DESIGN AND DEVELOPMENT OF A WEB ENABLED INTERACTIVE SYSTEM
TO SUPPORT ENVIRONMENTAL ENGINEERING TRAINING

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DESIGN AND DEVELOPMENT OF A WEB ENABLED INTERACTIVE SYSTEM
TO SUPPORT ENVIRONMENTAL ENGINEERING TRAINING

A THESIS APPROVED FOR THE SCHOOL OF INDUSTRIAL ENGINEERING

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ABSTRACT

Organizations are using Internet as a tool to share information for increasing the speed of communication. The concept of using web-based training as a tool to educate the employees is gaining significance. This can be attributed to the changing market needs that require “just-in-time” training with declining budgets.

This thesis presents research in the development of a web-based training system for technical education. An asynchronous learning environment has been designed and developed using multimedia components to facilitate online training at Tinker Air Force Base for environmental engineering compliance.

The web-based training system is accessed through a simple browser and uses a web-compatible database. The latest Internet technologies are used in creating media rich environments to explain concepts. Techniques to integrate the presentation and testing facilities are devised to help users review concepts during the learning process.

The design and development of the back-end database incorporates user tracking features and system management features. The development of the training environment is covered with emphasis on designing the container and navigation system, and integrating the various multimedia components harmoniously. Multimedia components that require a large bandwidth for a smooth operation are incorporated in this system and made available across all bandwidths. In order to maintain quality of service and effectiveness of delivery, the waiting time and sensitivity to network variations are reduced. Various methods to incorporate built-in streaming and compression techniques are experimented and implemented to prepare media for web-compatible delivery.
Society has seen a rapid industrial growth due in part to the technology advancements in the past decade. Companies are re-structuring the labor force to retain specific skills that will be an advantage to their development in the future. Furthermore, outsourcing of labor, material and skill that are less significant to be retained as an asset are becoming common in order to reduce the operating and overhead costs. This budget conscious economy, governed by a volatile and dynamic market, has forced organizations to focus more on efficient training methods. These training methods need to be directed to assist employees in meeting the varying demands by making them respond effectively to changes in practice. Winners of this Internet driven economy are industries that adopted strategies to train their personnel “just-in-time” to have a competitive edge in the market (Le Beau, 2000).

Staff competency is the building block of a successful organization (Latino, 1999). Development of technical skills and knowledge is a basic requirement for “corporate survival”. Companies need to focus on identifying critical areas that require improvements by auditing current training facilities to accommodate a long-term training solution.

There are several critical issues that need to be rationalized before planning the implementation of a training program so that the industry is benefited strategically both on a long-term and short-term basis. The factors to develop training strategies depend on
organizational objectives that ranged from compliance, productivity improvement to executive training for updates with the latest technologies and procedures.

Training has always been an issue and a large part of budgets in companies to educate the workforce. “Industries in the United States spend an estimated $50 billion annually on training workers” (Latino, 1999). Some organizations tried to do extensive training but they had too many programs that were ambiguous due to poor planning. This led to frustration, causing productivity loss, negative learning curves, and low return on investments (Lepree, 2000). On the other hand, there were programs adopted by industries in which under-training resulted in quality deregulation and market share loss due to poor practice. To balance the effects of these two extremes, Mike Coleman, (Director of technical education with PRIMEDIA Workplace Learning, Carrollton, TX) suggested that training must be conducted to help workers comply with regulations, and improve the knowledge base in the organization (Lepree, 2000).

Though learning and working are contemplated to be two very conflicting activities in humans, the stereotyped working behavior is the major factor that made employees resistant to change and learning. Actually when training is left to the employee’s own pace with no constraints in material and time, it will work effectively because he/she will have the flexibility and privacy to experiment and learn without any embarrassments.

1.1 TRENDS IN INDUSTRIAL TRAINING

From the past, compared to the future, there has been numerous changes in the way employees of an organization are trained to work. Untill the 1980’s, higher
education (universities and colleges) emphasized towards concepts such as “chalk and
talk” as the primary mode of delivery (Telematics for education and training, 1999).
Although colleges also have laboratories to provide experience to the students, they lack
focus on developing specialized technical skills. Consequently these have forced
organizations to create apprentice-training programs (Gilchrist, 1997). Once an employee
was appointed he/she was put into the rotational training program to learn the skills and
trades on the job.

Traditional training in organizations is usually done in classrooms with an
instructor facilitating the learning process by applying the theoretical concepts to
practice. Presently companies still train their workforce partly using this strategy, since
“learning is a social activity”, where the society serves as the communication device
(Dataquest, 1999). Classroom training requires a considerable amount of investment to
acquire space and arrange for trainers. Such training has become less frequent due to the
limited opportunities for experimental learning. The inability to accommodate busy
schedules, and eliminate geographical or physical barriers, caused organizations to
implement new strategies to support “Just-In-Time” training to cope up with the market
trends (Le Beau, 2001).

In order to maintain a cost effective program, organizations have shifted their
focus towards non-traditional methods, such as web-based training, to provide user-
oriented systems that cope with the demands of just-in-time training (Imparato, 2000).
Current technology trends in training try to integrate technologies to provide a
constructive and virtual environment for participative-intensive training (Stokes, 2001).
1.2 EVOLUTION OF LEARNING DEVICES FOR TRAINING

Learning environments have generally been considered to be a face-to-face instruction-based teaching. This can be attributed in part to the socialistic approach towards education that made humans dependent on someone to teach new concepts. Developments in the telecommunication and electronic sector facilitated the evolution of innovative types of learning devices to enhance learning through alternative methods. The training environments have been progressing steadily from the use of objects and models such as teaching aids to video tools and virtual environments simulating the students with real time situations (Dede, 1995).

The first mode of technology used in training was paper based. Communication mediums such as manuals and workbooks have been used to distribute learning material for many years. As the expectations of the users changed to observe and listen to the instructor teach concepts, more powerful tools such as video conferencing and video telecasting have been employed to remove the barriers faced in using primitive methods. Video telecasting helped in reaching distances in education within a very short time lag, which could not be thought of in the past. The digital revolution, which made electronic equipment cheaper, made it feasible for organizations to integrate different technologies to improve educational practice by coping with the need for speed and interactivity (Omoregie, 1996).

The past two decades have seen major technology revolutions in education with personal computers dominating the education arena (Mosher, 2000). The video telecasting techniques, which changed the traditional classroom training, were replaced
by computer-based training within this time span. Though each technique revolutionized methodologies of teaching, their limitations initiated the development of newer methods.

1.3 RATIONALE FOR WEB-BASED TRAINING

Every person is not talented in everything. One person may be skilled in a particular area and weak in another. This forced companies to face the arduous task of identifying the strengths and weaknesses for improvement. For example, an engineer may be skilled in technical and analytical work but may not always be good in communication to express his thoughts clearly to a group. This happens to people who are conscious to interact with others in a group fearing rebuttal of their opinions. Though it may be beneficial to train each one individually, the investment in time and money to instruct a massive work force restricts organizations in implementing such traditional training schemes. Moreover, the uncertainty of facing unique situations for individual training needs caused the necessity of a flexible, private tutoring system that accommodates various possibilities. The difficulty to update distributed learning material (Advisor, 2001), find effective instructors, accommodate training for personnel constrained by geographic locations, and create time to take personnel without affecting production limits the use of traditional training methods (Summers, 2000).

Every problem has a solution, but key to effectiveness depends on the methodology of approach and the time taken for implementation. The new concepts that revolutionized this cyber economy provide the right answers to use the Internet and multimedia tools to develop hands-on technical training for employees and workers. Though new concepts such as e learning and web-based training are not replacements to
instructor-led training, they are tools that will bring together both trainers and students (Smith, 2001).

1.4 THESIS OBJECTIVE

Even though much has been written about the use of Internet technologies in education, there is still not much support and resources available on what design tools to use for development and what tools to incorporate in a technical training environment to make it a worthwhile and useful training device. One of the objectives of this thesis is to develop a web-based training system by researching the capabilities of different Internet technologies to provide a cohesive, independent and self-contained environment that can enable learning.

Internet technologies have developed so vastly that it is impractical to give a complete overview of its capabilities in education. This thesis aims to not only present a theoretical discussion on how to use the design tools, but also to provide a starting point for developers to select and build systems based on similar concepts by finding their own way on the internet.

1.5 OUTLINE

The thesis covers the design and development of the web-based training system for environmental engineering regulation compliance. The next chapter presents a literature review that will provide a general introduction to the relevant areas of instructional techniques and trends in the industry, with a convergence towards web-based instruction. Several training systems developed through course management
software, and delivered as readymade packages are investigated to analyze the merits and
demerits to develop a good web-based training system.

Chapters 3 and 4 are the key chapters of this thesis. In chapter 3, details of the
new web-based training system developed for this research are discussed. This chapter
covers the design of the various components that build the infrastructure of the system.
Significant importance is given to the design of the front-end and incorporation of special
features to meet the needs of Tinker Air Force Base. In continuity with chapter 3, chapter
4 presents a look at the design of the actual learning environment; this chapter covers the
integration techniques used to incorporate the media components in the environment.

Chapter 5 elucidates the various technologies used in the web-based training
system. This chapter will discuss on how the commercial software was used in the
development, and explain the benefit to developers in using them. In chapter 6, an
assessment of the effectiveness of the training system is presented to support the
usefulness of the thesis. Finally, the concluding chapter provides recommendations for
future improvement and research in improving the web-based training systems.
CHAPTER 2
LITERATURE SURVEY

The background of this chapter is to provide the reader with a basic introduction to the relevant areas of this thesis. Education and training are closely related terms that are often confused. Since this thesis is involved with training, it is necessary to understand the difference.

Education is a general process used to develop and stimulate growth in the mental abilities of the students through instruction-based schooling (Burgess, 2001). Education is primarily concerned with the process of providing the basic infrastructure of knowledge with various concepts. Training, on the other hand, is the process of coaching a student to become more proficient, to improve efficiencies and attain new skills (Brown & Dugid, 1991). Training may also be called as an education process, which is dependent on an organization’s needs.

As this research is concerned with the design and development of a non-traditional method of training, distance education, its evolution and the various trends associated with it, are discussed. In addition an extensive research on the issues concerned with the design of a web-based training system along with their benefits and demerits are also presented along with a review of current online training systems.

2.1 TYPES OF INSTRUCTION

There are two types of education/training processes. They are self-centered or material-centered learning and instructor-based learning. These methods can be further
classified into two categories based on their delivery mode. The instructor-based training resembles the traditional based education that is enclosed between “four walls” (McManus, 1997). On the other hand, the self-centered learning falls under the category of distance education because of the spatial constraints involved in accessing the material. Since this thesis is concentrated more with self-centered learning, the literature survey is focused more towards those details.

2.2 CURRENT TRAINING TOOLS

There are different methods to train and educate the employees in an organization. Since the method depends on the needs, requirements and organizational culture, selection of the best tool that will adapt to the work force is important. Various tools that are currently used in the industry are discussed briefly.

The lecture and presentation methods facilitated by an instructor are the most widely used mechanisms. Since humans are brought up in a social environment, the method of an instructor delivering information with audio/visual aids has been widely used to educate small groups. Due to demands and competency requirements, organizations that do not have the time buffer to allocate production time for training have used coaching, mentor-based training, on-the-job training and self-directed learning as alternate methods. Computer Aided Instructional (CAI) simulations created with the technology advancements became effective tools to build constructive environments for serving those who can work better individually (Gamas & Solberg, 1997).

