Yang, 2000). The student depicted their perceptions about the structure of the web site. The results demonstrate that they perceived the structure of the web site as convenient and they were comfortable with it. This assumption could be supported with findings obtained from Ersoy's (2003) study. He also used the same web structure which was constructed like the web-based learning site of Özden (2002).

From students perceptions it may be concluded that the web-based science course was closer to the instructivist philosophy and behaviorist learning theory. The literature shows that there are fundamental philosophical differences between objectivist and cognitivist learning theories based on instructivist and constructivist epistemologies (Rowland, 1995; Bednar, Cunningham, Duffy & Perry, 1995). However, in the real classroom environment, a "mix" of objectivist and cognitivist, and inline with that, instructivist and constructivist instruction/learning design is being used (Davidson, 1998, Yang, 2000).

Passerine & Granger (2002), Özden (2002) recommended as the ideal paradigm of online course design a mixture of instructivist and constructivist elements. The students found the pedagogical philosophy of the web site of the course as a mixture of instructivist and constructivist elements. Moreover, as stated by Mayer there is no need for discovery learning to have constructivist learning (Moreno & Mayer, 1999). Constructing meaning can also be achieved by a well-designed and organized directed learning. This is parallel with what

the students said in their interviews related to the pedagogical philosophy. Most of the students found the overall design of the course good for the aim of web-based learning.

While students' stated their primary source of information as the course content in the web site, which was closer to objectivist theory, they also used other components of the web site of the course for supporting their learning like cognitive tools, films and additional links which were closer to cognitive learning theory and constructivist philosophy Jonassen's (1999, p.221). The findings of this study are parallel to those of previous studies. Armatas (2003) found the additional links to other online study resources to be useful or very useful.

Hanafi, Zuraidah, & Rozhan (2004) indicated that the respondents perceived the high degree of necessity of the online support services to be provided for them. They perceived that the information regarding examination procedures should be made available online. The information on examinations that is normally furnished to them includes the dates, venues and times of examinations. From students perceptions it could be seen that the students preferred taking exams online. They stated that "it was funny to take exams on the computer. There was no need to wait for the anouncement of the grades. As soon as the exam finished, one could have learn the mistakes and their correct results. Therefore, I would not forget the truth about this topic. In traditional exams, however, we had to wait minimum for a week. At that time, I would have forgotten my responses to the questions." One of the strengths of CAA is that students can receive feedback quickly as they progress through the assessment. Most of the survey results (McKenna & Bull, 1999), show that this

is among the main advantages of CAA. Hargreaves (2004) indicated that the computer tests were found to have an overall positive effect on children's performance.

As Ozcelik (2002) and Rasmussen, Northrup & Lee (1997) and Yıldırım (2001) indicated the importance of demonstration provided at the beginning of the course. The results indicated that enough information about the features and usage of the web site part were given to the students.

In summary, to make effective use of web-based learning, the features of the web site should be designed in a manner that they are parallel to the goal of the related utility. As well as navigation support, the content should be kept in summary to minimize reading from the computer with enough graphs and pictures without having download problems. In terms of visual design, each web page should be designed in a way that minimal information on each page is provided with as a mixture of instructivist and constructivist elements. Moreover, it is found that using self-assessment tools for students played an important role for students' motivation and interaction which is a key to success in web-based learning.

5.2 Implications for Education

This case study sheds light on development and utilization of a web-based learning tool in secondary science course. The findings of this study assist other researchers and developers in their development and utilization of web-based learning system.

In the literature there is a limited number of research studies related with overloaded heavy curriculum and educational problems in Turkey.

The study is a case study, where the findings are very specific to this case, and generalization from the results might not be credible for other cases. However, in particular instances, the analogous features of the cases can let the stakeholders be inspired from the study.

In web-based learning environments, web-based instruction can enhance the learning environment in terms of time and place flexibility and alternative mode of instruction. The students can benefit from the web sites even with the face-to-face instruction. Besides the low level of participation to the forum and chat in this case, but there were some students using this communication tool. In the learning environment, every student is not expected to be comfortable with the ongoing instructional strategies. Therefore, it might be better if the course could offer alternative, or additional, learning strategies and environments. Even for a small number of the students, engaging the web site or different learning options would help to reach targeted learning.

The implication of the web-based learning in the course may include activities engaging the online communication tools to make them more attractive. It seems that the instructor slightly lacked the facilitator role in the environment. The student may get more positive ideas about computer mediated communication if the instructor plans learning experiences, where the students are able to see the benefits of the tools directly in learning.

Like in classrooms, the instructor may need to watch the actions in the online environment or arrange activities for online environments. Such software systems seem to be beneficial and should be integrated into the design of the course.

Student-student and student-instructor communication should be encouraged and necessary facilities should be provided.

Print materials (i.e. Books, hardcopy reading materials should be provided to students. Most of the students in the current study indicated that the web site of the course was their primary source of learning materials, but most of them preferred to print out the materials on the content web-pages.

5.3 Recommendations for Further Research

A formative evaluation of the perceptions may be recommended for the researcher. During the semester, there might be changes in the perceptions depending on certain aspects, like midterm results, selection of group members or topics, or newly added materials to the web site.

The participation to the online communication tools were evaluated quantitatively in the study. The total time spent in the web site and in the chat session, and the numbers of posts sent to the e-mail were analyzed as participation indicators. The qualitative analysis of these usages may illuminate the forces behind the perceptions.

Beside the contribution of this study, there seems to be further research in web-based learning environments that can be conducted. Following is a list of recommendations for future research on this issue.

Firstly, a further research investigating both components, web-based instruction and the face-to-face instruction, of the web-based learning environment may be performed to see the effects of the combined activities.

The design of the face-to-face instruction may affect the students' perceptions about web-based instruction system.

Secondly, an additional research may explore the online communication style of the students in the web-based learning. Some students in the current study had used e-mail and chat and stated that they benefited from them, even though the number of respondents was small. Additional research may ask the question whether the communication of those students through online tools is different, and if so, what makes this difference.

Thirdly, further research may be conducted to see the impact of the previous knowledge about how to collaborate or how to work do group-work efficiently. Jonassen (1996) gives notice that collaboration is a rare strategy. He adds that in order to get the most benefit from collaboration, students should learn how to communicate, how to assume a leadership, how to deal with a conflicts when they arise. Learners' collaborative learning skills may affect the perception and the way they use collaboration tools. A further research may show the extent of this effect, and if so, students may need additional training activities to gain collaborative learning skills.

Fourthly, another research may investigate the attitudes and perceptions of online teachers on web-based learning. The teacher perceptions and attitudes may affect the performance in the online environment. Since the time and efforts spent on more than one environment is not negligibly small, the teacher's point of view is important in the evaluation of web-based learning environments.

Fifthly, further studies should investigate how the interface takes the role of the metacognitive strategies or how the interface facilitates the use of the metacognitive strategies.

Finally, further studies should investigate web-based learning with different student characteristics like grade level, background, and learning styles.

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APPENDIX – A

Student Views

Aşağıda Fen Bilgi Konuları hakkında bazı cümleler göreceksiniz. Her cümlenin karşısına size en uygun olan seçeneğe (X) işareti koyunuz.

		Kesinlikle katılıyorum	Katılıyorum	Fikrim Yok	Katılmıyorum	Kesinlikle Katılmıyorum
1	Fen Bilgisi dersini seviyorum.					
2	Fen Bilgisi dersindeki bilgiler sıkıcıdır.					
3	Fen Bilgisi konularını seviyorum.					
4	Konular benim gelişimim için faydalı.					
5	Fen Bilgisi sınavlarından korkarım					
6	Fen bilgisi konularını tartışmayı severim.					
7	Fen Bilgisi konuları beni rahatsız eder.					
8	Fen Bilgisi konuları çok ilginçtir.					
9	Fen Bilgisi konuları beni korkutur.					
10	Fen Bilgisi konularını öğrenmek kolaydır.					
11	Fen Bilgisi konularını çalışmak hoşuma gider.					
12	Mümkün olsa, Fen Bilgisini öğrenmem.					
13	Herkes Fen Bilgisi hakkında bilgiye sahip olmalı.					
14	Fen Bilgisi ders saatleri daha fazla olmalı.					
15	Fen Bilgisi konularının kritik düşünme yeteneğine etkisi yoktur.					
16	Fen Bilgisi konularını çalışırken sıkılırım.					
17	Fen Bilgisi konuları hakkında daha fazla bilgi edinmek isterim.					
18	Fen bilgisi hakkında hiçbir şey duymak istemiyorum.					
19	Fen Bilgisi konuları şaşırtıcıdır.					
20	Fen Bilgisi konularını sevmem.					
21	Fen Bilgisi konuları herkes tarafından bilinmelidir.					

		Kesinlikle katılıyorum	Katılıyorum	Fikrim Yok	Katılmıyorum	Kesinlikle Katılmıyorum
22	Fen Bilgisi konularını dinlemek istemem.					
23	Fen Bilgisi dersinin hiç verilmemesini isterim.					
24	İlköğretimdeki her öğrenci Fen Bilgisi dersi almalıdır.					
25	Fen Bilgisi derinde başarılı olabileceğime inanıyorum.					
26	Kariyerimde Fen Bilgisi dersinin faydalı olacağına inanmıyorum.					
27	Fen Bilgisi konuları ilginç değildir					
28	Fen Bilgisi dersinde öğretilen bilgiler güncel hayatta gereksizdir.					
29	Fen Bilgisi konuları düşünme yeteneğimi arttırır.					
30	Fen Bilgisi konularının ileriki yaşamımda ne işe yarayacağını bilemiyorum.					
31	Fen Bilgisi konularına çalışırken kendimi rahat hissediyorum.					

APPENDIX – B

GÖRÜŞME SORULARI

Web Destekli Öğrenme ortamlarının etkinliğine yönelik bir araştırma yapıyorum ve Fen Bilgisi dersi hakkındaki görüşlerini öğrenmek istiyorum. Bu görüşmede verdiğin bilgiler sadece araştırma amaçlı kullanılacak, ders notunuzu kesinlikle etkilemeyecek ve kişisel bilgileriniz de saklı tutulacaktır. Görüşme süresi dakika olacak. İznizle görüşmeyi kaydetmek istiyorum. Verdiğiniz bilgiler için şimdiden teşekkür ederim.