Material-centered and multimedia-oriented training is a new concept being implemented by most organizations to improve their efficiencies at a controlled cost.
Apart from computer-based training methods, the technology revolution has also provided a number of other methods such as, video conferencing, audio/video presentations, satellite/cable TV broadcasts and slide presentations. Since the computer-based training is a mode of distance education technique, the concept of distance education is discussed briefly in the next section.

2.3 DISTANCE EDUCATION

Learning has become a continuous process in recent times. Distance learning is the mode of education linking the learner to the educational content beyond the four walls of a classroom. There are two contexts in which distance learning was defined. The first was a more specific definition stated by the Strategic Plan of the Oregon Community Colleges For distance Learning (SPOCCDL, 1997). SPOCCDL Planning Committee defined distance learning based on the quality of the delivery medium. Distance learning was defined as “The process of facilitating teaching and learning through a wide variety of methods and linkages including a full range of student support services appropriate to the learning environment in which the learner and provider are separated by time and/or place in order to provide expanded student access, improved instructional quality, and increased effectiveness”.

The second context was a broader aspect stated by Harper, which focused more towards the communication process involved (Harper, 1996). Distance learning was defined as an “educational process that occurs when instruction is delivered to students, physically remote from the location or campus of program origin, the main campus, or the primary resources that support instruction. In this process, the requirements for a
course or program may be completed through remote communications with instructional and support staff including either one-way or two-way written, electronic or other media forms.”

From the above two definitions, the terms distance education may seem confusing with self-study, since both forms provide the freedom for the user to learn at the own pace. Though the two terms may seem synonymous, there was a contrasting difference. In a self-study, the student goes through the learning process by defining own goals to prepare the study material. While on the other hand in distance education, the methodology of approach and support was designed to facilitate an effective learning based on the student’s needs.

2.4 DISTANCE EDUCATION VS. TRADITIONAL EDUCATION

At this stage, though the concept of distance education may be clear, it is important to differentiate it from the traditional education process to understand the methodology of teaching. Traditional classroom-based teaching led by an instructor has been the most pervasive and intensive type of education in our interdependent society. This type of education primarily involved a regular stream of continuous learning without any long breaks. Under this methodology, universities and schools designed certified programs, hired faculty members to develop curricula and placed the responsibility and accountability on them to meet individual academic needs to mold students. This type of education prevents flexibility due to design constraints and prerequisites imposed.

Although distance education has been around for more than a century, it has not been accepted as a traditional educational process due to an absence of human
interactivity (Coffman, 2000). This type of education attracts students interested in acquiring certified credit through a non-traditional method and without any imposition in attendance. This also allows students to earn specific credit after work, by placing them with the responsibility and accountability for learning.

2.5 SYNCHRONOUS LEARNING VS. ASYNCHRONOUS LEARNING

In both traditional based education and distance learning environments, the learning process was governed by synchronous and asynchronous methods. Synchronous learning is a process of communication, which involved an instant exchange of information such as a feedback, or response to a signal. This is a mechanism inherent with traditional classroom-based teaching because of the socialistic environment that allowed students to interact with the instructor (Alonso, 1995). Synchronous learning has also become possible in a distance-learning environment by using digital networks to build electronic classrooms. The development of multimedia-based software, chat rooms, and audio/video conferencing capabilities supported this type of learning extensively.

Unlike the synchronous method, asynchronous method is a more independent process. In asynchronous learning, the communication is an “anytime-anywhere” process in which relevant course materials are supplied to the user (Mayadas, 2000). This method is implemented by distributing material to the user in the form of electronic, digital or paper based media depending on the requirements. Moreover, since asynchronous learning is constrained by dual communication, the learning process is dependent on the student itself.
Though there are many contrasting differences between synchronous and asynchronous learning, both forms of education have to be interactive and engaging to retain the student’s concentration to make learning a creative experience (Hardin, 1999). A creative learning experience can be attained through innovative application of various new technologies, which is discussed in the next section.

2.6 TECHNOLOGIES IN TRAINING

Even in this technology driven world, industries still conduct training by using traditional techniques. This is due, in part, by the misconception that students learn best through an instructor-centered medium (Mosher, 2000). Efficiency in management and effectiveness of delivery are primary factors that influence the success of training. The rapid developments in digital technology, such as improved broadband networks, electronic media and telecommunication have spurred the implementation of new and innovative training methods. In addition, the power and flexibility of these new technologies have enhanced “synchronous” and “asynchronous” learning through non-traditional methods, which were not available in the past with the traditional technologies. The development of audio and video technologies, along with fax, email, and voicemail, increased the physical distance between the learner and the instructor by maintaining a fast, efficient, reliable and a one-way communication process (Omoregie, 1996). Like other recent developments in digital technologies, microwave technologies made high-tech electronic equipment more accessible for organizations by allowing them to privately own satellites or rent bandwidth to improve the infrastructure for training (Jackson, 2000).
2.7 ROLE OF COMPUTERS IN TRAINING

In education, computers have exploited available technologies, such as the various multimedia tools to develop interactive courses. The feature to integrate text, animations, photos, interactive media, audio, and video into a self-contained learning in computer-based training (CBT) shifted the trend from using a single technology as a delivery system (Ulmer & Weisburg, 1999). In the text “Making CBT happen”, Gery defined computer-based training as “an interactive learning experience between the learner and computer in which the computer provides the majority of the stimulus, the learner must respond, and the computer analyzes the response and provides feedback to the learner” (Gery, 1993). This definition clearly explicates how computers played a pivotal role in stimulating the learner’s response to signals for analysis and feedback in the learning progression. This stimulation was through the process of interactivity created by designing structured tests, simulations, games, and drills.

2.8 WWW AND EDUCATION

The Internet was a boom to the various technologies in education and training. Web-based education is a collaboration of computer-based training with Internet tools that provided standardized working environments, with the instantaneous transmission of data to remote locations. These media rich information were displayed in standard browsers through a simple graphical interface by using the multimedia technologies used to create CBT modules. Flexibility to update distributed content, continuous access to the material, and efficient student management were distinct features that became possible
with the integration of the World Wide Web and computer-based training methods (Greenberg, 1999).

There have been several factors that cut across the trends in developing online training environments to meet the changing educational demands in the industry. For example, the emphasis on interactivity where participation was made more intensive influenced the need to create pro-active learning environments that fostered acquiring knowledge and problem solving skills without memorizing the material (Summers, 2000). Furthermore, the shift in orientation from an instructor-based system to a more learner-centric system facilitated this type of learning. Likewise, the necessity of the workforce to become competent and to give the companies a competitive edge transformed learning in industries from a finite to a continuous life-long process, by emphasizing learning at any age (Suegilly, 1997). In many fields such as science and technology, continuous learning has become a requirement for industries to catch up with the current rate of advancements in technology.

James Duderstat (1997), Professor of Science and Engineering at the University of Michigan, suggested that the shift in the industrial learning trend from “Just-in-case” learning to “Just-in-time” learning forced the use of the Internet’s capabilities in training. This was done to supply training content at a high speed and emphasize on individual learning. Since the shape of the learning curve and learning technique varied for each individual, support for individual learning became necessary to accommodate different levels of students.

The need for a flexible environment with all these barriers removed, fostered the development of more advanced training systems. By using the components of the World
Wide Web, training to meet the industrial needs of the new millennium became possible. In order to train for speed, a new learning paradigm that adopted a “constructivist” approach was used to build web-based training systems that harnessed various internet technologies (Greenberg, 1999).

A survey conducted by Alpine Media Corporation projected the expected use of various technologies by learners (Figure 2.1). Though individualized learning and collaborative learning will have an equal share, it was suggested that the use of Internet technologies, where user participation is made more intensive would play a major role in meeting the educational needs.

Figure 2.1: Projected technology use by learners

Courtesy: Alpine Media Corporation, USA
2.9 SUPPORTING TOOLS OF WBT

The various tools used to facilitate the communication process and support learning are discussed below.

**E-mail:** E-mail, also known as electronic mail is the most widely used personal communication tool in the networked environment (Graus, 1999). Email is similar to the process of sending a regular mail, but the difference is in the delivery mechanism, where regular mail is distributed through a postal service, while the email through digital networks. The primary advantages of this tool are portable access, fast “one-to-many” or “one-to-one” communication, and the advantage of sending and receiving small data packages that require immediate attention or notification.

**Newsgroups:** Newsgroups are mailing communities formed to serve and help people who share particular areas of interest. This is an open-ended communication where members in the community share their knowledge gained through experience. The advantage of this tool is through posting queries of specific problems, help is sought from anybody in the community and not from one facilitator.

**Chat:** Chats are synchronous communication mechanisms that allow for the instantaneous exchange of written information. Chat rooms or session helps network people from diverse geographic locations through an informal mode of communication. In the past, live verbal communication could not be supported with audio conferencing.
Today, technological developments have made possible the integration of live audio conferencing and written communication (Wolf, 2000).

**FTP:** “File Transfer Protocol” is a program that enables personal computer users to copy and transfer data from one computer to another, through a communication network. Though only a small user group can be served with such programs because of distribution concerns, it is an efficient way to transfer a large volume of data.

**Telnet:** Telnet is a program that connects personal computer users to another computer and permits the user to operate files on the remotely located machine without copying them to the local machine. This program became a popular tool among students of universities and other schools, because it allowed them to run highly computational programs efficiently (North, 1994). When software licensing, computing speed, and file size become a major issue, telnet is a good tool to use.

**Search Engines:** Search engines are powerful web-based programs that are used to retrieve specific information on topics by scanning documents on the World Wide Web. They provide an opportunity for the student to perform an extensive research to understand concepts by accessing remotely located data in a very short span of time, which could not be even thought of in the past.
2.10 Web-based training (WBT)

Web-based training combined the features of its predecessors used in the distance learning environments (Graus, 1999). Web-based training is an advancement of computer-based training that integrated the World Wide Web. Many features available with distance learning environments and CBT were also applied in web-based training systems. The following is a list of few of the common features between CBT and WBT.

- Student controlled learning provides students with the confidence and privacy to participate in the learning process.
- Different learning styles and technique were accommodated, since this is a student-managed environment.
- Ease of development and maintenance aided in the development of customized training modules and environments to meet specific student community needs.

Though WBT is an advancement of CBT, there are several features that distinguish web-based training systems from computer-based training systems.

- The accessibility of a WBT is made available round the clock, 24 hours a day/7 days a week from any location, while a CBT is available only upon distribution.
- Using WBT reduces the cost of reaching learners at remote locations because of the use of the globally connected communication networks, while in CBT transportation and delivery are critical in material distribution.
- “Just-in-time” training is possible to a large audience using personal computers with the use of web-based training, while using CBT there is a time lag between distribution and usage.
- The process of “one-to-many” distribution of content standardized the mode of delivery for all the users and made updating an easy process, since media at only one location had to be changed and updated. Updating distributed material for learning using CBT becomes costly because of development and distribution costs.

- Since WBT uses the Internet, multi-users interface is an optional feature that can be made available to support a collaborative working environment. In CBT, since the end user is isolated, learning and working are basically individual processes.

2.11 REVIEW OF ONLINE TRAINING SYSTEMS

Since there cannot be one service provider to meet all the demands of the millions of users in the market, there have been different organizations building online training systems to target a specific groups of users. Each training system distinguishes itself from the other with unique capabilities and features. Uniqueness varies in the developmental, instructional, and administrative features to student tools available in the learning environment. This section is concerned in exploring online learning systems. Systems developed using WebCT, Blackboard, customized WBT systems to target specific population groups, such as eCourses, and training modules developed by Geo E learning and Gram Media are investigated to analyze the positive and negative aspects for design considerations.

All the systems, though built on different software and platforms have many common features, which were found to be a basic necessity for web-based training. The following is a list of a few of these features.
• Secure and restricted access with “sign in” and “sign out” features using username and password
• Student group management for managing various classes
• Online testing facilities

WebCT (www.webct.com), is a course management software designed by the faculty of computer science at the University of British Columbia, Canada (WebCT press release, 2001). Being one of most dominant courseware management developer, WebCT currently serves 2172 institutions in 72 countries worldwide (WebCT press release, 2001). WebCT was primarily developed to serve online course management. Its design features permitted development and hosting of WBT systems on private servers by institutions. For example, chat, message boards, and bulletin boards are incorporated for personal and group communication. Other features of WebCT included course-monitoring tools such as progress, time and content tracking. Progress tracking, tracks the response of the users in the system, time tracking tracks the time spent by each students in the system, and content tracking tracks the content accessed by students. Another feature is book-marking, a tool that tracks the latest accessed content of the student in order to guide him/her back to the same position on the next session.

Though are several features that made WebCT unique, its inadequate flexibility to modify presentation templates constrained the system with variety in delivery. WebCT is useful to develop WBT systems with good support tools for classroom teaching. Its application is limited to instructor-centered teaching and cannot guide users through the learning process with online testing in a single environment.
The limitations of the implementation model of WebCT were considerably reduced in Blackboard (www.blackboard.com). Blackboard, a similar teaching and learning WBT system was designed to support improvements in the infrastructure of higher education to reduce the communication gap between the students and the teacher. It was developed as a joint project between Educom, The Department of Defense and the White House to design a general framework for web-based learning with an objective of standardizing the mode of communication and to easing the content management. Current developments in Blackboard’s “instructional management systems” have reached more than 300,000 users to learners at around 3,300 institutions in 70 countries (Blackboard press release, September, 1999).

Important features of Blackboard that made it an unique web-based training system were the support of online homework and assignment submission through a secure environment. Blackboard’s web-based search engine was an integrated feature that provided independent research-based learning, on various topics. The student calendar, personalized page, email, address book of fellow students, and online grade checking provided students additional tools to support and manage learning. The administrative features for the instructor in creating discussion boards and, starting chat communities to facilitate discussion were made available. The provision to create timed tests with a wide variety of question templates offered a variety of testing formats. Finally, the Blackboard system allowed the integration of institutional administrative systems, such as registration and grades directly with the learning environment.

Though many features can be incorporated in a WBT system by using Blackboard, this system was still limited in fostering learning in a single environment.
Although Blackboard was designed to provide additional tools for the instructor to upload files, the unavailability of features to open the contents at the remote location forced the users to download file content into the system before viewing. This may not always be favorable for students working in a highly secure environments where downloading is a restriction.

The limitations of using Blackboard and WebCT are that they provide a general framework structure for development of web-based training systems. Though the flexibility to build WBT systems from scratch in a short time is an unique feature, systems developed using Blackboard lacked the ability to incorporate an interactive teaching environment. Support tools for technical education such as collaborative learning environments were components that were not supported in both systems. This concept of collaborative learning was supported with eCourses (www.ecourses.ou.edu); a web-based training environment developed by the Engineering Media Lab at the University of Oklahoma for statics and dynamics courses. eCourses incorporated many positive features available in Blackboard and WebCT and also reduced their limitations in an online learning environment.

The drawing board tool, one of the features of eCourses, allowed users to discuss through a “multi-user” interactive graphical interface and a live chat facility. These extra features supported collaborative learning. Another unique feature available with this system was the optional facility that allowed the instructor to select and administer random question generation and standardized question generation for students in tests and assignments. The system also integrated an external web board tool as a component to facilitate open discussions amongst students on special topics and assignments. In
addition, streaming of large video lectures was made available to students through compression techniques for any-time access, even through a low bandwidth connection. The system also presented 3-D simulations for students to experiment and understand concepts more easily and provided engineering tools, such as matrix calculator, and unit converters to support the student through the web.

Even though the eCourses system at the University of Oklahoma considered many of the limitations of the previously reviewed systems, there were components identified that were not optimized for transmission. For example, though the video lectures are compressed and streamed to provide the students with a classroom feeling by being able to see the instructor teach concepts, the quality of the long lectures was distorted when viewed through a modem, due to data loss in continuous transfers using unreliable network connections. Furthermore, since other components such as online homework submission and lectures were located in different places, the users must go through different clicks to access these components. This prevents a guided learning process where self-testing is available after concepts have been introduced.

Another web-based training system that used the concepts of the other systems but also incorporated the new idea of 3-D interface to mimic a real environment was developed by Geo learning (www.geolearning.com). This training system was developed to provide training in various fields in the business community. It used an extensive breakdown structure to provide intensive training on specific topics, by providing access to multiple features, like search and glossary, for research through a one-button click. Shockwave technology was used in building the system to deliver a self-contained
environment for presentation and testing. This shockwave technology also gave the system flexibility to run on different platform without changing the format and layout.

Though there were many positive aspects and new concepts are incorporated in the Geo WBT system, Geo focused primarily on the graphics without explaining the instructional purpose. Furthermore, the system lacked consistency on a global basis because of its many navigation and feedback mechanisms used in the interface. Although direct access to multiple features was supported for facilitating learning, these features became prominent elements on the stage while making contents insignificant. Though the interactive tutorials incorporated in this system were good features for technical education, the constrained exploration process with pre-designed steps limited users in experimenting and learning.

The inconsistencies and boundaries of WebCT, Blackboard, eCourses and Geo were handled considerably by Gram Media (www.grammedia.com). Gram Media developed WBT modules to facilitate job safety training through the Internet. The unique features of this system were the integration of animations, simulations, graphics, and text into a single environment to facilitate a parallel learning and experimenting process. A simple user interface with bi-directional navigation was designed to prevent the user from getting lost inside the environment. This system separated the navigational features from the main content to give more emphasis on the material and not on the features available. Features implemented by Gram Media to provide the user with the flexibility to move inside the system with a maximum degree of freedom include provisions to access progress, review summary contents of the lessons, and return back to the stage where left.
Though Gram Media had many features that were not incorporated by other systems, its environment had certain issues of concern. One such concern was the lack of continuity in the learning process due to frequent waiting times to download each frame that explained concepts. The disadvantage of this method was the possibility of users not willing to break continuity in learning a single concept. The constraint imposed on interactive media that forces the user to answer each question correctly before proceeding, may cause frustration when users are not provided with feedback as a response to their input. Though restricting users may be a good feature in some cases, as it provides an opportunity to explore and learn, the lack of feedback is a major concern in designing interactive activities.

There are many online systems available, which have unique capabilities that have been used by various organizations to support web-based training. However an environment is not available for which audio, video, animations, simulation, high quality graphics, and illustrations are integrated optimally to support engineering training in one system. The incorporation of the positive features of other systems and the need to deal with the critical issues limiting the current WBT systems, spurred this research.
There are many online systems existing that are used by various organizations to support web-based training. One of the missing components in the previously reviewed web-based training systems was the unavailability of an intuitive environment for both administrative and student type of users. This feature was considered significant because of the necessity to manage and train a large work force with ease. Management in a web-based training system is comparable to that of managing an organization. As one person cannot effectively manage an entire work force, and also as too many people cause confusion, allowing multiple managerial users with different levels of power in the system to supervise personnel within the department in small groups is important. Furthermore, the feature to provide managing users with the ability to assign only necessary learning material for their group of users without affecting the overall training system was implemented.

The need in the currently developed training system to accommodate users from different departments and functional areas through a standardized interface required the design of a flexible database that minimized the storage of redundant information. In addition, as the existing online learning systems did not integrate audio, video, animations, simulation, high quality graphics, and illustrations in a learning environment to support engineering training, they were integrated suitably to explain concepts.

This chapter presents the various technical aspects involved in designing the web-based training system. The different components that constitute a training system are database, front-end, learning environment, and the server. In this chapter, the design of a
database and front-end are discussed briefly. An overview of the general framework of the lessons structure, and the various user tracking and administrative features incorporated to ease management are explained.

3.1 DATABASE DESIGN

Before the database design is discussed, the concept of a database and the purpose of integrating it with the web-based training system must be understood. A database is the place where data collected about the system can be stored and retrieved conveniently in an organized manner (Silbertschatz, 1997). The collected information is stored in files, which are further organized into records and items that are linked through well-defined relationships.

The front-end interface appears to be a set of html pages hyper-linked with each other. Actually if one were to develop, organize and manage each and every page in the system for different user requests and user types at different levels, the process will become tedious because of the numerous possibilities. In order to determine the privileges of the various users accessing the system, a tracking features with an information checking and verification process with prior stored data is required. In order to cater to these requirements, the integration of a database with the website became an essential component to provide a robust and flexible system.

Microsoft Access, a Windows-based relational database application was integrated to provide the database for the online training system. Access was used because of the wide availability, compatibility and stability on Windows 2000 servers. The simple graphical user interface, functionality and extensive help features made database programming easy. The ease of use to correlate information, maintain
relationships between tables, and write queries was a major advantage available for the development.

The database design started with the need to track and identify users to personalize the training environment. The design progressed with development of the Entity-Relationship diagram as shown in Figure 3.1. The E-R diagram was used to organize the data in such a way that redundancy in data storage due to duplication was minimized.

![Figure 3.1 E-R Diagram](image-url)

Once the database design was complete, access from the front-end website was developed through an Open Database Connectivity (ODBC). ODBC is an Application
programming Interface (API) that interfaced the database with the web by using a unique identification name (DSN, “Data Source Name”). Though the database was compatible for web access, it is an individual program like the front-end application. The database required middle wear technology such as ASP and SQL to initiate the interaction, and interface the functionality with the web. The advantage of using ODBC was the flexibility that it provides to upgrade the web-based training system with other powerful or new database programs without any major modifications in programming.

3.2 LEARNING SYSTEM STRUCTURE

A modular and hierarchical structure was incorporated in designing the organization of the learning system. Five levels were maintained to hierarchically structure contents. The learning material was classified into modules at each level to ease the content and course management by providing flexibility for reuse. The structure of the learning system is shown in Figure 3.2.
The structure was designed in close relationship to that of an academic curriculum. Each level can be compared relatively to a traditional education system. The top level in the system structure was broadly divided into categories called “modules”; this stage is similar to the different streams and majors in the academic curriculum that a student can take. As there may be different courses available in each stream that make them unique, the modules consists of individual “lessons” that supplement information on related topics.
The lessons were further divided into “objectives” to provide a fundamental learning experience for the students with explicit material focusing on specific topics. These objectives, which are the building blocks for the entire learning system, and are comparable to the different chapters in a textbook followed for a course.

The last level in the learning system was the content organization and presentation in each objective. The contents in the objective were displayed by segregating into frames. This level in the system is similar to the pages of each chapter in the textbook. As each chapter may vary in the number of pages, the objectives were also designed to vary from 1–20 frames depending on the volume of content. Though each frame displayed specific content, they were made self-contained in a single environment for an objective. This was done to maintain continuity in learning and minimize waiting time to load each frame. This frame-based structure was designed to display small chunks of material and help the user to grasp concepts gradually before proceeding to the next one.