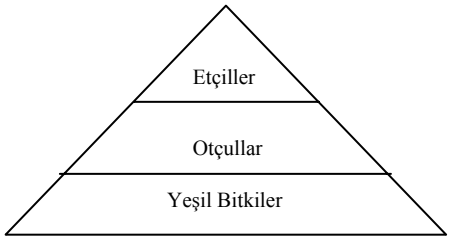
1. Fen Bilgisi dersinden beklentilerin nelerdir?
    - Beklentilerinin hangileri karşılandı?
    - Karşılanmayanlar neden karşılanmadı?
2. Ders için hazırlanan Web sitesi içerisinde istediğin konuya rahatça ulaşabiliyormuydun? Nasıl?
3. Dersi vermek için kullanılan Web destekli öğretim biçiminin hangi özellikleri (ders anlatımı, ödevler, filmler, deney bölümleri, evde uğraş bölümleri, Etkinlik sayfaları, Biliyor musun sayfaları, Ek çalışma sayfaları) içeriği öğrenmende katkıda bulundu? Nasıl anlatırmısın?
    - Web sayfasında bulunan konu anlatımlarının öğrenmene etkisi oldu mu? Nasıl?
    - Web sayfasında bulunan deneylerin öğrenmene etkisi oldu mu? Nasıl?
    - Web sayfasında bulunan video gösterimlerinin öğrenmene etkisi oldu mu? Nasıl?
    - Web sayfasında bulunan etkinliklerin öğrenmene etkisi oldu mu? Nasıl?
    - Web sayfasında bulunan deneylerin öğrenmene etkisi oldu mu? Nasıl?
    - Web sayfasında bulunan ödevlerinöğrenmene etkisi oldu mu? Nasıl?
    -
4. Ders içeriğine Web üzerinden erişimin sana faydaları veya zararları oldu mu? Olduysa bunlar nelerdir açıklar mısın?

5. Web sayfasındaki araçlardan (Mail, Chat, Sözlük) hangilerini hangi sıklıkla kullandın?
   - Kullandığın araçlar içeriği öğrenmende katkıda bulundu mu? Nasıl?
   - Hiç kullanmadığın araç var mı? Hangileri?
6. Dönem boyunca karşılaştığın problemler nelerdir? (Öğretmene erişim, ders materyaline erişim, web sayfasına erişim, ödevler, …..) Bu problemler daha sonra giderildi mi?
7. Web destekli ders yapmak öğrenme alışkanlıklarında ve dersi anlamanda bir değişiklik yaptı mı? Nasıl?
8. Dersi öğrenmek için dersin web sayfasındaki içerik ve okumalardan başka kaynak kullandın mı? Kullandıysan bunlar nelerdir?
9. İleride tekrar web destekli öğretim biçiminde anlatılan ders yapmayı düşünür müsün? Nedenini açıklar mısın?
10. Ders süresince Web'i nasıl kullandığını kısaca açıklar mısın?
11. Web'de verilen örnek durumlar, alıştırmalar, videolar bilgileri gerçek hayatla ilişkilendirmenize faydalı oldu mu?
12. Sence Web destekli öğretimin geleceği nasıl?

APPENDIX – C

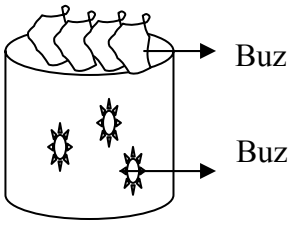
THE SCIENCE ACHIEVEMENT TESTS (SATS)
6. SINIF ERİŞİ SORULARI

1. Yandaki enerji piramidi için aşağıdakilerden hangisi doğrudur?



A) Yeşil bitkilerde diğerlerine oranla enerji de fazla canlı sayısı da fazladır.
B) Otçullar etçillere göre daha az enerjiye sahiptir fakat sayıda fazladır.
C) Etçiller en fazla enerjiye sahip sayıca en az canlı grubudur.
D) Yeşil bitkilerin enerjisi diğerlerine oranla az ancak sayıları fazladır.

2.



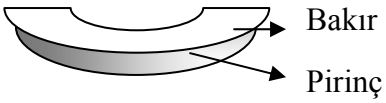
Yandaki bardakta 20 °C'lik bir odada içi buz dolu olarak bulunmaktadır. Bu bardağın dış yüzü neden buğulanır?

A) Bardaktan genleşerek taşan sudan
B) Havadaki nemin, bardağın dış yüzeyinde yoğunlaşmasından
C) Bardağın cam olmasından
D) Bardağın iç yüzünün soğuk, dış yüzünün sıcak olmasından

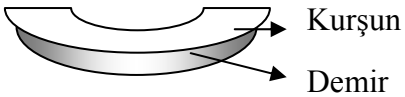
3. Kurşun > Pirinç > Bakır > Demir

Yukarıdaki metaller eşit sıcaklık artışlarındaki genleşme miktarına göre büyük küçüğe doğru sırlanmıştır. Bunlarla 200 °C de oluşturulan aşağıdaki metal çiftlerinden hangisinin 600 °C deki genleşmesi doğru verilmiştir?

A)



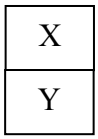
B)



C)

D)

4. Sıcaklıkları, X 30°C, Y ise 10°C olan iki katı cisim şekildeki gibi üst üste konuyor.

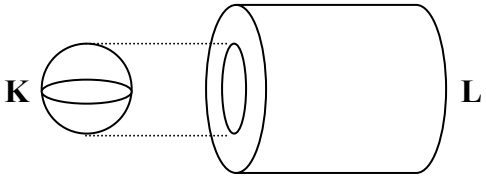


I**.** Isının akış yönü X'ten Y'ye doğrudur.
II. X cisminin boyutları küçülür.
III. Y cismi ısı alır.

ifadelerinden hangisi veya hangileri doğru olur?

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

5.

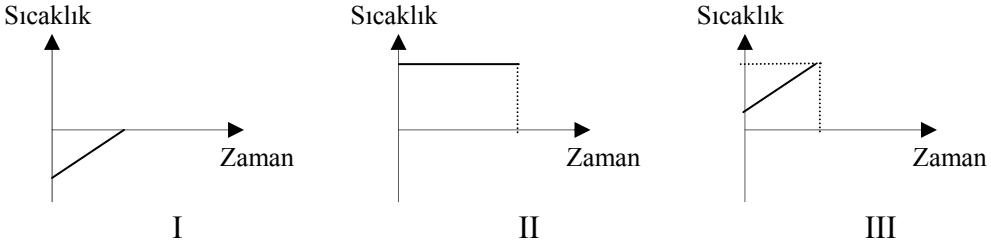


Şekilde görülen K küresi aynı maddeden yapılmış ve içi boş olan L silindirinin içinden geçememektedir. K küresinin L silindirinin içinden geçebilmesi için aşağıdakilerden hangisinin yapılması gerekir?

A) K ve L ısıtılmalıdır B) K ve L soğutulmalıdır.

C) k ısıtılıp, L soğutulmalıdır D) K soğutulup, L ısıtılmalıdır.

6.

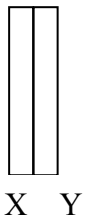


I II III

Işık alan bir maddenin sıcaklık-zaman grafiği yukarıdaki üç şekilde belirtilenlerden hangisi veya hangileri gibi olabilir?

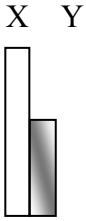
A) Yalnız I B) Yalnız II C) I, III D) I, II, III

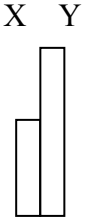
7. Şekildeki X ve Y metallerinden meydana gelen metal çifti aynı sıcaklıkta ve aynı boydadır. X'in genleşme katsayısı Y'den büyük ise, bu şekil ısıtılınca yeni şekli aşağıdakilerden hangisi gibi olur?



A) 

B) 

C) 

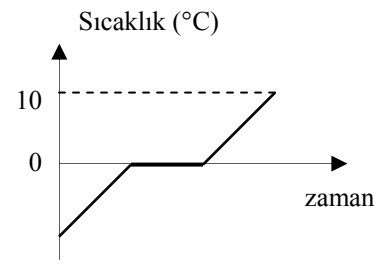
D) 

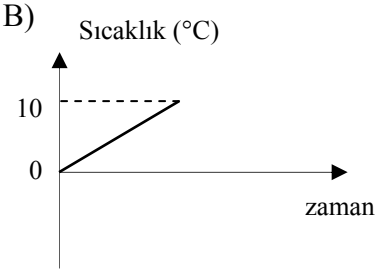
8. 

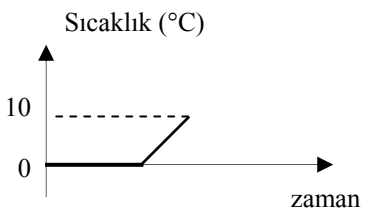
Oda sıcaklığında aynı boyda olan K ve L metallerinden meydana gelen KL metal çifti soğutulunca yandaki gibi oluyor. Buna göre aşağıdakilerden hangisi doğrudur?

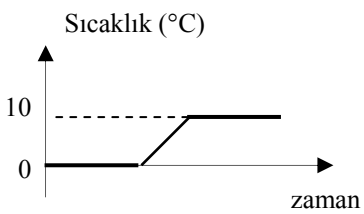
A) L'nin genleşme katsayısı K'dan büyüktür.
B) Genleşme katsayıları hakkında bir şey söylenemez.
C) K'nin genleşme katsayısı L'den büyüktür.
D) KL metal çifti soğutulunca eski haline geri gelir.

9. Aşağıdaki grafiklerden hangisi 0°C de buzun 10°C de su haline gelişini gösterir?

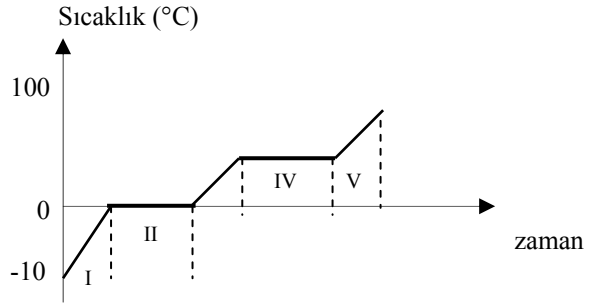
A) 

B) 

D) 

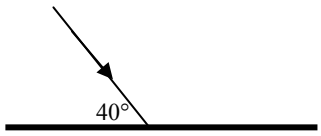
C) 

10. Aşağıdaki grafikte cisim hangi aralıklarda hal değişikliğine uğramaktadır?



A) II, IV B) I, II, III C) 1, III, IV D) I, II, III, IV, V

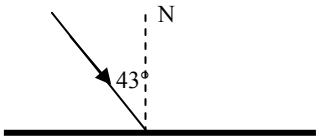
11. Şekildeki düz aynada yansıyan ışının gelen ışınla yaptığı açı kaç derecedir?



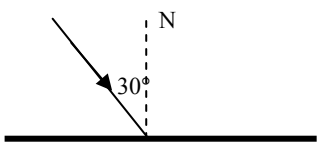
A) 40 B) 50 C) 80 D) 100

12. Aşağıdakilerden hangisinde düz aynaya gelen ışık ışının aynayla yaptığı açı, yansıyan ışınla yaptığı açıya eşittir?

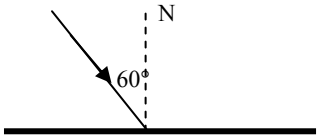
A)



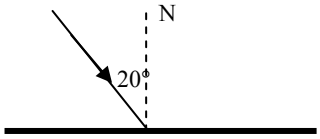
B)



C)

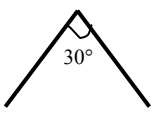


D)



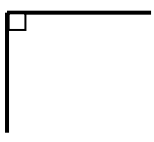
13. Aşağıdaki seçeneklerden hangisinde iki düz aynada cismin görüntü sayısının en fazla olması beklenir?