3.3 FRONT-END DESIGN

There were several issues considered in designing the front-end system because the course delivery is through a web browser. Since the client machine configuration cannot be imposed, the need to provide a robust system accessible by all users became necessary. First, the need to eliminate the hardware constraints of having a large screen was eradicated by designing the layout of the HTML pages for an 800x600 screen resolution. This design was incorporated so that information was not offset from the main screen horizontally for small monitor users. Secondly, as browser plug-ins were used to support interactivity in the lessons, constraints in using the system due to the unavailability of the browser technology was minimized by using two common plug-ins.
that were available as freeware versions in the internet. Shockwave player and QuickTime were the two browser technologies used for delivering the learning material.

The other important aspects in the front-end design, which involved, incorporation of different types of users, and navigation design are discussed in this section.

### 3.3.1 Types of users

Information organization is an important aspect for delivery, since the front-end display was based on the type of user accessing the system. Users were categorized into four types in this system. They were administrative user, manager user, regular users, and guest users. Even though there were different types of users accessing through the same interface, the privileges and features accessible for each user was identified after checking the database.

A three-tier management system (Figure 3.3) was used to design the hierarchical structure of control in the system.

![Figure 3.3 Management tier](image-url)
In this system, multiple administrators can be setup to ease the general management and website maintenance, and several manager users can be setup to supervise personnel from their own workforce. Administrative users are power users in the system having the highest privileges to access management features and options for administration purposes. Since, there are several administrative features incorporated, a detailed discussion is presented later in this chapter.

The second level in the 3-tier system is the manager user. These users were provided with capabilities similar to administrative users. Their privileges were limited only up to supervising capabilities such as setting up and managing students only in their group. Finally, the lowest levels of users are regular users and guest users. These users were given no administrative privileges but were provided with the interface that allowed them to access the training content and support features. Guest users were classified as anonymous users visiting the website. They are users not setup as students either by an administrator or a manager. For these types of users, though entry was not restricted, access to content was limited for security issues in the organization. As they are not registered and approved users for training, information tracking was not done for recording in the database to avoid irrelevant data storage.

3.3.2 Navigation and Layout

The online training system developed is currently hosted at the University of Oklahoma and can be accessed at http://tinker.ou.edu. Frame-network based navigation was followed, since it allowed access to various features at different levels by keeping the navigation menus static, regardless of what level the user is currently at. In order to make
the interface attractive, a graphical user interface was designed. ASP and HTML were used to develop and organize the layout of the features.

The homepage is the first page that appears when the training system is accessed. This page was incorporated with various features that give a general overview of the training system as shown in Figure 3.4. Since external technology other than the browser were used for the lessons, facilities to manually check the installation status of the plug-ins were provided. Graphical links to websites providing these plug-ins was incorporated on the main page itself.

![Figure 3.4 Web-based training system main page](image)

Links to access the “topics” and “help” from the menu were built-in at this stage to present the list of areas covered for training, and assist first time users of the training
system in getting familiarized to gain entry. The entry into the system is through a login process, where the user has to enter username and password. For the guest users, access into the system is not stopped, but is permitted by registering as a temporary user through the “Guest Register” link.

Once the user enters the system successfully, there are several parallel procedures that take place. First, checks are done with the database to confirm the identity of the user to determine the privileges. Then information is retrieved from the database to provide a personalized training environment.

The secondary process executed is the procedure to confirm the installation status of plug-ins in the system. An automatic routine check is done for testing at this stage and a popup window is used to give the status as shown in Figure 3.5. This is done so that, even if the user overlooks to check while entering the system, he/she is provided with a feedback as a last warning to take necessary action required to install the plug-ins before viewing the lessons.

![Figure 3.5 Browser plug-in status feedback](image)

**Figure 3.5 Browser plug-in status feedback**
The navigation inside the system to access the lessons is also a 3-tier process. This process was designed to aid in information and content organization in the training system. The various stages in the 3-tier system of navigation are discussed briefly.

**Stage 1:**

The first stage is the personalized page that appears after login. There are two menus provided at this level as shown in Figure 3.6.

![Figure 3.6 Stage-1 of the 3-tier navigation system](image)

The options in the top menu vary based on the type of user. For all the users, support features to check progress, modify profile, acquire help, and view terminologies used are provided by popping up on a separate browser window as shown in the Figure 3.7. JavaScript was used to control the size and location of the browser window. Java
script was also used for targeting these multiple features accessed from the menu to the same browser popped. This control was provided so that several windows are not opened to confuse the user. At this stage, for users with administrative capabilities an additional link was provided on the top menu of the interface to access the management features.

Figure 3.7 Pop up browser window for support features

Stage 2:

The user is taken to the second stage, by selecting any option from the drop down list on the left menu as shown in Figure 3.8. At this stage, additional graphical links of the assigned lessons are dynamically displayed for the module selected based on the user information retrieved from the database. Lessons assigned to the user are only displayed and added to the left menu. This feature was incorporated so that the users are provided
with just the information and links required. Freedom to navigate quickly between modules was maintained so that users are presented with features to access them easily.

Another feature in this stage was the numeric system followed for listing the lessons. This scheme was implemented to provide managers the flexibility to re-organize and change the order of listing depending on the user requirements. Furthermore, the flexibility to use the same graphics in all the modules to build the lesson menu without any major development and changes in scripting is an advantage of using the numeric scheme. To avoid confusing the user with the numbering system, information regarding the topic for each lesson was displayed in the center of the stage.

Figure 3.8 Stage-2 of the 3-tier navigation system
Stage 3:

The third stage is entered when the links to the lessons are clicked. The list of objectives available and links to access them are displayed at the middle of the stage as shown in Figure 3.9. The numeric system that was used to represent lessons was used for representing links to access objectives at this stage. The graphical links are made active for the user to directly access the objective only after it has been completed once. Brief information about the topic and the subject covered in each objective was summarized beside each link.

![Figure 3.9 Stage-3 of the 3-tier navigation system](image)

An unique feature at this stage was the integration of the “Start” button, which is a book marking tool integrated with the interface to remember the last completed objective.
of the user. This tool restarts exactly at the same place quit by the user in the previous session. The purpose of incorporating this tool was to reduce the mental load on the user to remember course managerial information. The book marking is implemented by recording the time and date the objective was accessed into the database using SQL, ASP, and Director Lingo. Information is stored for each user in the database to facilitate data management. Upon completion of an objective, feedback is given with a check mark displayed to the left of the graphical link representing each objective to indicate status of completion. This check mark was incorporated to present information to the user about the status of material accessed in each lesson.

3.4 LESSON OPERATION

The level of operation in the lessons can be classified into two categories. The first is the process to access the objectives, and then the second is the method to view the contents inside each objective. The method of accessing the objectives is discussed in this section. As the operation inside the objective is concerned with the navigation in the learning environment, it is discussed later in chapter 4.

The method to directly access the objectives is dependent on the status of completion of the listed objectives for each lesson. Though there are buttons provided for an objective when users access the lesson, they are activated only after they have been viewed completely. This mechanism was implemented so that first time users accessing the assigned objectives can be forced to go through a linear process to completely view the assigned material. Another factor that governed this implementation was the ability to gradually introduce concepts and enhance smooth learning without causing confusion due to wide variety of information and options.
3.5 USER TRACKING

An ideal design for the web-based training system would have been to locate and track each and every response of the user. This may provide the feature to support users to start exactly where they left the last time in an objective. The response of the training system will be affected and slowed due to the frequent interaction with the server to write and retrieve data. In order to tackle this issue of minimizing the delay by improving the response, data tracking was done only at the completion of each objective.

In addition to tracking objectives, other user information such as time spent in each objective, responses to the activities, and date last accessed were also tracked. This was done to provide both the user and the administration with statistical data of the progress and utilization of the system. Information in the database was stored based on latest response for an objective to minimize the size of the database.

3.6 ADMINISTRATIVE FEATURES

Even though remote access of the training system is supported through web delivery by using a simple interface, restricting management with physical and technical knowledge constraints could cause problems in the future. Since managers want to manage systems in a simple manner at their own desk and without spending time for training, a web-based administrative system was integrated. The administrative features are management privileges provided to a user to manage the system through the web browser itself. This system is a separate page as shown in Figure 3.10 that can be accessed through a special link that appears in the menu only for administrative users.
The left menu bar of the administrative page provides links to modify profile information, system preferences and manage group, department, user progress and guest user access information. The profile link is similar to those of basic users, but also provides the capability to modify the personal information and system settings.

The “Manage User”, “Manage Group” and “Manage Department” links supports in setting up and modifying user accounts. The “Manage Group” section helps in managing the lesson assignment for the different groups of users in the system. A group can be set up in numerous ways as the requirements vary based on the working background.

Users from different departments having similar functional responsibilities require the same learning material. The “Manage Group” was incorporated to set up and assign
training material to groups of users. This tool helps in minimizing the workload for managers to assign material to all users, as they are given the ability to allocate directly to groups. The “Manage Department” link provides managerial users with the options to set up new departments easily in the system by entering basic information of the department. The “Manage User” supports registering new users in the system by entering basic information to create an identity. This information allows a personalized environment to be displayed for each student by identifying them with a group and department.

The “User Progress” link was incorporated to provide administrative type of users with the option of previewing the performance based on individual users, groups, and departments. This tool was integrated to support the management in analyzing and evaluating the progress in a multi-faceted way. Though all the information of a user is stored at the same location in the database, these different ways of displaying the same information were dynamically created based on the requirement by using ASP and SQL.

The “Manage Guest” link was designed to provide the administrators with the option to decide what lesson content can be accessible to unauthorized guest users entering the system. As security and confidentiality are important factors for organizations, this tool was provided to allow the companies to manage their own restrictions. The benefit of incorporating this feature was that flexibility to modify these parameters was not constrained to the developers but made available to the administrators of the system through a simple web browser.
CHAPTER 4
LEARNING ENVIRONMENT DESIGN

The past research in designing WBT systems were emphasized more on the discovery of new technologies and the effectiveness of integrating them with the training environment. This research, on the other hand, is not concerned in developing a whole new tool to revolutionize learning, but to effectively harness the available web technologies to facilitate a “Guided Learning” process. In this chapter, the technical aspects in the design and development of the WBT are discussed with more emphasis on the integration of the various technologies to develop an intuitive learning environment.

4.1 CONTAINER SELECTION

A container is an environment that can hold text, sound, graphics and other multimedia technologies in a single environment. As technical training required a high level of interactivity, a double stage container system was used in delivering the information.

The first level container is the Internet browser. The browser was used because of its ability to work as a client program connecting the user to the World Wide Web. The features available with browsers to read HTML documents, follow links were considered critical for the navigation inside the training system. Although online services such as America Online, CompuServe and Prodigy have their own browsers, the web-based training system was designed to be compatible with the two most popular browsers Microsoft Internet explorer and Netscape Navigator. Both of these are graphical browsers that can display text, graphics, and multimedia information.
A Browser is a basic interface limited to just presentation because of its capability to only interpret HTML code. In order to develop media rich environments that support interactivity, other technologies such as Java and Director can be used as secondary containers to the browser. Java is a powerful simulation language with which a high degree of interactivity can be designed. It was not used due its programming complexity. Director Shockwave was used as the secondary container because of its programming flexibility and streaming capability.

4.2 CONTAINER DESIGN

The container design is concerned with the design and layout of the secondary container. Information and media were integrated and designed at this level, and embedded inside the browser as a single file. As the previously reviewed online training systems lacked in integrating presentation and interactive testing facilities in a single environment, they were integrated for the newly designed web-based training system.