A)

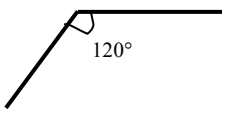


B)

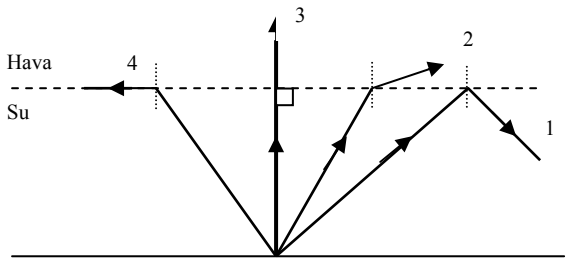
C)



D)

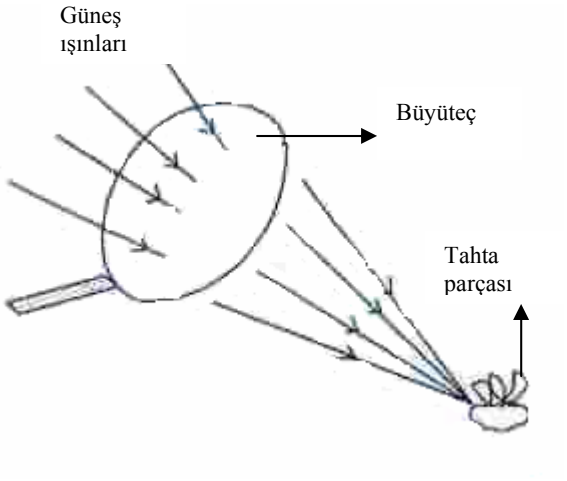


14. K noktasından şekildeki ışık ışınlarından hangisinin gelme açısı sınır açısından <u>büyüktür?</u>



A) 1 B) 2 C) 3 D) 40

15.



Güneşli bir günde büyüteçle, şekildeki deney yapıldığında tahta parçasının bir süre sonra tutuşup yandığı gözlenir. Bu deneyle aşağıdakilerden hangisine <u>ulaşılmaz</u>?

A) Büyüteç ince kenarlı mercekten yapılmıştır.
B) Büyüteç kalın kenarlı mercekten yapılmıştır
C) Enerji dönüştürülebilir.
D) ışık ışınları bir noktada toplanabilir.

16. Ses, aşağıdaki ortamlardan hangisinde yayılmaz?

A) katı B) sıvı C) gaz D) boşlukta

17. Aynı ses, değişik uzaklıklardan dinlenirse hangi özelliği değişir?

A) yankı B) frekans C) şiddet D) rezonans

18. Bir sesin kalın veya ince olması onun hangi özelliğine bağlıdır?

A) kaynağın cinsine B) frekansına
C) şiddetine D) geçişliğine

19. Telefondaki arkadaşımızın sesini tanıyabilmemiz, sesin hangi özelliğinden kaynaklanır?

A) tınısı B) frekansına C) şiddetine D) genliği

20. Frekansları aynı olan ses kaynaklarından birisinin titreşiminin, diğerini etkileyerek titreştirmesine ne denir?

A) rezonans B) sesin şiddeti C) yankı D) tını

21. Bir kaynaktan çıkan ses dalgalarının hava ortamında 4 saniyede 1376 m uzaklığa gidebildiği heaplanmıştır. Buna göre sesin havadaki hızı kaç m/s dir?

A) 5404 B) 2752 C) 344 D) 172

22. Ses, aşağıdaki ortamların hangisinde daha hızlı bir şekilde yayılır?

A) okyanus B) uzay C) çelik D) hava

23. Bulunduğunuz yerden 2720 m uzakta çakan şimşeğin gürültüsünü 8 sn sonra duyduğumuza göre, sesin yayılma hızı kaç m/ dir?

A) 680 B) 340 C) 272 D) 170

24. Aynı cins tellerden yapılmış olan düzeneklerden elde edilmiş frekans sayıları verilmiştir. Buna göre hangisinden kalın ses elde edilir?

A) 125 B) 215 C) 320 D) 360

25. Bir sesin hangi kaynaktan geldiğini belirten özelliğine ne ad verilir?

A) frekans B) tını C) şiddet D) hız

26. Bir ses kaynağının hızlı titreşmesi ne çeşit bir ses yaratır?

A) kalın B) sessiz C) ince D) zayıf

27. Aşağıdakilerden hangisi sesin özelliklerinden değildir?

A) tınısı B) şiddeti C) yüksekliği D) yoğunluğu

28. Bağıran bir kişinin çıkarmış olduğu ses 1360m uzağa kaç saniyede ulaşır?

A) 2 B) 3 C) 4 D) 5

29. Sesin hangi özelliği ile denizlerin ve okyanusların derinliği ölçülür?

A) rezonans B) yansıma C) tını D) şiddet

30. Havada uçmakta olan bir helikoptere gönderilen bir ses 20 saniye sonra geri geldiğine göre, helikopterin yerden yüksekliği kaç metredir?

A) 6800 B) 3400 C) 1360 D) 800

31. Frekans, titreşen bir telin;
I. Cins II.Gerginlik III.Kesit

özelliklerinden hangilerine bağlıdır?

A) yalnız I B) yalnız II C) II-III D) I-II-III

32. Aşağıdakilerden hangisi orta kulaktadır?

A) kulak kepçesi B) kulak yolu
C) kulak kemikleri D) duyu hücreleri

33. Şimşek görüldükten bir müddet sonra gök gürültüsünü duymamızın nedeni aşağıdakilerden hangisidir?

A) Şimşek oluşumunda büyük bir elektriklenme olması
B) Işık hızının ses hızından büyük olması
C) Ses ve ışığın havada yayılabilmesi
D) Sesin elektriklenmeden etkilenmesi

34. Dış kulağı orta kulağa bağlayan kısma ne denir?

A) kulak zarı B) östaki borusu C) iç kulak D) üzengi

35. İşitme sinirleri kulağın hangi bölümünde bulunmaktadır?

A) diş kulak B) orta kulak C) iç kulak D) kulak zarı

36. Dünyadaki bütün enerjilerin kaynağı aşağıdakilerden hangisidir?

A) petrol B) kömür C) reactor D) güneş

37. Işınların ayna odağında toplanarak ısı oluşturması, aşağıdakilerden hangisidir?

A) ışık bir ısı kaynağıdır
B) ışığın yansıması, ısının da yansımasıdır
C) ısıdan ışık elde edilir
D) ısı ile ışık enerjisi aynıdır

38. Koyu renkli cisim yada maddeler ısıyı az yansıtırlar. Bu özellikten mevsimlere göre giyinmede nasıl yararlanılır?

A) koyu renkli giyecekler yazın serin tutar
B) kışın koyu renkli giyecekler giyilir
C) kışın açık renkli giyecekler giyilir
D) bu özelliğin giyeceklerle ilgili bir önemi yoktur

39. Oda sıcaklığındaki, cam bardağa soğuk su konulmuştur. Bir sürere sonra bardağın dış yüzeyinin terlediği görülmüştür. Bunun nedeni aşağıdaki seçeneklerden hangisi olabilir?

A) bardaktan genleşerek taşan sudan
B) havadaki nemin, bardağın dış yüzeyinde yoğunlaşmasından
C) cam bardak olmasından
D) bardağın iç yüzünün soğuk, dış yüzünün sıcak olmasından

40. Kap içerisinde kaynamakta olan su niçin azalır?

A) su içindeki hava kabarcıklarının dışarıya çıkmasından
B) ısınan su moleküllerinin birbirine daha çok yakınlaşmasından
C) ısı etkisiyle suyun molekül yapısının değişmesinden
D) su moleküllerinin enerji kazanarak hal değiştirmesinden

41. Aya giden bir uzay gemisi, dünyaya dönerken gerekli önlemler alınmazsa, atmosfere girdiği an yanabilir. Bu yüksek ısı nasıl oluşur?

A) güneşin, atmosferin dış yüzeyine daha yakın olmasından
B) hızla haraket eden aracın, havayla sürtünmesinden
C) çalıştırılan dönüş roketleri yakıtlarının çok fazla olmasından
D) uzay gemisinde, dönüş anında atom enerjisinin kullanılmasından

42. Maddelerin halleriyle ilgili verilen bilgilerden hangisi doğrudur?

A) katı ve sıvı haldeki maddelerin molekülleri serbest hareket edemez
B) bütün maddelerin, hal değişi sırasında kimyasal özellikler değişir
C) katı, sıvı, gaz haldeki maddeler ısı verildiğinde moleküllerinin hareket enerjisi artar
D) gaz halindeki maddeler elektrik akımını katı ve sıvılara göre daha iyi iletir

43. Elektrik sobalarında ısıtıcı telin arkasında metal levha konur. Bunun nedeni aşağıdakilerden hangisi olabilir?

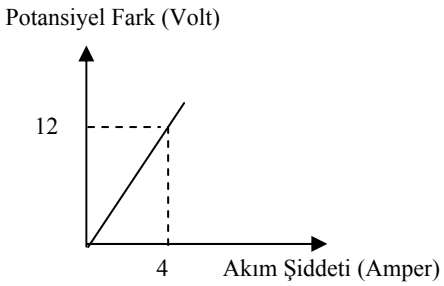
A) güzel görünmesi
B) daha dayanıklı olması
C) kolay yanması
D) ısının yansımasını sağlamak

44. Bir sürahide su donunca, sürahiyi çatlatır. Bunun nednei aşağıdakilerden hanfgisi olabilir?

A) sürahinin camı, soğuğa karşı dayanıksızdır
B) su, buz haline gelince hacmi büyür
C) sürahi çok soğuduğu için bulunduğu ortamın sıcağına dayanamaz
D) sürahinin hacmi küçülür

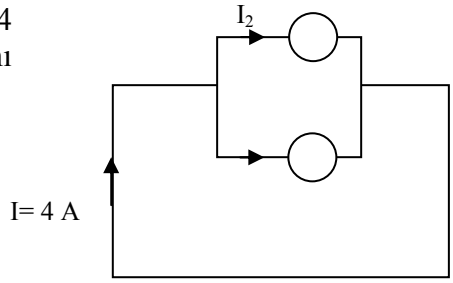
7. SINIF ERİŞİ SORULARI

1. Şekildeki potansiyel fark akım şiddeti verilen iletkenin direnci kaç ohmdur ?



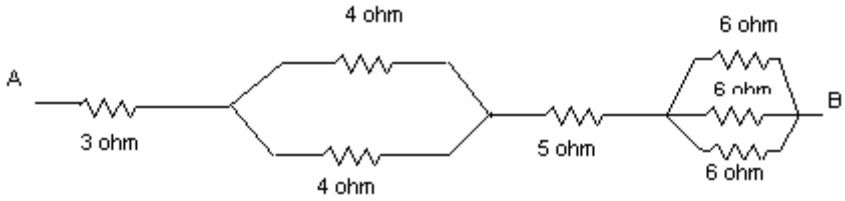
A) 12 B) 4 C) 3 D) 0.3

2. Şekildeki devrede ana koldan 4 amperlik akım geçtiğine göre I_2 akımı kaç amper olmalıdır?



A) 1,5 B) 2 C) 2,5 D) 3

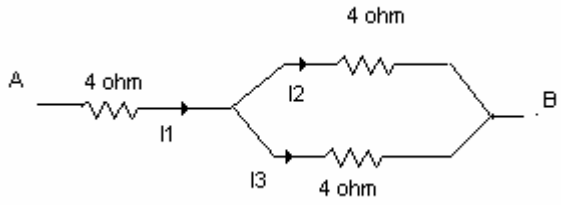
3.



Yukarıda şekli verilen devrede A-B noktaları arasındaki eşdeğer kaç ohm dur?

A) 12 B) 16 C) 18 D) 24

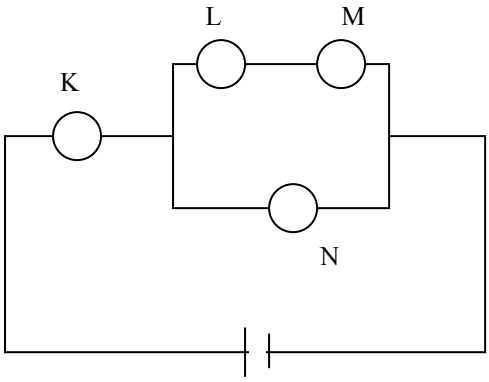
4.



Şekildeki devrede kullanılan dirençler özdeş olup her birinin direnci 4 ohm dur. Bu dirençlerden geçen akım şiddetlerinin büyüklükleri için aşağıdakilerden hangisi doğrudur?

A) $I_1 = I_2 = I_3$ B) $I_1 > I_2 = I_3$ C) $I_1 < I_2 < I_3$ D) $I_2 > I_1 = I_3$

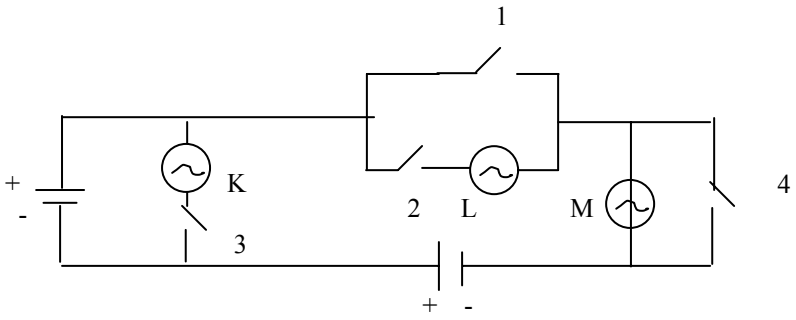
5.



Yukarıdaki şekilde K, L, M, N harfleriyle gösterilen ampullerden hangisi çıkarıldığında, bütün ampullerin parlaklığı aynı olur?

A) K B) L C) M D) N

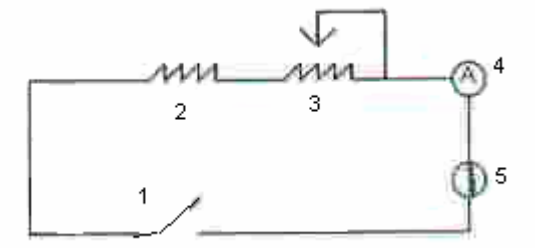
6.



Yalnız L lambasının yanması için hangi anahtar veya anahtarlar kapatılmalıdır?

A) Yalnız 2 B) Yalnız 4 C) 1-4 D) 2-4

7.



Yukarıdaki devre şemasında (1) ve (5) sayıları hangi devre elemanlarını gösterir?

	1	5
A)	Anahtar	Ampermetre
B)	Anahtar	Ampul
C)	Ampul	Anahtar
D)	Ampermetre	Anahtar

8.

I II

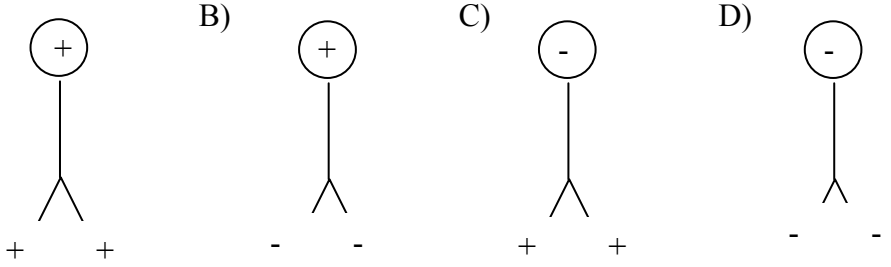
(Yüklü X Elektroskopu) (Yüklü Y Elektroskopu)

Yüklü bir A çubuğu şekil–1' deki yüklü bir X elektroskopuna yaklaştırıldığında elektroskopun yaprakları daha fazla açılıyor. Aynı çubuk şekil-2'deki yüklü Y elektroskopuna yaklaştırıldığında yaprakları kapanıyor. Elektroskopların ve A çubuğunun yüklerinin işaretleri aşağıdakilerden hangisi olabilir?

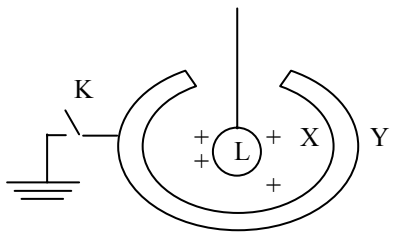
	A	X Elektroskopu	Y Elektroskopu
A)	-	+	-
B)	-	-	-
C)	+	+	+
D)	+	+	-

9. Negatif yüklü bir çubuk yüksüz bir elektroskopun topuzuna yaklaştırılırsa, elektroskoptaki yük dağılımı aşağıdakilerden hangisi olur?

A) B) C) D)



10. Nötr kürenin içine (+) yüklü L küresine sarkıtılıyor. K anahtarı kısa bir sure kapatılıp tekrar açılıyor. L küresi hiçbir yere dokunmadan geri çıkılınca, X ve Y bölgelerinin yükü için ne söylenebilir.



	X	Y
A)	+	-
B)	-	+
C)	O	-
D)	-	0

11. Bir insanda başlangıçta beynin daha sonar omuriliğin yönettiği iş aşağıdakilerden hangisi olabilir?

A) İsteyerek gözlerini kapalı tutma B) Düşerken bir yere tutunma

C) Bir yiyeceğin tadını alma D) Müzik eşliğinde, dans etme

12. I. İris
II. Kornea
III. Sarı Benek
IV. Kör nokta

Yukarıdakilerden hangileri gözün ağ tabakasında bulunur?

A) I-II B) I-III C) II-IV D) III-IV

13. Aşağıdakilerden hangisi iskeletin görevi <u>değildir?</u>

A) Vücuda desteklik yaparak biçim verir.
B) İç organları dış etkenlere karşı korur.
C) Besinleri kana geçebilecek hale getirir.
D) Alyuvarların ve bazı akyuvarların yapımını sağlar.

14. Aşağıdakilerden hangisi doğrudur?

	Uzun Kemik	Kısa kemik	Yassı kemik
A)	Uyluk	Bilek	Kürek
B)	Omurlar	Ön kol	Baldır
C)	Dirsek	Kaval	Üst kol
D)	Üst çene	Baldır	Kaval

15. Çizgili kasların özellikleri ile ilgili olarak aşağıdakilerden hangisi <u>yanlıştır</u>?

A) Sindirim, dolaşım ve boşaltım sistemindeki organların yapısında bulunur.
B) Hızlı kasılıp gevşerler.
C) Kırmızı renklidir.
D) İsteğimizle çalışırlar.

16. Gelişmiş organizmalarda vücudu oluşturan yapılar büyükten küçüğe doğru sıralanırsa hangi sıralama doğru olur?

A) doku-sistem-organ-hücre B)hücre-doku-organ-sistem
C) organ-doku-hücre-sistem D)sistem-organ-doku-hücre

17. Aşağıdakilerden hangisi iskeletin görevi değildir?

A) vücuda desteklik yaparak biçim verir
B)iç organları etkilere karşı korur
C) besinleri kana geçebilecek hale getirir
D) alyuvarların ve bazı akyuvarların yapımını sağlar

18. Aşağıdaki kemiklerden hangisi kısa kemiklere örnektir?

A) pazı B) kaval C) leğen D) parmak

19. Aşağıdakilerden hangisi doğrudur?

A) uyluk-bilek-kürek
B)omurlar-ön kol-baldır dirsek-kaval-üst kol
C) dirsek-kaval-üst kol
D) üst çene-baldır-kaval

20. Vücudumuzda eklemler, hareket yeteneklerine göre azdan çoğa doğru nasıl sıralanır?

A) omuz eklemi-kafatası eklemleri-omurlar arası eklem
B) kafatası eklemi-omurlar arsı eklem-omuz eklemi
C) omurlar arası eklem-kafatası eklemleri-omuz eklemi
D) omuz eklemi-omurlar arası eklem-kafatası eklemleri

21. İskeleti oluşturan kemiklerin birbirine bağlandığı yere ne denir?

A) periost B) eklem C) lif D) tendon

22. Çizgili kasların özellikleri ile ilgili olarak aşağıdakilerden hangisi yanlıştır?

A) sindirim, dolaşım ve boşaltım sistemindeki organların yapısında bulunur
B) hızlı kasılıp gevşerler
C) kırmızı renklidir
D) isteğimizle çalışırlar

23. Düz kaslarla ilgili verilen bilgilerden hangisi doğrudur?

A) kemiğin aşınmasını önler
B) kalbin yapısında bulunur
C) isteğimiz dışında hareket ederler
D) kol ve bacaklarda bulunur

24. Akciğerle alınan oksijen en son hangi yapıda kullanılır?

A) mitokondri
B) alveol
C) nefron
D) alyuvarların ve bazı akyuvarların yapımını sağlar

25. Aşağıdakilerden hangisi soluk verme sırasında gerçekleşir?

A) diyafram kası kasılır
B) kaburga kasları kasılır
C) alveollere oksijen alınır
D) akciğerler daralır

26. Akciğerlerde, oksijenin karbondioksit ile yer değiştirmesi hangilerinin arasında olur?

A) Alveol – atardamar
B) Bronşçuk - toplardamar
C) Alveol – kılcal damar
D) Bronş - kılcal damar

27. Solunum olayının gerçekleşme sırası aşağıdaki seçeneklerin hangisinde doğru olarak verilmiştir?

A) burun-bronş-alveol-gırtlak-soluk borusu
B) bronş-gırtlak-burun-soluk borusu-alveol
C) burun-gırtlak-soluk borusu-bronş-alveol
D) gırtlak-burun-soluk borusu-alveol-bronş

28. Vücut hücrelerinde kirlenmiş olan kan, toplardamarlarla vasıtasıyla kalbin hangi odacığına gelir?

A) sağ karıncık
B) sol kulakçık
C) sağ kulakçık
D) sol karıncık

29. Kan dolaşımı ile ilgili olarak aşağıdakilerden hangisi doğrudur?

A) akciğer atardamarı, temiz kanı kalbin sol karıncığına getirir
B) temizlenmiş olan kan, akciğer atardamarı ile kalbin sol kulakçığına gelir
C) vücut hücrelerinde kirlenmiş olan kan, toplardamar yoluyla akciğere gelir
D) kalbin sol karıncığındaki temiz kan, akciğer toplardamarı ile vücuda yayılır.