There were several factors that influenced the design. First, in order to maintain consistency in the delivery, the frame size was standardized for a 550x480 pixel dimension in the system. Though there were no hard constraints and formulas to calculate the dimension of the frame, the decision was made through qualitative analysis by considering several factors such as screen resolution and hardware constraints. The screen resolution was used to design the overall layout of the web-based training system and the frame dimension was used to set the standard for the interface. The frame size was set less than the screen resolution so that the learning environments appears to be a part of the entire system. A larger frame size provided more space and flexibility to incorporate extra features and a smaller dimension created a compact environment. Since
empty space on a large frame and lack of space in a compact frame were disconcerting for presenting material, a tradeoff was done to select this dimension.

Second, in order to provide variety in the presentation style to avoid repetitiveness, different templates were designed. To guide the user in the environment for easily identifying and locating various features, a group layout structure was incorporated in the template’s design. Elements of similar functionality were grouped together. An example of a template is represented in Figure 4.1. The layout was designed such that text elements highlighting points, graphics illustrating concepts, and buttons for regular and administrative users to control the navigation were grouped and organized in a single frame.

![Figure 4.1 Design layout of a template](image)

In Figure 4.1, there are two blue bars; the top bar is the title bar, and the bottom bar is the navigation bar. Features not concerned directly with the learning material were incorporated in this region. The media elements of the learning content were displayed in
the space between the two bars. The elements were displayed at the center so that the immediate attention of the user is focused on the content. This design was included to minimize the distraction and confusion caused due to incorporation of extra features. The logo and the title for the objective were placed in the title bar. To provide the user with an overview of the topic discussed throughout the objective, a general title was provided. To be more clear-cut as the level of detail increases in discussing concepts, each frame is given a specific title apart from the objective title.

4.3 NAVIGATION SYSTEM

A simple navigation system with limited options was provided, so that the user’s time was not wasted on researching how to use the features. A graphical user interface with a push-button system was used so that the functionality of each button can be understood easily through visual identification. To keep the system simple, a linear presentation with bi-directional navigation was implemented. Forward, repeat, and back buttons as shown in Figure 4.2(a) are built-in as the primary navigational features for the system.

Figure 4.2(a) Regular user                     Figure 4.2(b) Administrative user
These buttons were arranged in a chronological order based on their functionality, so that the stereotyped behavior in humans to click the right most buttons to go next, and click the left most buttons to go back is supported. The repeat button was located at the center because its functionality lies between the other two features. The repeat button was incorporated to provide the user with the option to review the material again before proceeding.

It can be seen in Figure 4.2(b) that there is an additional set of small forward and back buttons apart from the buttons available for the regular student users. These buttons were additional features provided to support users with administrative privileges. As administrators were not required to complete each objective frame by frame, they were provided with this feature to quickly browse through the contents. This is a feature that does not appear for a normal user, as they must view all the frames completely. The administrative buttons were separated from the primary navigation system and located at the left hand corner of the navigation bar. They were not integrated with the regular buttons because of their difference in functionality.

4.4 COLLABORATION TOOLS

In traditional classroom-based teaching, users generally receive more input than just words on a page. To help compensate for this, multiple multimedia tools were integrated in the web-based training system to provide the same instincts. Text, graphics, animations, simulations, audio and video were the elements integrated. Learning was made a memorable process by explaining difficult concepts with not just words, but also by providing an opportunity to engage the user’s attention to improve his/her observation skills. The unique feature of this training system was the integration of these
technologies, which have unique objectives when used individually, to accomplish a unified objective of stimulating the learning capabilities.

Although multiple media can be incorporated in the instructional setting, two main questions of “Why should this feature be used?” and “How can it be used?” were considered to rationalize the selection. This was particularly done to reduce the conflict between the objectives of each technology, and also facilitate developing media for low bandwidth connections.

4.4.1 Text

Text is used to provide brief instruction or summaries of concepts in a frame, so that the user is not overloaded and tired with too much content. An instructional tone, emphasizing information was used to retain the user’s attention. Anti-aliased text that blends with the background color without any sharp edges was used to make the presentation environment attractive. An aspect, considered before incorporating this media element in the system, was the ease of authoring in Director Shockwave. Text elements were widely used to summarize learning material since an internal text editor, easily accessible through a graphical user interface, was available.

4.4.2 Pictures

Graphics is used in the system to enhance the learning experience through visual stimulation. Since “a picture is worth more than a thousand words”, graphical illustrations were widely used in the WBT to explain complex concepts. The pictures used are schematic diagrams developed with graphic authoring tools, images taken from clipart, and high-resolution photographs of people, processes, and equipment.
4.4.3 Animation

Animation is integrated along with the other elements to improve the value of the educational experience. As static environments with just text are uninteresting, animations were used to take advantage and focus the user’s attention to support a stimulated learning process. Animations were used to stage story-like presentations, show processes, and also explain intricate concepts that need to be represented over a period of time.

Flash was used to develop animations, which is discussed in the next chapter. An example of an animation integrated with other presentation material in the environment is shown in Figure 4.3. This illustration explained the mechanism of how a venturi controls a High Velocity Low Pressure (HVLP) spray gun. The technical aspects were explained by mimicking the actual behavior of the particles with motion. The large red particles represented the paint that mixes with the air inside the gun. The white arrows appeared as particles start flowing through the venturi to represent the direction of movement. Corresponding pressure drops between in the inlet and outlet were also represented to demonstrate the influence of pressure in the spray gun. The compressed particles sprayed from the gun were also animated and their size and speed were correspondingly varied to illustrate the working.
Simulations were used to illustrate technical aspects by providing the user hands-on-training through an interactive exploration process along with the presentation material. Simple user-friendly games such as matching, Tic-tac-toe, Jeopardy, and engineering-based simulations were created to keep the user excited and interested in the learning process. Special engineering simulations were developed based on the instructional needs to deliver the concept effectively, and guide the user through the investigation process.
An example of a simulation is shown in Figure 4.4. This simulation is developed to illustrate the impact of diameter and length of the hose on performance of a spray gun. Different hoses of varying diameter and length were arranged, and the user was provided with the option to vary pressure using a slider and compare the inlet and outlet pressure across the hose. Audio feedback was integrated to explain the impact of selecting each hose and guide the user in selecting the correct one.

![Figure 4.4 Example of simulation activity](image)

**4.4.5 Audio**

Audio is used in the system for two purposes; first as a narration, and then to give feedback to a user’s response in simulations. Sound narration was used in every frame to
reinforce ideas and concepts presented as text or graphics. The lengths of the audio clips were neither too long nor too short, so that the user’s attention was not diverted from the main content. The sound intensity for the feedback effects was maintained below the maximum level of the narrations, so that no shock is caused due to a sudden alert.

4.4.6 Video

Although video is characterized by large file size, it is used to illustrate examples from the actual working environment to give a pragmatic approach towards training. In order to maintain the quality to support a smooth web delivery, the movie clips were compressed and maintained to short durations of 10-30 seconds. As video requires a broad bandwidth to download quickly and synchronize with the content, the effect of bandwidth was minimized by using QuickTime technology, which has built-in streaming capabilities.

Even though Director Shockwave supported QuickTime inside the authoring environment, the video element was not incorporated into the container. This was due to the firewall protection in high security organizations that restricted entry of video data when both media were integrated. In order to distinctly avoid the situation of showing the video as an external element, it was made to pop up in a browser window. The size of the browser window was fixed to match the dimension of the video clip and the location on the screen was pre-designed such that it appeared synchronously with other learning content as shown in Figure 4.5.
LESSON OPERATION

Industries organize and implement training programs to improve the awareness amongst the workforce to follow correct procedures while working, and do not conduct them to recognize academic excellence. Thus the primary focus of the training program was to educate and make users understand their responsibilities by making them view the contents thoroughly. Industries were benefited through these training programs by saving tremendous operating cost when workers realize the importance of correct procedures.

This web-based training system was developed on the prime focus to provide a support tool to the workers, which can be used at any time to brush through concepts without any constraints. The underlying concept used to design the system was to test
users at a regular pace after delivering small chunks of material. First a presentation mechanism with audio, video, sound, text, and animations was used to deliver concepts. Then testing tools, such as simulation activities and multiple choice questions were incorporated to evaluate the user’s knowledge on the topic discussed. Since the main purpose was to encourage users to go through the content as frequently as possible, no constraints were imposed inside the system for the user to review concepts by jumping back and forth before responding to the activities.

In this web-based training environment, the sound was used as the instrument to control the user from proceeding inside the objective. Sound was used as the primary mode to deliver information and it was synchronized to highlight the texts that were used to summarize the point narrated. A sequential highlighting was designed so that the users were guided to follow the presentation. When student users are viewing the presentation in a frame, they are not restricted in going to a previous objective or frame for reviewing. Once they go back in an objective, they are constrained from proceeding forward until all the sound narrations are completed for that frame. This was done to simplify the development, minimize the data tracking and also limit the options for the user to skip contents.

4.6 GRAPHIC COMPRESSION TECHNIQUE

Director Shockwave supports the incorporation of many graphic formats. In order to optimize the Shockwave container for web delivery, it is ideal to have a reduced file size. Though efficient compression techniques are available with Director Shockwave to condense the file size, clever integration of the additional components can improve the efficiency by optimizing further.
Graphics is one of the critical components that control the file size of the container. The graphic compression technique used is discussed in this section. Two types of external graphic sources were used for compression. The high-resolution photograph and the vector-based clip art image were imported as Flash Shockwave files, and graphics created using drawing tools were imported as Bitmaps for compression in shockwave. Though high-end graphics can be imported for compression directly as Bitmap, Joint Photographic Expert Group (JPEG) or Graphical Interface Format (GIF), they are imported as Flash Shockwave image files. Bitmap format was used for certain small graphics developed using commercial drawing tools. JPEG or GIF formats were not used due to the lack of support in Director to integrate such graphics, and compress them further to reduce the file size as they have already been compressed to be web-compatible.

Graphics were imported in two formats, which required two compression techniques, the direct compression and the two-stage compression technique. In the direct compression technique, the graphic was directly imported into the medium as a bitmap file and compressed using Shockwave. The two stage compression technique incorporated the method of compressing the bitmap first using Flash and then using Director. The two-stage compression technique of recompressing Flash compressed bitmap images again in Shockwave was found to be more efficient when compared to other techniques. Comparison between the direct compression technique and two-stage compression technique is shown in Table 4.1. It can be observed that even though both techniques used the same parent file as source, the two-stage compression technique was more efficient than the direct compression technique by 25%.
Table 4.1 Comparison of graphic compression techniques

<table>
<thead>
<tr>
<th></th>
<th>Parent Source File size</th>
<th>Stage 1 (Flash)</th>
<th>Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single stage Compression</td>
<td>127 Kb</td>
<td>-</td>
<td>17 Kb</td>
</tr>
<tr>
<td>Two stage compression</td>
<td>127 Kb</td>
<td>9 Kb</td>
<td>13 Kb</td>
</tr>
</tbody>
</table>

The direct compression technique was used for graphics created using drawing tools. As these graphics developed are governed by a low file size, there will not be a significant difference between the two compression techniques. In order to save time and labor the two-stage compression technique was only used for high-end graphics that have a large file size.

4.7 STREAMING

The web-based training system developed for this research is essentially a collection of media elements, which are integrated, organized, and sequentially presented in the Shockwave container. The Shockwave container is a media sensitive multimedia application that requires a large bandwidth for effective operation. Forcing the users to wait for a long time to load the contents is not acceptable due to the disruptions caused in the learning continuity. In order to reduce the effect of bandwidth to deliver multimedia components, streaming technology available with Shockwave was used.