30. Aşağıdakilerden hangisi, kalbin sağ karıncığındaki kirli kanı akciğere getirir?

A) akciğer atardamarı, temiz kanı kalbin sol karıncığına getirir
B) akciğer toplardamarı
C) aort atardamarı
D) alt ana toplardamarı

31. Aşağıdakilerden hangisi temiz kan taşır?

A) akciğer toplardamarı
B) üst ana toplardamarı
C) alt ana toplardamarı
D) akciğer atardamarı

32. Kirli kan, akciğerlerde temizlendikten sonra kalbin hangi odacığına gelir?

A) sağ kulakçığa
B) sol kulakçığa
C) sağ karıncığa
D) sol karıncığa

33. Sağ kulakçık gevşerse kalbimiz nasıl çalışır?

A) temiz kan sağ karıncığa geçer
B) kirli kan sol karıncığa geçer
C) sağ kulakçığa kirli kan gelir
D) sol kulakçıktan akciğerlere kirli kan gelir

34. Aşağıda verilen eşleştirmelerden hangisi yanlıştır?
A) yağ-ince bağırsak
B) nişasta-ağız, ince bağırsak
C) protein-mide, ince bağırsak
D) madensel tuz-mide

35. Aşağıdakilerden hangisi proteinlerin sindirimi sonucunda meydana gelir?

A) gliserin
B) aminoasit
C) glikoz
D) nişasta

36. Protein sindirimi nerde olur?
A) sadece ince bağırsakta
B) sadece midede
C) ağızda başlar, midede biter
D) midede başlar, ince bağırsakta biter

37. Sindirilmiş besinlerin kana geçmesini sağlayan timürler nerede bulunur?
A) ince bağırsakta
B) midede
C) karaciğerde
D) yemek borusunda

38. İnsan vücudunda karbonhidratların sindirimi nerede tamamlanır?
A) midede
B) ağızda
C) ince bağırsakta
D) kalın bağırsakta

39. Boşaltım sistemi aşağıdakilerden hangilerinin dışarı atılmasını sağlar?
I. Karbondioksit
II. Ürik asit
III. Üre

A) yalnız III
B) I-II
C) II-III
D) I-II-III

40. Üre ve ürik asit hangi maddenin parçalanmasında oluşur?

A) yağ
B) nişasta
C) şeker
D) protein

41. İdrarın oluşumundan sonra dışarı atılmasına kadar geçtiği yollar hangi seçenekte doğru sırasıyla verilmiştir?

A) idrar kanalı-idrar torbası-havuzcuk
B) idrar torbası-idrar kanalı-havuzcuk
C) havuzcuk-idrar kanalı-idrar torbası
D) idrar torbası-havuzcuk-idrar kanalı

42. Aşağıdakilerden hangisi nöronun kısımlarından değildir?

A) akson
B) hücre çekirdeği
C) dendrite
D) hücre duvarı

43. Çevredeki uyartıların sinir merkezlerine iletilmesini sağlayan sinirlere ne ad verilir?

A) duyu siniri
B) hareket siniri
C) ara sinir
D) merkezi sinir

44. Aşağıdakilerden hangisi kasların uyumlu çalışmasını ve dengeyi sağlayan merkezdir?

A) beyincik
B) beyin
C) omurilik
D) Omurilik soğanı

45. Düşünmeden otomatik olarak yaptığımız hareketleri sinir sistemimizdeki hangi merkez kontrol eder?

A) beyin
B) omurilik
C) beyincik
D) omurilik soğanı

46. Bir insanda başlangıçta beynin daha sonra omuriliğin yönettiği iş aşağıdakilerden hangisi olabilir?

A) isteyerek gözlerini kapalı tutma
B) düşerken bir yere tutunma
C) bir yiyeceğin tadını alma
D) müzik eşliğinde, bildiği bir dansı yapmak

47 I. İris II. Kornea III. Sarı benek IV.Kör nokta
Yukarıdakilerden hangileri gözün ağ tabakasında bulunur?

A) I – II B) I - III
C) II – IV D) III - IV

48. Görüntü, gözün hangi bölümünde oluşur?
A) İris B) Sarı leke
C) Sert tabaka D) Göz merceği

49. Seslerin toplandığı ve sinirlere aktarıldığı yerler hangi seçenekte doğru olarak verilmiştir?

A) Kulak kepçesi - Salyangoz B) Oval pencere - Kulak yolu
C) Kulak zarı – Dalız D) Dalız - Yarım daire kanalları

50. Aşağıdaki yapılardan hangisi orta kulakta bulunmaz?

A) Çekiç B) Örs
C) Üzengi D) Salyangoz

51. Kulak yapısını oluşturan kısımlardan hangisi işitme ile ilgili değildir?

A) Salyangoz B) Kulak zarı
C) Yarım daire kanalları D)Çekiç, örs, üzengi kemikleri

52. Kulağın dengemizi sağlamada görevli kısmı, aşağıdakilerden hangisidir?

A) Yarım daire kanalları B) Çekiç, örs, üzengi kemikleri
C) Salyangoz D) Kulak zarı

53. Kulağımızın hangi kısmı, oval pencere yoluyla gelen ses dalgalarını salyangoza iletir?

A) Yarım daire kanalları B) Östaki borusu
C) Üzengi kemiği D) Dalız

54. Basınçtan dolayı kulak zarında meydana gelen değişiklikler hangi yapı tarafından ayarlanır?

A) Salyangoz B) Oval pencere
C) Östaki borusu D) Yarım daire kanalları

55. Aşağıdakilerden hangisi derinin görevlerinden değildir?

A) Solunuma yardımcı olmak B) Kan dolaşımını düzenlemek
C) Vücut sıcaklığını ayarlamak D) Vücudu dış etkilerden korumak

56. I . Bitkiyi toprağa bağlamak II. Yapraklara su iletmek III. Topraktan su ve suda çözünmüş mineralleri almak
Yukarıdakilerden hangisi ya da hangileri kökün görevi değildir?

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

57. Kökün üzerindeki emici tüylerin görevi, aşağıdakilerden hangisidir?

A) Bitkiyi toprağa bağlar
B) Kökün uzamasını ve kalınlaşmasını sağlar
C) Topraktaki su ve suda erimiş maddeleri alırlar
D) Gelişerek başka kökleri meydana getirir

58. Aşağıdakilerden hangisi saçak köktür?

A) Soğan
B) Fasulye
C) Nohut
D) Havuç

59. Aşağıdakilerden hangisi gövdenin görevi değildir?

A) Bitkinin dik durmasını sağlamak
B) Su ve madensel tuzları yapraklara iletmek
C) Dal, yaprak ve çiçekleri taşımak
D) Terlemeyi sağlamak

60. Aşağıdaki "bitki-gövde" eşlemelerinden hangisi yanlıştır?

A) Fasulye – Sarılıcı
B) Çam - Odunsu
C) Çilek – Sürünücü
D) Kabak - Odunsu

61. Aşağıdaki bitkilerden hangisinin gövdesi dik durmayıp toprakta süründüğü için sürünücü gövde adını alır?

A) Çilek
B) Soğan
C) Patates
D) Maydanoz

62. Aşağıdakilerden hangisi yaprağın görevi değildir?

A) Terleme
B) Tozlaşma
C) Solunum
D) Fotosentez

63. Yaprakta gaz alışverişini sağlayan yapı aşağıdakilerden hangisidir?

A) Yaprak kını
B) Rizoid
C) Stoma
D) Yüksük

64
I. Su II. Oksijen III. Karbondioksit IV. Organik madde V. Güneş ışığı
Yeşil bitkiler besin yaparken yukarıdakilerden hangisini kullanır?

A) I ve III
B) I, III ve V
C) II ve V
D) III, IV ve V

65. Yüksek yapılı yeşil bir bitki aydınlık ortamdan karanlık ortama bırakıldığında, bitkide bir süre sonra aşağıdakilerden hangisinin olması beklenir?

A) Klorofil maddesinin azalması
B) Beslenme şeklinin değişmesi
C) Karbondioksit kullanımının artması
D) Karbondioksit çıkışının azalması

66. Karbondioksit+ X

A) Enerji – Su
B) Su - Oksijen
C) Oksijen – Su
D) Su - Enerji

67. Aşağıdakilerden hangisi çiçeğin erkek organında bulunur?

A) Yumurta
B) Taç yaprak
C) Polen
D) Spor kesesi

68. Aşağıdakilerden hangisi çiçeksiz bitkidir?

A) Arpa
B) Buğday
C) Fındık
D) Eğrelti otu

69. Eşeysiz ve eşeyli üremenin düzenli olarak birbirini izlemesine ne ad verilir?

A) Sporlanma
B) Döl almaşı
C) Tomurcuklanma
D) Tozlaşma

70. Tozlaşma sonunda çiçek tozları hangi kısma gelir?

A) Dişicik tepesine
B) Dişicik borusuna
C) Erkek organa
D) Yumurtalığa

71. Polen nedir?

A) Dişi üreme hücresi
B) Bitki taslağı
C) Erkek üreme hücresi
D) Yumurta

72. Hem hayvan hem bitki hücrelerinde bir arada bulunmayan organeller hangileridir?

A) Sentrozom - Kloroplast - Hücre Duvarı
B) Sentrozom - Hücre zarı - Çekirdekçik
C) Sitoplazma - Koful - Çekirdek
D) Sitoplazma - Koful - Ribozom

73. Yapısında Sentrozom bulunduran bir hücrede aşağıdakilerden hangisi bulunmaz?

A) Çekirdek
B) Plastit
C) Hücre zarı
D) Lizozom

74. Kas ve böbrek hücreleri görevlerini yapabilmek için çok fazla enerji üretirler. Buna göre bu hücrelerde hangi organel çok sayıda bulunmaktadır?