Streaming is the process by which the Shockwave container starts playing quickly before downloading all the contents. To maintain the quality of service, the waiting time is minimized by gradually downloading the contents as the material is viewed. Although there are no special techniques available to optimize the performance, the fundamental rule of making the delivery component small is followed to improve the efficiency. The
streaming technique used is illustrated with Figure 4.6 and explained in the next paragraph.

There are three stages in streaming: first is the data packet generation stage; second is the network delivery; and last is the playback at the client machine. Though the contents for an objective are made self-contained in a single Shockwave container, the network delivers the multimedia component to the end user as small chunks of data. When there is a user request to access a file, the contents are generated steadily as small data packets. The left-hand diagonal line in Figure 4.6 represents the continuously generated data packets. These data packets are then transferred to the network continuously as they are generated and then delivered constantly to client machine making the request. Though this is a continuous process, the delivery at the client
machine is offset by a time-phase lag to the generation due to the delay in transfer across the network. The right-hand diagonal line represents the status of the data packets delivered at the client machine. Though the network tries to deliver the data continuously, there is no assurance for the reliability and timeliness of transmission, since transfer is dependent on the network traffic as represented by the wavy line. In order to dampen the effects due to fluctuations in the network connections and maintain the offset in playback to sustain continuity, the playback buffering is pushed to the right until the variations in the network delays are unnoticed.

4.7.1 Audio Streaming

An estimated amount of 5-20 minutes of high quality sound was integrated in each objective to present the information. WAV and AIFF are popular audio formats that can be used to provide quality sound media. Though these formats provide good quality, their large file sizes restricts them from being used in the web-based system. This is due to the bandwidth issues that need to be considered to optimize and deliver quality service. Since sound cannot be neglected because of technology constraints, compressed formats that are compatible for web delivery are used in the system.

Shockwave audio, a compressed sound format compatible with Director Shockwave was used as the sound delivery medium. Though the size of the sound files is reduced tremendously by a 1:16 ratio when compared to the WAV format, sound files are still not embedded inside the Shockwave container due to several reasons that affect the performance of system.

First of all, the narrations are not one big sound file but multiple files for each frame in an objective. This eliminates the constraint of downloading all media
components before playback. The quality of delivery deteriorates due to poor memory management, caused by the increased file size when sound is embedded inside the Shockwave. Both Shockwave audio and Shockwave have streaming capabilities. The integration of the two media will not only override the ability of Shockwave audio to stream, but also cause priority problems in downloading media components. This will cause conflict in delivery since correct media may not be downloaded when required.

In order to avoid conflict, and make use of the streaming capabilities of both media, audio streaming is done individually. Sound is broken into multiple files to synchronize with the presentation in each frame. The next audio file to be played is preloaded to maintain continuity. Using this mechanism to stream the required sound file when needed, a more enhanced control for memory management and downloading is made possible. Furthermore, utilization of the network to the maximum possible extent is maintained by balancing the downloading load.

4.7.2 Video Streaming Technique

There are four standard digital video formats: QuickTime, Video for Windows, Real Player and MPEG that can be used to deliver the video through the Internet. Video file sizes tend to be large and are not appropriate for delivery across low bandwidth due to the long downloading time required. The fundamental concept of streaming was to deliver content with a reduced file size. The video file size was reduced with CODEC compression algorithms by optimizing parameters such as dimension, frame rate, output format, depth of colors, and data streaming rate. MPEG streaming video format requires special servers such using Real Time Streaming Protocol (RTSP) or Real-Time Transfer Protocol (RTP). Instead, QuickTime format is used in this research. The ability of
QuickTime to be hosted from a server with Hyper Text Transfer Protocol (HTTP) server, aided in reducing hardware technology required. Although Video for Windows (.avi format) can also be used for streaming from a HTTP server, QuickTime provided more efficient compression and streaming techniques.

In order to understand how to select a server, the data transfer mechanism of RTSP and HTTP servers must be understood. RTSP server is used to broadcast digital video based on the end users requirement. The advantage of streaming, using this technique was that the digital video content delivered is constantly monitored and checked at the client’s machine to track data required for transfer. This mechanism is useful to broadcast large video files to a remote machine without burdening the client with memory problems. On the other hand, in HTTP server based transport, the media content is delivered continuously as small data packets without checking the status of delivery. Since in the web-based training system designed, there is no necessity to monitor the client request because of the small size of the digital video, the HTTP server used to host the training system was determined sufficient.

Digital video involves handling of extremely large volumes of data. The file size of an uncompressed digital video can be too intense for web transmission. An important consideration was using best compression techniques to make the digital video compatible across all bandwidths without deteriorating quality. Frame size, frame rate, and data rate were major settings in applying compression techniques. Sorenson CODEC compression technique was used because of the efficient file size reduction that was possible with QuickTime format.

For best picture quality, the frame size of the digital video prepared must match the frame size of the original video. Since file size is more important than the picture
quality for web delivery, the frame size is reduced to 240x180 pixel dimension for minimizing the amount of data to be compressed. The different resolution and dimension standards used in designing the different components of the web-based training system are explained in Table 4.2

<table>
<thead>
<tr>
<th>Dimension (Pixels)</th>
<th>Screen resolution considered for designing WBT</th>
<th>800 x 600</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standardized frame size for interface</td>
<td>550 x 480</td>
</tr>
<tr>
<td></td>
<td>Standardized frame size for digital video</td>
<td>240 x 180</td>
</tr>
</tbody>
</table>

In order to maintain the motion quality, applying an optimal frame rate that does not affect file size and quality is important. As video uses a sequence of images that are played continuously, the frame rate was used to set the number of images per second of video. A high frame rate could not be set to maintain quality, since the file size increased tremendously. On the other hand, as a low frame rate deteriorates the picture quality, a frame rate of 15 frames per second was set so that quality and size are reasonable for compression.

Frame size, and frame rate only reduce the volume of data to be compressed. The actual compression takes place in setting the data rate. The goal in setting the degree of compression was to maintain the clip within the capacity of the network. If a high data rate is set for minimizing the compression ratio, then errors such as dropped frames are caused due to the large file size and unreliable transmission. On the other hand as high
compression with a low data rate deteriorates the picture quality, a data rate of 20 Kbytes/second that is suitable for modem transfer is set for the digital video.
CHAPTER 5

DESIGN TOOLS

Technology has made multimedia construction an easier process by minimizing the strain caused by developing hand written code. Though current authoring environments are providing all the features to develop a wide variety of applications, the kind of interface varies depending on the objective. There is a wide range of authoring tools available to develop each type of multimedia application. This chapter discusses the various design tools used for development of the entire web based training system used in this research. The reasons and benefits of selecting and using the commercial software tools are elucidated.

5.1 MACROMEDIA DREAMWEAVER

The majority of the front-end systems that consist of static web content, and the digital media were embedded in the HTML pages. Dreamweaver, a visual HTML editor developed by Macromedia, was used to support authoring of HTML files. Though there were a large selection of visual HTML editors such as Microsoft FrontPage, Adobe Pagemill, and Pagebuilder, Dreamweaver was selected because of the extended support given to the developers in strong site management and frame-based development through a graphical user interface. The advantage of using Dreamweaver was that the HTML code and JavaScript were generated automatically when development is done to incorporate special effects.
5.2 MACROMEDIA DIRECTOR

The secondary container used to deliver the training content was developed through Macromedia Director. Though Macromedia itself develops other authoring tools such as Flash and Authorware, Director was selected because of its programming, authoring, streaming, and compression capabilities.

The capability of Director was exploited to incorporate the different types of high-end media elements into a single container. Using the inbuilt compression, an integrated interactive multimedia environment at a reduced file size was created. The programming capability called “Lingo” Scripting was used to design scripts for the navigation system, presentations, and simulations. The scripting flexibility and the variable level of control were used to accommodate variety in development by including different styles and templates with very little modification. The ability to communicate with the web-based database and control the media elements through Lingo script without any physical handling was used to develop a flexible system that accommodated different responses and requests. The unique feature available in Director to share commonly used files as an external element provided the graphic elements for the interface in Shockwave. This feature known as “Shared Cast” helped in minimizing the effective size of the shockwave by making the interface graphics as external media. This also provided the flexibility to make changes easily by making modification only in one place and not in every Shockwave file.
5.3 MACROMEDIA FLASH

Flash, a vector-based animation tool developed by Macromedia, was used to develop high quality animations, and compress the high-resolution photographs and clip-art images. The compatibility of Shockwave player to run Flash Shockwave files, and the wide availability of Flash Shockwave player plug-ins greatly influenced the selection of Flash as the animation tool. The development environment in Flash is similar to that of a movie stage where the different elements are arranged on the time line to determine the sequence of appearance.

As maintaining a low file size is the key for quality streaming, the efficient compression algorithm available with Flash was exploited to develop complex animations at low file sizes. The drawing, modifying, and organizing capabilities inside the authoring environment were accessible through its simple visual interface. The layering concept incorporated in Flash was used extensively to create independent entities on different layers so that they can be organized and controlled without affecting other objects. The special features such as masking, and guiding layers were used to give sophisticated effects to the animation without much complexity in programming. The frame-based development made Flash a powerful multimedia tool, since it possessed the ability to assign different scripts and dictate the settings independently on different frames.

5.4 ADOBE PREMIERE

Premiere is a simple and powerful video editing multimedia tool developed by Adobe. Though Affect Effects, another video editing tool was available, the flexibility to
support different media formats through the user-friendly graphical interface aided in selecting Premiere as the video-editing tool. A special feature available was the support to capture and edit video data from VHS and DV format. This facilitated the availability of video with a wide range of quality for development.

The various commands menus, toolboxes and floating palettes provided additional features to manipulate the video with an enhanced control. Editing such as reduction of duration or application of special effects was done by placing the imported clips on the timeline. The single-step development that optimized and exported contents of the timeline into a single video file allowed integration of multiple video clips and photographs along with the video. Features such as the monitor window, was used extensively in the development to display the current state of the movie clip placed on the timeline before being exported. This feature enabled authoring by saving time in changing and optimizing parameters to maintain quality. Support extended in premiere to import file in a particular format and export the same video program into a different format after compression facilitated the use of a wide range of media.

5.5 MEDIA CLEANER

Media Cleaner, developed by Terrain Interactive was used as the video compression tool to develop streaming video elements in the system. Media Cleaner was used in the second stage of preparing the video clips for the system. Though other tools, such as Stream Anywhere developed by Sonic Foundry, and Premiere developed by Adobe were available, the various compression and streaming technologies in Media Cleaner helped in experimenting with different methods quickly. The feature to compress
files in batches was not available with other tools. This feature helped in saving time and labor to set parameters for every file being compressed. The simple interface to add the source files for compression with the drag and drop mechanism simplified the process of locating the media. The wizard and advanced setting that guided in selecting the different parameters were exploited for efficient development.

5.6 ADOBE PHOTOSHOP

Photoshop is a graphic editing and development tool developed by Adobe. This tool has a similar interface to that of Adobe premiere, but was focused toward digital graphics. Though there are commercial software such as Photo Styler, Painter, and PhotoDraw, Photoshop was used because of the enhanced capability it provided with the integration of Kai Power Tools.

Photoshop was used in the system to develop graphics for the front-end interface and optimize the high resolution photographs used for training. The front-end graphics are of two types: one was the graphics developed for the navigation system; and the other was the images and photographs used for explaining concepts. Though Photoshop is not a drawing tool, it was used to develop and export simple images and graphics for the navigation system. The pixel-based environment provided the ability to edit high-resolution images by changing properties such as tint, color and contrast. Producing sophisticated effects and creating crisp graphics were supreme features available with this tool.
5.8 SOUND FORGE

Audio was used extensively in the training system to reinforce concepts. As a large number of audio files needed to be manipulated, an efficient method to record, digitize, and edit sound was necessary. Sound Forge, developed by Sonic Foundry, is a Windows-based desktop audio editing and processing tool that was used to edit sound. Its ability to simply cut, copy, and paste sound based on the requirements made the dividing of the main source files for each frame an easy process. Various sound effects such as fading, mixing, and adjusting volume levels were used to edit the media with special effects.
CHAPTER 6
CONCLUSIONS

6.1 SUMMARY

A web-based training system for environmental engineering training was developed for Tinker Air Force base. Extensive research on various online training systems was done to analyze their capabilities, merits and demerits. The positive features of available training systems and the missing components that were considered necessary for technical training were incorporated in the newly developed web-based training system.

The web-based training system was broadly divided into 5 modules with the capability to expand in the future to add more content. The modules were then broken down into lessons that contained objectives to focus on explicit training material. Both the learning content and the administrative features were made available through a basic browser to minimize technology constraints. An intuitive graphical user interface for the front-end was designed to simplify the use of the system.

Four types of users and a hierarchical organization structure were designed to ease the management of the system. A web-compatible database was designed and tied with the training system to support information tracking and management. The database was designed such that it provided flexibility and an enhanced control of the system by minimizing redundancy in data storage.

Extensive research on developing the actual learning environment was done to integrate a wide range of media elements. Web compatible audio, video, text, animation,
and simulation were integrated in a single environment. Flexible scripts that controlled
the media elements were designed such that they can be reused in the development of the
Shockwave. This flexibility helped in reducing the development and debugging time
since programming was done only once for the navigation, presentation, and testing
mechanisms. Special simulations and animations were designed and integrated with the
presentation material to illustrate technical issues in training.

Efficient methods to stream audio and video through compression techniques was
experimented and implemented to support the smooth delivery of streaming media. In
order to guide developers of web-based training systems a brief overview was presented
on the various commercial software tools used for the development.

6.2 CONTRIBUTIONS

• Modular and hierarchical structure for the training system was designed to
  promote flexibility and incorporate future developments.
• Information tracking mechanisms were devised to retrieve and store user
  information in a web-compatible database tied with the training system.
• Templates for the second level Shockwave container in the double container
  system were designed to standardize the design and delivery.
• Methods to integrate the various multimedia elements harmoniously without any
  technology conflicts were devised.
• Shared-cast technology was implemented to share common resources from a
  single source across the contents in web-based training system to maintain
  consistency and reduce effective file size.
• Flexible scripts that can be reused to minimize development time were designed.
• Efficient graphic compression techniques were incorporated to reduce the file size of contents.
• Streaming of audio, video and shockwave through various built-in compression and streaming techniques were experimented and implemented in preparing media for web-compatible delivery.

6.3 RECOMMENDATIONS FOR FUTURE RESEARCH

The objective to develop a web-based training system for environmental engineering compliance was accomplished. However, there are still many areas that can be researched to deliver a more efficient system for technical training. The infrastructure in the learning environment was designed promoting flexibility to incorporate future developments as continuation of this research.

Simulations and animations were integrated in the environment to stimulate an active learning process. The limitation of these media to two-dimensional format did not mimic the actual environment, as objects are three-dimensional. To enhance student understanding of technical concepts, incorporation of 3D graphics in simulations and animations is a suggestion for future research.

In the current system, the navigation was designed for a linear based presentation that allowed the user to jump back and forth by only one frame. Users are not given the option to navigate freely within the completed contents in an objective. It is suggested for future research to incorporate features that allow users to navigate without any
constraints. Furthermore, providing users with a more enhanced control within the learning environment is an area that can be researched.

Although this research extensively incorporated most media elements inside one environment, QuickTime video was used as an external media. This was due to the firewall issue that could not be resolved in high security organizations to download Shockwave and QuickTime when integrated. It is suggested that a scope for future research is available to integrate the video element inside a single environment by exploring the network security and data transmission technologies.
REFERENCES


www.coe.uh.edu/insite/elec_pub/HTML1997/de_barr.htm


Burgess, Vance, 2001 Education Vs Training.
www.cops.uwf.edu/eme4454/week1/educationvstraining.htm

Byers, Anne, (1993), "Distance learning program reaches adult learners", Rural Adult Education FORUM, October/November, Vol. 6, No. 1.

Coffman, Steve, (2001), Distance Education and Virtual Reference: Where Are We Headed?, Computer Libraries, Vol. 21, No. 4 • April.
www.infotoday.com/cilmag/apr01/coffman.htm

Dataquest, Januaryry, 31st, 1999
www.dqindia.com/jan3199/dw1.htm

www.ed.gov/Technology/Futures/dede.html
Duderstadt, James J., “Transforming the University to Serve the Digital Age”,

*CAUSE/EFFECT* Volume 20, Number 4, Winter 1997-98, pp. 21-32


Gilly, Sue, “A Different View of Organizational Learning” February 21, 1997

[www.flash.net/~jteague/Sue/orglearn.html](http://www.flash.net/~jteague/Sue/orglearn.html)

Gilchrist, Michelle, (1997), Catapillar Dealer Academy.

[www.blanchardmachinery.com/employment/dealeracademy.htm](http://www.blanchardmachinery.com/employment/dealeracademy.htm)

Gibson, Elizabeth J., Brewer, Patrick W., Dholakia, Ajay, Vouk, Mladen A.,


Graus, Johan, 1999, An Evaluation of the Usefulness of the Internet in the EFL Classroom


McManus, Thomas Fox, (1997), Redefining the University: The Changing Role of Distance Education. [www.coe.uh.edu/insite/elec_pub/HTML1997/de_mcma.htm](http://www.coe.uh.edu/insite/elec_pub/HTML1997/de_mcma.htm)

North, Tim, 1994, “ The Internet and Usenet Global Computer Networks”


Telematics for education and training: United States, Canada, Australia, volume 1, Executive summary and analysis 225, 1999 www.ethoseurope.org/ethos/survey/vol2/contents.htm

U.R.L  www.lbcc.cc.or.us/spoccde/spoccde.html
U.R.L  www.webct.com/service/ViewContent?contentID=3555192
U.R.L  www.cooks.edu/traditional_vs.htm.
U.R.L  www.marshall.edu/it/cit/webct/compare/comparison.html.
U.R.L  www.ecourses.ou.edu/


www.advisor.com/Articles.nsf/aid/SMITT187

“Web-Based Authoring Tools Comparison Report”, Digital Media Center,
University of Minnesota, 1998.

www.umn.edu/dmc/portfolio/comparison/index.shtml

Weisburg, M, Ullmer E.J., (1999), "Distance Learning Revisited: Lifelong Learning and the National Information Infrastructure"


Wolf, Karsten D., “Implementing a powerful learning environment on the Internet”

www.wipaed.sowi.uni-bamberg.de/wise/kdwolf.html
Willis, Barry, (1993), "Distance Education - Strategies and Tools and Distance Education-A Practical Guide".  www.uidaho.edu/evo/distglan.html.

Yoakam, Michael, IPSE - Distance Learning,

 www.ihets.org/consortium/ipse/fdhandbook/dist_learn.html
APPENDICES

Appendix A  Lingo Script
Appendix B  Simulation Script
Appendix C  ASP script
APPENDIX A: LINGO SCRIPT

***********************************************************
Script that initializes starting variables before playback of Shockwave
***********************************************************

global AnswerList, gMyPath, gNumrite, gHiliteColor
global gTracker, gSTracker

On StartMovie

    -- The answer list is initialized.
    -- gNumrite is the score that is going to be passed by the  end of this objective
    -- gNumrite is a global variable which is initialized. It is used in the script for evaluating
    -- gHiliteColor is a global variable which is used to turn the color of the presentation
    -- text of each frame.
    gTracker = 0
    gSTracker = 0
    AnswerList = []
    gNumrite = 0
    gHiliteColor = color(#rgb,0,0,0)
    -- "Sw1" is the variable passed from the .asp file that contains this shockwave. It is
    -- and external parameter which contains the path to update the database.

    If externalParamName ("sw1") = "sw1" then
        gMyPath = externalParamValue ("sw1")
    end if

    --"sw2" is an external parameter which contains the information regarding the type of
    -- user. This will be required to turn off and on the quick navigation button provided for
    -- special users such as adminsitrators. Administrator "sw2 = 1" and rest of
    -- users value is 1. This value will be got from the database.

end startMovie
On Preparemovie

if externalParamName ("sw2") = "sw2" then
    userType = externalParamValue ("sw2")
    If userType = 0 then
        sprite(3).visible = False
        sprite(4).visible = False
        sprite(5).visible = False
        sprite(10).visible = False
        sprite(50).Loc = point(102,421)
    end if
end if
end if
end

***********************************************************
Sequential playback control for every frame in page
***********************************************************

global gHiliteColor, q, gTracker, gSTracker

On BeginSprite me

    q = word 2 of the framelabel
    gSTracker = 0
    stop member("F ",& q)
end

On Enterframe me

    q = word 2 of the framelabel
    displayFrame
    If gSTracker = 0 then
        member("F ",& q).volume = 255
        member("Frame"&q).color = gHiliteColor
    else If gSTracker = 1 then
        member("F ",&q).volume = 0
end if
play member("F "& q)
end

On ExitFrame
If member("F "&q).percentPlayed = 100 then
    go next
else
    go to the frame
end if
end

***********************************************************
Playback control of last frame for each page
***********************************************************

global gHiliteColor, q, gTracker, gSTracker
On Enterframe me
    q = word 2 of the framelabel
displayFrame
    member("Frame"&q).color = gHiliteColor
    If gSTracker = 0 then
        member("F "&q).volume = 255
        gSTracker = 1
    end if

    If gTracker = 0 then
        play member("F "& q)
    end if
end

end
On ExitFrame me
  If member("F "& q).percentPlayed = 100 then
    sprite(8).Loc = Point(605, 439)
    gTracker = gTracker+1
    gSTracker = 0
    member("F " & q).volume = 0
    sprite(7).Loc = Point(605, 439)
  end if
  go to the frame
end

***********************************************************************
Button behavior for navigation
***********************************************************************

Property pActionNavigation, pActionFrame
Property pActionLingo
-- This script is placed over any button in the shockwave.
-- This is used for controlling navigation and any functional use.
On getPropertyDescriptionList me
  list = [:]
  addProp list, #pActionNavigation, [#Comment:"Action Navigation", #format:#String, #range:["None","go to frame", "play frame", "play done"], #default:"None"]
  addprop list, #pActionFrame, [#Comment:"Frame.", #format:#frame, default:""]
  addProp list, #pActionLingo, [#Comment:"ActionLingo", #format:#string, default:""]
  return list
end
On Mouseup me
  doAction(me)
On doAction

if pActionNavigation = "go to frame" then
    Cursor(0)
    if value(pActionFrame)>0 then
        go to frame value(pActionFrame)
    else
        go to frame pActionFrame
    end if
else if pActionNavigation = "play frame" then
    cursor(0)
    play frame pActionFrame
else if pActionFrame = "play Done" then
    cursor(0)
    play done
end if

if pActionLingo <>"" then
    do pActionLingo
end if
end

********************************************************************************

Method to control of audio playback
********************************************************************************

global q, gSTracker
On Mouseup me
    q = word 2 of the framelabel
    gSTracker = 1
    member("F "&q).stop()
    member("F "&q).volume = 0
end