A) Lizozom
B) Endoplazmik retikulum
C) Ribozom
D) Mitokondri

75. Aşağıdakilerden hangisi hücre zarının özelliği değildir?

A) Canlı olma
B) Esnek olma
C) Tam geçirgen olma
D) Saydam olma

76. Bitkilerdeki salgı dokusu, çeşitli bitkilerde farklı işlevler gerçekleştirilmektedir? Buna göre, aşağıdakilerden hangisi salgı dokusunun bitkilerdeki görevlerinden değildir?

A) Böcekçil bitkilerde sindirime yardımcı olabilir.
B) Tozlaşmayı kolaylaştırabilir.
C) Bitkiyi çürükçül canlılardan koruyabilir.
D) Topraktan su ve mineralleri emer

77. Aşağıdaki dokulardan hayvansal doku değildir?

A) Epitel doku
B) Meristem doku
C) Kan doku
D) Kas doku

78. Aşağıdakilerden hangisinin hareket etmesi elektrik akımının oluşmasına neden olur?

A) Atom
B) Elektron
C) Madde
D) Proton

79. Elektrik akımının yönü nasıldır?

A) (+)'dan (-)'ye doğrudur
B) (+)'dan (+)'ya doğrudur
C) (-)'den (+)'ya doğrudur
D) (-)'den (-)'ye doğrudur

80. Bir iletkenin uçları arasındaki potansiyel farkını ölçen araç hangisidir?

A) Ampermetre
B) Voltmetre
C) Reosta
D) Direnç

81. Bir iletkenin direnci aşağıdakilerden hangisine bağlı değildir?
A) Cinsine
B) Boyuna
C) Kesitine
D)Şekline

82. Aşağıdaki özellikleri verilen tellerden direnci en büyük olan hangisidir?

A) Kesiti 2 mm olan
B) Kesiti 1 cm olan
C) Kesiti 1 mm olan
D) Kesiti 2 cm olan

83. Aşağıdaki araçlardan hangisi devreye seri bağlanmaz?

A) Direnç
B) Ampermetre
C) Ampul
D) Voltmetre

84. Reosta ne işe yarar?

A) Akım şiddetini değiştirir
B) Devreyi açıp kapatır
C) Potansiyel farkı değiştirir
D) Elektrik enerjisini kimyasal enerjiye çevirir

85. 20 tane 1,5 V'luk pili paralel bağlarsak kaç volt elde edilir?

A) 0,07 V
B) 1,5 V
C) 20 V
D) 30 V

86. Elektrik devresinde özdeş 3 direnç nasıl bağlanırsa direnç artar?

A) Paralel
B) Seri
C) Karışık
D) Direncin değeri değişmez

87. Bir iletkenin iki ucu arasındaki potansiyel farkı sabit kalmak şartıyla devreye paralel bir direnç eklenirse devrede dolanan akım şiddeti ne olur?

A) Artar
B) Azalır
C) Aynı kalır
D) Hesaplanamaz

88. Bir iletkenin iki ucu arsındaki potansiyel farkı 220 volt olmak kaydıyla iletkenin direnci 2 katına çıkarsa devrede dolanan akım şiddeti ne olur?

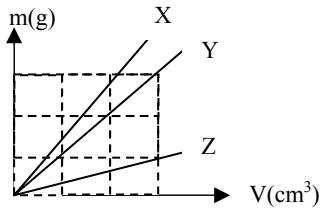
A) 4 kat azalır
B) 4 kat artar
C) Yarıya iner
D) 2 kat artar

89. Paralel bağlı pillerin sayısını artırmakla devrede bulunan ampulün parlaklığı nasıl olur?

A) Artar
B) Azalır
C) Söner
D) Değişmez

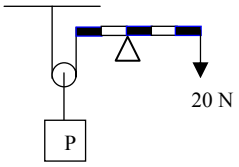
8. SINIF ERİŞİ SORULARI

1. Grafikte X, Y ve Z maddelerinin kütle-hacim ilişkisi gösterilmiştir. Maddelerin yoğunlukları d_x, d_y ve d_z arasındaki doğru sıralama aşağıdakilerden hangisidir?



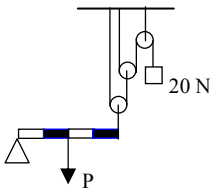
A) $d_x = d_y > d_z$ B) $d_x > d_y > d_z$ C) $d_y > d_z > d_x$ D) $d_z > d_y > d_x$

2. Makara ve çubuğun ağırlığı önemsizdir. Bu sistemi dengeleyen P yükü kaç N dur?



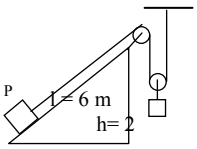
A) 15 B) 30 C) 60 D) 120

3. Şekildeki sistemi dengeleyen P yükü kaç N olur ? (Makaralar ve çubuk ağırlıksızdır)



A) 40 B) 80 C) 160 D) 320

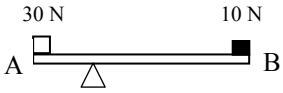
4.



Şekildeki 20 N ağırlığındaki cismi dengeleyen P yükü kaç N dur ?

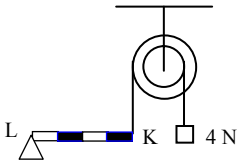
A) 30 B) 40 C) 60 D) 120

5. Şekildeki ağırlıksız çubuk dengededir. Cisimler yer değiştirildiğinde A ucuna eklenmesi gereken ağırlığı kaç N olur ?



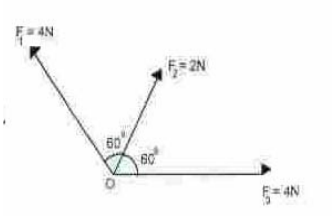
A) 20 B) 30 C) 60 D) 80

6. Şekildeki sistem dengede olduğuna göre homojen KL çubuğunun ağırlığı kaç N dur ?



A) 2 B) 4 C) 6 D) 8

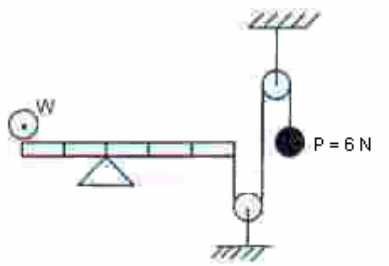
7.



Şekildeki O noktasına etki eden kuvvetlerin bileşkesi kaç N dur ?

A) 5 B) 6 C) 8 D) 10

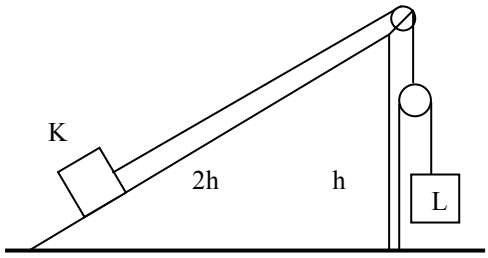
8.



Şekildeki sistem dengede olduğuna göre, W yükü kaç N dur ?

A) 2 B) 6 C) 9 D) 18

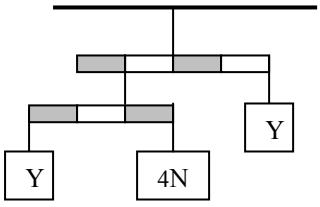
9.



Şekildeki system dengededir. Buna göre cisimlerin ağırlıkları oranı K/L nedir?

A) 1 B) 2 C) 3 D) 4

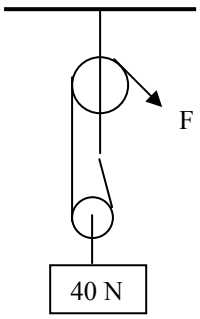
10.



Eşit bölmeli çubuklar ağırlıksız ve system dengede olduğuna gore, X/Y oranı nadir?

A) 4/10 B) 2/3 C) 3/2 D) 10/4

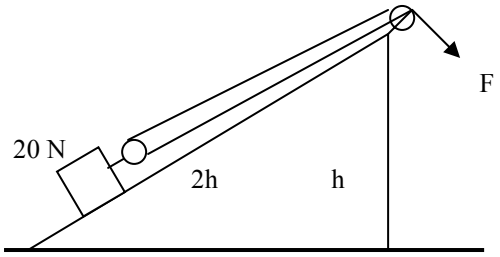
11.



Şekildeki sistemde makara ağırlığı 10 N ve yük 40 N dur. Sistemi dengeleyen F kuvveti kaç N dur ?

A) 20 B) 25 C) 40 D) 50

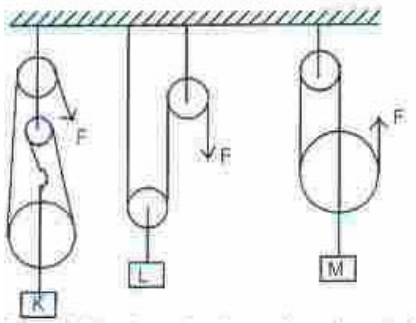
12.



Şekildeki düzenekte 20 N'luk cismi, sabit hızla yukarı çeken F kuvveti kaç N olur ?

A) 5 B) 10 C) 15 D) 20

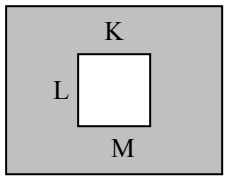
13.



Şekildeki sistemlerde makaralar ağırlıksız, sürtünmeler önemsizdir. K, L ve M yükleri üç ayrı sistemde eşit F kuvvetiyle dengeleniyor. Buna göre yüklerin büyüklükleri arasında nasil bir bağıntı vardır ?

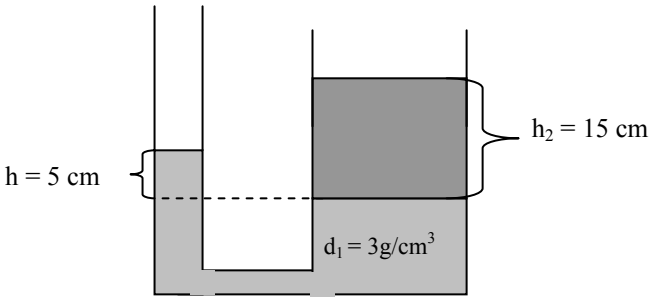
A) K>L>M B) K=M>L C) K>L=M D) K=L=M

14. Su içinde bulunan cismin K, L, M noktalarına etki eden basınçların büyükten küçüğe doğru sıralanışı aşağıdakişlerden hangisidir ?



A) K, L, M B) L, M, K C) M, L, K D) M, K, L

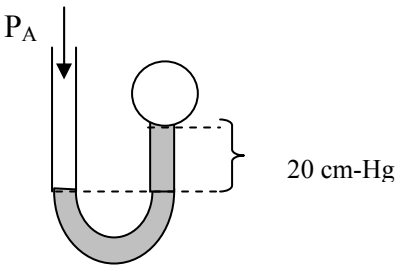
15.



d_1 ve d_2 özkütleli sıvılar şekildeki gibi dengededir. Sıvılardan eşit hacimlerde alınarak yapılan karışımın özkütlesi kaç g/cm^3 olur?

A) 1 B) 2 C) 3 D) 5

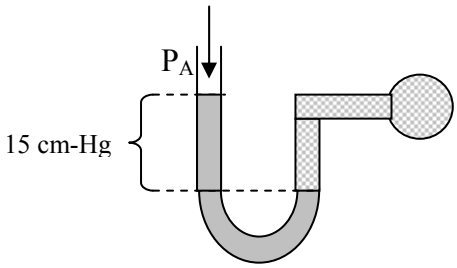
16.



Aaçık hava basıncının 70 cm-Hg olduğu bir yerde, gazın basıncı kaç cm-Hg olur?

A) 20 B) 50 C) 70 D) 90

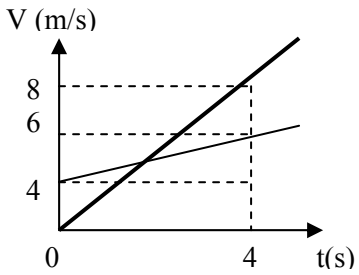
17.



Açık hava basıncının 70 cm-HG olduğu yerde gazın basıncı kaç cm-Hg olur?

A) 15 B) 55 C) 70 D) 85

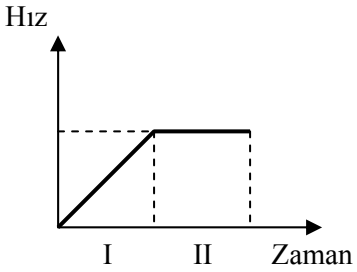
18.



Yan yana iken harekete geçen K ve L hareketlilerine ait hiz-zaman grafiği şekilde verilmiştir. Bu iki aracın 4 sn sonra birbirlerine göre durumları aşağıdakilerden hangisidir?

A) K, L'den 2 m. öndedir.
B) K, L'den 4 m. öndedir.
C) K ve L aynı hizadadır.
D) L, K'dan 4 m. öndedir.

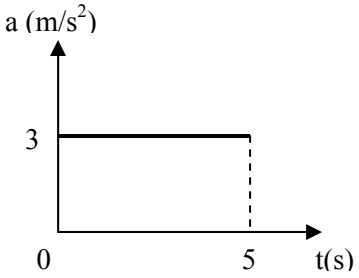
19.



Bir cismin hız zaman grafiği şekildeki gibidir. Buna göre, cisim I. ve II. Zaman aralıklarında nasıl hareket etmektedir?

	I	II
A)	Hızlanan	Sabit Hızlı
B)	Yavaşlayan	Sabit Hızlı
C)	Sabit Hızlı	Hızlanan
D)	Hızlanan	Yavaşlayan

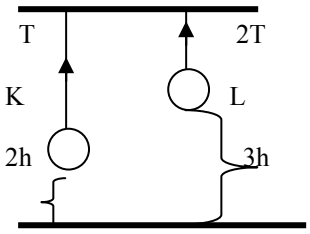
20. İlk hızı 30 m/s olan bir hareketlinin ivme – zaman grafiği şekildeki gibidir. t = 5 saniye sonunda hareketlinin hızı kaç m/s olur?



A) 3
B) 5
C) 15
D) 45

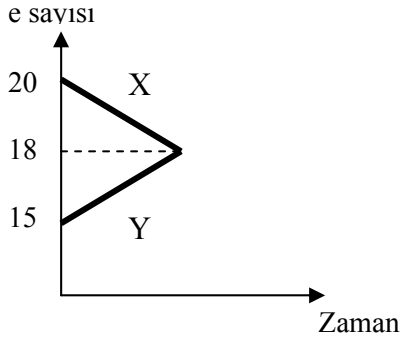
21.

K v e L cisimlerinin asıldıkları iplerdeki gerilme kuvvetleri sırasıyla T ve 2T dir. **K cisminin yere göre potansiyel enerjisi E olduğuna göre, L cisminin potansiyel enerjisi kaç E dir?**



A) 1 B) 2 C) 3 D) 4

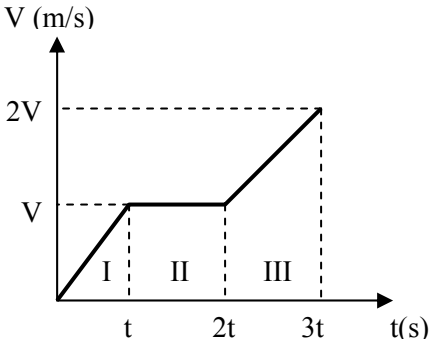
22.



X ve Y elementleri bileşik oluştururlar. Zamanla e sayıları yukarıdaki gibi değişmektedir. Buna göre bileşiğin molekül formülü aşağıdakilerden hangisidir?

A) Y_2X_3 B) X_2Y_3 C) Y_3X_2 D) X_3Y_2

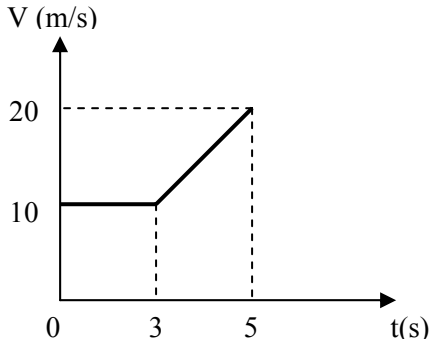
23.



V – t grafiği şekildeki gibi olan bir cisim için, aşağıdakilerden hangisi doğrudur ?

A) Cisim hareketi boyunca hızlanmıştır.
B) Cisme II. bölgede etki eden kuvvet sıfırdır.
C) Cisim I. ve II. bölgede yavaşlamıştır.
D) Cisme III. bölgede etki eden kuvvet en büyüktür.

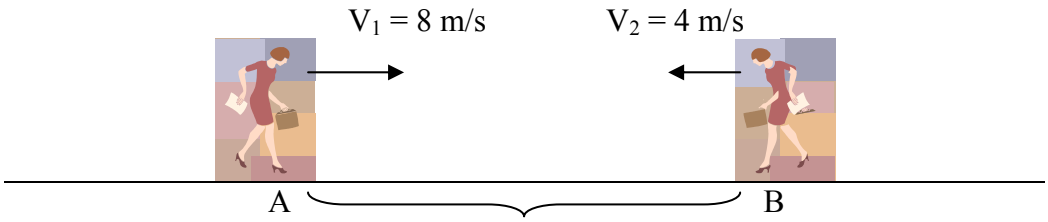
24.



Hız zaman grafiği şekildeki gibi olan bir cisim, 5 saniye sonunda kaç metre yol alır ?

A) 30 B) 50 C) 60 D) 70

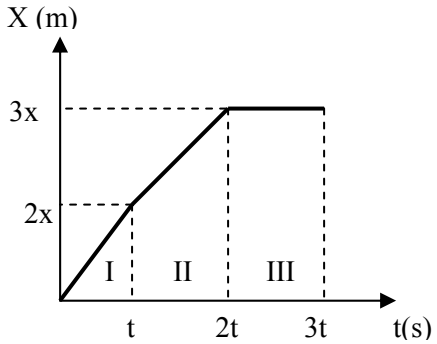
25.



Aralarındaki uzaklık 120 m olan iki kişi birbirine doğru 8 m/s ve 4 m/s sabit hızla koşmaya başlıyorlar. Koşucular A noktasından kaç m ileride karşılaşırlar?

A) 80 B) 40 C) 30 D) 10

26.

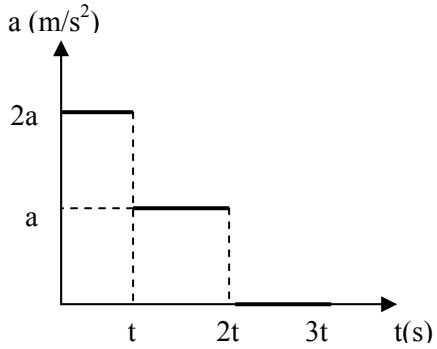


Konum zaman grafiği şekildeki gibi olan araç için, aşağıdakilerden hangisi doğrudur?

A) I. Bölgede düzgün hızlanır. B) II. Bölgede düzgün yavaşlar

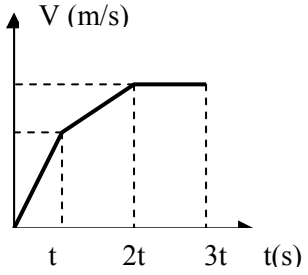
C) II. Bölgede düzgün hızlanır. D) III. Bölgede duruyor.

27.

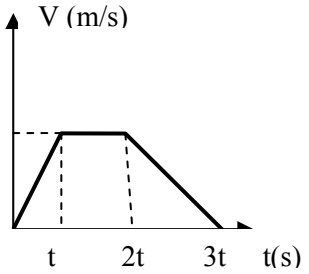


Dururken bir kuvvet etkisinde harekete başlayan cismin ivme – zaman grafiği şekildeki gibidir. Bu cismin hız zaman grafiği aşağıdakilerden hangisidir?

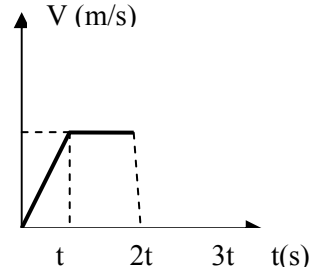
A)



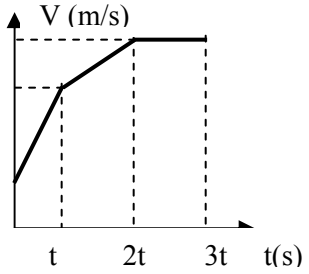
B)



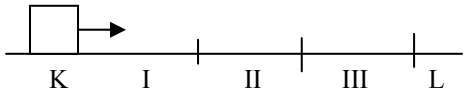
C)

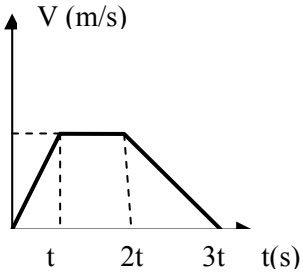


D)



28.

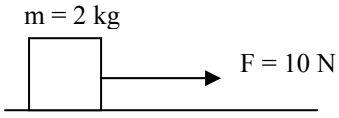




Bir cisim F kuvvetiyle KL yolu boyunca çekiliyor. Cismin hız – zaman grafiği şekildeki gibi olduğuna göre, yolun hangi bölümleri kesinlikle sürtünmelidir?

A) Yalnız I B) Yalnız II C) I-II D) II ve III

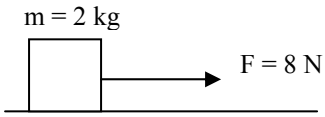
29.



Sürtünme katsayısının 0,1 olan yüzeyde, 2 kg kütleli cisim, 10 N'luk kuvvetle çekiliyor. Cismin ivmesi kaç m/s^2 dir?

A) 1 B) 3 C) 4 D) 5

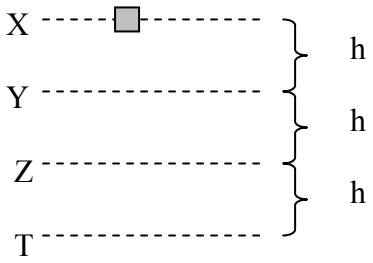
30.



Sürtünmesiz yatay yüzeyde duran 2 kg kütleli cisim, 8 N'luk yatay kuvvetin etkisi ile 10 saniye hareket ediyor. Bu sürenin sonunda cismin hızı kaç m/s olur?

A) 16 B) 20 C) 36 D) 40

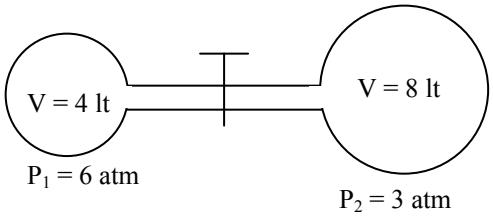
31.



Bir cisim 3h yükseklikteki X noktasından serbest bırakılıyor. Cismin Y noktasındaki kinetik enerjisi E_Y, Z noktasındaki kinetik enerjisi E_Z olduğuna göre E_Y / E_Z oranı nedir?

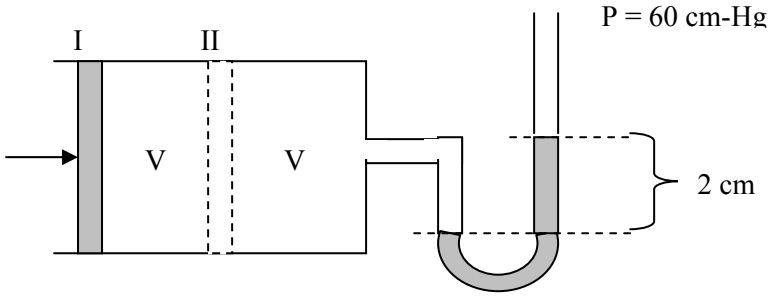
A) 1 B) 2 C) 1/2 D) ¼

32. Sabit sıcaklıktaki sistemdeki musluk açılınca, gaz karışımının son basıncı kaç atm olur?



A) 4 B) 26 C) 12 D) 24

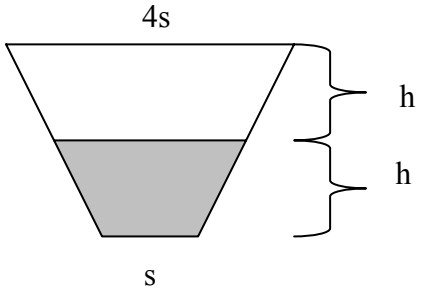
33.



Piston I konumundayken, cıva seviyeleri arasındaki fark 2 cm dir. Piston F kuvveti ile itilerek II konumuna getiriliyor. Bu durumda cıva seviyelerindeki yeni fark kaç cm olur?

A) 60 B) 64 C) 124 D) 184

34.



Şekildeki gibi duran kabın her tarafı kapalıdır. Suyun tabana yaptığı basınç P_1, kabın yere yaptığı basınç P_2 dir. Kap üst yüzü alta gelecek biçimde çevrildiğinde, tabandaki P_1, P_2 basınçları için aşağıdakilerden hangisi doğru olur?

	P_1	P_2
A)	Azalır	Azalır
B)	Artar	Artar
C)	Azalır	Artar
D)	Artar	Azalır

35. Aşağıdakilerden hangisi 1A grubunun (Alkali Metal) özelliği değildir?

A) Isı ve elektriği iletirler
B) Özkütleleri azdır
C) Kararlı yapıdadır.
D) (+1) değerlikli iyon halinde bileşik oluştururlar.

36. Aşağıdakilerden hangisi 8A grubunun (Soygaz) özelliğidir?
A) Özkütleleri azdır.
B) Isı ve elektriği iyi iletirler
C) Renksiz gazdırlar
D) Son yörüngelerinde 1 elektron bulunur.

37. Hacmi 9 cm3 olan bir alüminyum parçasının kütlesi 24,3 gramdır. Buna göre, alüminyumun özkütlesi kaç gr/cm3tür?

A) 2,7
B) 3
C) 3,2
D) 3,5

38. Bir dereceli silindirde 100 cm3 su bulunmaktadır. Kap içine her birinin kütlesi 12 gram olan özdeş bilyelerden 10 tane bırakılınca su düzeyi 140 cm3 çizgisine çıkıyor. Bilyelerin özkütlesi kaç gr/cm3tür?

A) 1,2
B) 2
C) 3
D) 3,5

39. Gümüş metalinin özkütlesi 10,5 g/cm3tür. Buna göre 20 cm3 metalin kütlesi kaç gram olur?
A) 100
B) 105
C) 190
D) 210

40. $_{17}X^{-1}$ ve $_{20}Y^{a}$ iyonlarının elektron sayıları birbirine eşittir. Y iyonunun yükü (a) kaçtır?

A) 4
B) 2
C) -2
D) -4

41. $_{19}X^{+1}$ iyonu ile Y^{-4} iyonları eşit sayıda elektron içerdiğine göre Y'nin atom numarası kaçtır?
14

A) 16
B) 18
C) 22
D) 14

42. Çamaşır sodası, yemek tuzu, naftalin ve kum yeterli miktarda su ile karıştırılıyor.

I. Süzgeç kağıdından geçirme
II. Süzgeç kağıdından geçen karışımı buharlaştırma işlemlerinden geçiriliyor.

I . işlem sonucunda süzgeç kağıdında ve II. işlem sonunda ısıtma kabında hangi maddeler kalır?

	I	II
A)	Çamaşır sodası, yemek tuzu	Naftalin, kum
B)	Çamaşır sodası, naftalin	Yemek tuzu, kum
C)	Naftalin, kum	Yemek tuzu
D)	Naftalin, kum	Çamaşır sodası, yemek tuzu

43. Seyreltik şekerli su çözeltisini derişik hale getirmek için aşağıdakilerden hangisi yapılamaz?

A) Çözeltiyi kaynatmak
B) Çözücü miktarını azaltmak
C) Çözünen miktarını arttırmak
D) Çözücü miktarını artırmak

44. Tuzlu su nasıl bir maddedir?

A) Süspansiyon
B) Derişik
C) Bileşik
D) Emülsiyon

45 I. Demirin paslanması II. Isıtılan telin boyunun uzaması III. Odunun kırılması IV. Suyun donması V.Tuzun suda erimesi
Yukarıdaki olaylardan hangisi yada hangilerinde madde kimyasal değişime uğramıştır?

A) Yalnız I
B) Yalnız III
C) I, IV, V
D) II, IV, V

46. Aşağıdakilerden hangisi sadece katı maddelerin özelliklerindendir?

A) Yapısını oluşturan taneciklerin serbestçe hareket etmesi
B) Sabit hacimlerinin olması
C) Yapısının atomlardan meydana gelmesi
D) Yapısını oluşturan taneciklerin birbirine sıkıca bağlı olması

47. Aşağıdakilerden hangisi gazların ve sıvıların ortak özelliğidir?

A) Bulunduğu kabı tamamen doldurma
B) Bulunduğu kabın şeklini alma
C) Belirli bir hacme sahip olma
D) Belirli bir şekle sahip olma

48. Aşağıdakilerden hangisi çözelti değildir?

A) Hava
B) Su ve tebeşir tozu karışımı
C) Şekerli su
D) Tuzlu su

49. Metal karışımlarına ne ad verilir?

A) Bileşik
B) Alaşım
C) Emülsiyon
D) Süspansiyon

50. Özdeş iki demir telden biri toz haline getirilirse, demir tel ile demir tozunun hangi özelliği birbirinden farklı olur?

A) Erime sıcaklıkları
B) Özkütleleri
C) Şekilleri
D) Kütleleri
51. Aşağıdaki ifadelerden hangisi yanlıştır?

A) Heterojen karışımlardaki her bir bölgenin özkütle ve molekül yapısı aynıdır?
B) Buzlu - su heterojen karışımdır.
C) Homojen karışımlar saydamdır ve süzüldüklerinde artık bırakmazlar.
D) Hava homojen karışımdır.

52. Kükürt, yemek tuzu, şeker ve demir tozundan oluşmuş karışımı bileşenlerine ayırmak için, aşağıdaki işlemlerin hangi sırasıyla yapılması en uygun olur? I. Suda çözerek süzme II. Tuzu çözen, şekeri çözmeyen bir sıvı karıştırıp sıvıyı buharlaştırma III. Karışıma mıknatıs yaklaştırma IV. Süzüntüyü buharlaştırma

A) III, II, IV,I
B) II, IV, I, III
C) III, I, IV, II
D) III, II, I, IV

53. Bir elementin iki izotop atomu için aşağıdaki ifadelerden hangisi kesinlikle doğrudur?

A) Nötron ve elektron sayıları aynıdır.
B) Nötron ve proton sayıları aynıdır
C) Proton sayıları aynıdır
D) Elektron ve proton sayıları aynıdır.

54. Atom numarası 9 olan X atomu ile atom numarası 12 olan Y atomlarının iyon hallerinde elektron sayılarının eşit olduğu iyon türü aşağıdakilerden hangisidir?

A) X^{+5}, Y^{-2}
B) X^{-5}, Y^{+2}
C) X^{-3}, Y^{+2}
D) X^{-1}, Y^{+2}

55. 2 kg kütleli bir cismin hızını 2 m/s'den 10 m/s'ye çıkarmak için cisme gereken enerji kaç joule'dür?

A) 6 B) 24 C) 96 D) 144

56. Durmakta olan iki araç aynı anda harekete başlamıştır. Bu iki araçtan birincisi t kadar süre sonra ikincisinden 2 kat daha fazla hız kazandığına göre birinci aracın ivmesinin, ikinci aracın ivmesine oranı aşağıdakilerden hangisidir?

A) 2 B) ½ C) ¼ D) 4

57. Bir cisim bulunduğu yerden 10 m yükseğe çıkarıldığında potansiyel enerjisi 200 joule artmaktadır. Buna göre, cismin kütlesi kaç kg olur?

A) 0,2 B) 1 C) 2 D) 4

58. Havadaki sürtünmelerin ihmal edildiği ortamda düşey doğrultuda yukarıya doğru atılan yerdeki futbol topu ile ilgili aşağıdakilerden hangisi yanlış olur?

A) Topun çıkabildiği en yüksek noktada hızı sıfır olur
B) Top yükseldikçe mekanik enerjisi artar.
C) Top yere atıldığı hızla düşer.
D) Hızının sıfır olduğu andaki potansiyel enerjisi yere çarptığı andaki kinetik enerjisine eşit olur.

59. Saniyede 450 jouleluk iş yapan makinenin gücü kaç watt olur?

A) 4,18 B) 9,81 C) 75 D) 450

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