86
Method to reset text lines before frame playback

Property frameName, lineNumber

On getPropertyDescriptionList me
  description = [:]
  addProp description, #frameName, [#default:"Frame1L", #format:#string, #comment:"Frame name", #range:['Frame1L", "Frame2L", "Frame3L", "Frame4L", "Frame5L", "Frame6L", "Frame7L", "Frame8L", "Frame9L"]]
  addProp description, #lineNumber, [#default:"1", #format:#string, #comment:"Line number"]
  return description
end

On Beginsprite me
  repeat with tempLineNumber = 1 to integer(lineNumber)
    member(frameName & tempLineNumber).color = color(#rgb,204, 204, 204)
  end repeat
end

Question Script to evaluate activity

global gNumrite, CorrGroupList, AnswerList, gMyPath
-- This is used to check the answers of multiple-choice questions.
On DetermineScore
  countList = AnswerList.count
  if AnswerList.count = 0 then
    AlertMessage
else
    checkList
end if
end

On AlertMessage
    alert "You have not selected an Answer Choice."
end

On CheckList
    q = word 2 of the framelabel
    q = value(q)

    -- This is used to get an explanation for particular questions from the cast member
    If CorrGroupList = AnswerList then
        sprite(25).member = member("Correct"&q)
        gNumrite = gNumrite + 1
    else
        sprite(25).member = member("InCorrect"&q)
        sprite(8).Loc = point(800,800)
        Sprite(23).loc = point(531,140)
        sprite(24).loc = point(447,310)
        sprite(25).loc = point(398,231)
        sprite(26).loc = point(608,378)
        myColor = color(#rgb,144,144,144)
        member("ans"&q&"1 b").color = myColor
        member("ans"&q&"2 b").color = myColor
        member("ans"&q&"3 b").color = myColor
    end
-- This is an array, which is passed to the database to update the score for the user.

On SubmitScore
InfoList = ["Score": gNumrite, "Module": 6, "Lesson": 4,
            "Objective": 1]
    postNetText(gMyPath, InfoList)
    put InfoList
end

On FinishedChkTest
    countList = AnswerList.count
    If AnswerList.count = 0 then
        AlertMessage
    else
        DetermineScore
        SubmitScore
    end if
end

On NextQuizNetwork
    gotoNetpage "../load_objective.asp?module=6&lesson=4&obj=2"
end

******************************************************************************
Question Frame Script to control playback
******************************************************************************

global gHiliteColor, q, gTracker, gSTracker
On Enterframe me
    q = word 2 of the framelabel
displayFrame
    If gSTracker = 0 then
        member("Q "&q).volume = 255
gTracker = 1
end if

If gTracker = 0 then
    play member("Q "& q)
end if
end

On ExitFrame me

If member("Q "& q).percentPlayed = 100 then
    gTracker = gTracker + 1
    gSTracker = 0
    member("Q "& q).volume = 0
end if
go to the frame
end

********************************************************************************
Checkbox scripts in question
********************************************************************************

Property pwhichQns, pwhichAns, pwhichisCorrect, pGroupList
global selectedQns, AnswerList, CorrGroupList
global currentsprite, anssprite1
On getPropertyDescriptionList me
    List= []
    List.addProp (#pwhichQns,#comment: "Question", #format: #string, #range: ["1", "2", "3"], #default:"1")
addProp list, #pGroupList, [#comment: "Correct Answers", #format: #list, #default: []]
    List.addProp (#pwhichAns,#comment: "Answer", #format: #string, #range: ["1", "2", "3", "4"], #default:"1")
List.addProp (#pwhichisCorrect,#comment: "Correct Answer?", #format: #boolean,


On Beginsprite me

q = word 2 of the framelabel
q = value(q)
If sprite(me.spritenum).member = member("ans"&q&"1 a") then
  anssprite1 = me.spritenum
end if

QuestionList = pwhichQns
AnswerList = []
end

On Mouseup me

selectedAns = pwhichAns
VselectedAns = value(selectedAns)
currentsprite = (anssprite1 + VselectedAns)-1
If sprite(currentsprite).member.hilite = True then
  AnswerList.add(VselectedAns)
else
  AnswerList.deleteOne(VselectedAns)
end if

Sort AnswerList
CorrGroupList = pGroupList
end
APPENDIX B: SIMULATION SCRIPT

***********************************************************
Initialization for Spray gun performance simulation
***********************************************************

global pwhichHose, gTracker, gSTracker, Theta

On EnterFrame me

  pwhichHose = 1
  Theta = 0
  sprite(45).setFlashProperty("",#alpha,20)
  sprite(46).setFlashProperty("",#alpha,20)
  sprite(47).setFlashProperty("",#alpha,20)
  sprite(48).setFlashProperty("",#alpha,20)
  sprite(54).setFlashProperty("",#alpha,20)
  sprite(55).setFlashProperty("",#alpha,20)
  sprite(56).setFlashProperty("",#alpha,20)
  sprite(57).setFlashProperty("",#alpha,20)

  member("speedValue").text = string(0)

  If gSTracker = 0 then
      member("A1").volume = 255
      member("A1").play()
      gSTracker = 1
  end if
end

On Exitframe me

  If member("A1").percentPlayed = 100 then
      pwhichHose = 2
      go next
  else
      go to the frame
  end if
end if
end

global pwhichHose, mem, D, L, X, Y, memo
global chek, angle

-- Hose Selection
On EnterFrame me
    member("A"&pwhichHose).volume = 255
    member("A"&pwhichHose).play()
sprite(20).Loch=20
    member("speedValue").text = string(0)
sprite(31).rotation = value(member("speedValue").text)
sprite(33).rotation = value(member("speedValue").text)
    Doit
End

***********************************************************
Subroutine Doit
***********************************************************

global pwhichHose, mem, D, L, X, Y, memo
global chek, angle, Theta

On Doit
    If pwhichHose = 2 then
        Set D = 0.25
        Set L = 50
        mem = "14H"
        wid = 366
        Hite = 28
        X = 285
        Y = 295
memo = 45
Theta = 0.02
else if pwhichHose = 4 then
    Set D = 0.375
    Set L = 50
    mem = "38H"
    wid = 366
    Hite = 30
    X = 285
    Y = 296
    memo = 46
    Theta = 0.08
else if pwhichHose = 6 then
    D = 0.5
    L = 50
    mem = "12H"
    wid = 366
    Hite = 34
    X = 285
    Y = 297
    memo = 47
    Theta = 0.3
    Theta = 0.15
else if pwhichHose = 8 then
    D = 1
    L = 50
    mem = "1H"
    wid = 366
    Hite = 38
    X = 285
    Y = 297
memo = 48
Theta = 0.2
else if pwhichHose = 3 then
  D = 0.25
  L = 25
  mem = "14H"
  wid = 366
  Hite = 28
  X = 285
  Y = 295
  memo = 54
  Theta = 0.04
else if pwhichHose = 5 then
  D = 0.375
  L = 25
  mem = "38H"
  wid = 366
  Hite = 30
  X = 285
  Y = 296
  memo = 55
  Theta = 0.13
else if pwhichHose = 7 then
  D = 0.5
  L = 25
  mem = "12H"
  wid = 366
  Hite = 34
  X = 285
  Y = 297
  memo = 56
Theta = 0.2
else if pwhichHose = 9 then
    D = 1
    L = 25
    mem = "1H"
    wid = 366
    Hite = 38
    X = 285
    Y = 297
    memo = 57
    Theta = 0.2
else
    go next
end if

sprite(24).member = member(mem)
sprite(24).width = wid
sprite(24).Height = Hite
sprite(24).LocH = X
sprite(24).LocV = Y
sprite(memo).setFlashProperty("", #alpha, 100)
ASound = pwhichHose + 1
member("A" & ASound).PreloadBuffer()
member("A" & ASound).PreloadTime = 3
end

*****************************************************************************

Setting Hose Identification
*****************************************************************************

Property pwhichHose
global D, L, mem, pwhichHose
On getPropertyDescriptionList me
  List= [:]
  addProp List, #pwhichHose,
    [#comment: "Hose", #format: #string, #range: ["1", "3", "5", "7", "2", "4", "6", "8"], #default:"1"]
  return List
end

Pressure slider script

global T, Angle
On Mousedown me
  set slider_sprite= the clickOn
  -- global T,T_min,T_max,T_step
  T_min = 0
  T_max = 300
  T_step = 1
  set max0=T_max
  set min0=T_min
  set step_size=T_step
  set steps=1+(max0-min0)/step_size
  set T=integer(min0+(step_size*slidh_calc(slider_sprite,steps)))
  set the text of member("speedValue") = string(T)
repeat while the mousedown
  set T=integer(min0+(step_size*slidh_calc(slider_sprite,steps)))
  set the text of member("speedValue") = string(T)
  Angle = T
  calculateAngle
end repeat
Angle = T
calculateAngle
end

***********************************************************
Pressure slider subroutine
***********************************************************
On slidh_calc slider_sprite,steps
-- horizontal slider
-- handle must be in next sprite after slider groove
set border=10
set steps=float(steps)
set x=float(the mouseH-the left of sprite slider_sprite - border +1)
set bar_size=float(the width of sprite slider_sprite-(2*border-1))
set step_size=bar_size/(steps-1)
set temp1=x/step_size
set temp1=integer(temp1)
if temp1 >= steps then set temp1=steps-1
if temp1 < 0 then set temp1=0
set temp_locH=the left of sprite slider_sprite+border+temp1*(step_size)-1
set the locH of sprite(slider_sprite+1) = temp_locH
put "SliderLocH="&temp_locH
updatestage
set ret_val=temp1
return ret_val
end

***********************************************************
Pressure Indicator angle calculation subroutine
***********************************************************
global p1, Angle, T, Theta, Info
On calculateAngle
If sprite(20).LocH > 20 then
    put "SliderLocH="&sprite(20).LocH
    sprite(63).Loc = point(800,800)
end if
    sprite(31).rotation = Angle*0.2
    sprite(33).rotation = Angle*Theta
end

**********************************************************************
Method to reset simulation for repeating activity
**********************************************************************

global pwhichHose, gTracker, gSTracker, Theta

On Mousedown me
    pwhichHose = 2
    Theta = 0
    sprite(45).setFlashProperty("",#alpha,20)
    sprite(46).setFlashProperty("",#alpha,20)
    sprite(47).setFlashProperty("",#alpha,20)
    sprite(48).setFlashProperty("",#alpha,20)
    sprite(54).setFlashProperty("",#alpha,20)
    sprite(55).setFlashProperty("",#alpha,20)
    sprite(56).setFlashProperty("",#alpha,20)
    sprite(57).setFlashProperty("",#alpha,20)
    member("speedValue").text = string(0)
    member("A"&pwhichHose).stop()
end

On Mouseup me
    go To Frame "F 2L2"
end
APPENDIX C: ASP SCRIPT

***********************************************************************

Method to Login inside the system
***********************************************************************

<!-- #include virtual="includes/scriptheader.asp"-->
<!-- #include virtual="includes/errorhandler.asp" -->
<%

'File Name: login.asp
'QueryString: ""
'Description:
'This file is to check whether a user is allowed to enter the system as well
'as to clear any particular information about the user when he is leaving.
'Comments:
'The following information are stored in cookies:
'   "userName", "userType", "firstName", "lastName"
Dim str_currentUser, str_currentPass, str_currentType
Dim obj_connect, obj_retrieve, str_SQL
str_currentType = "0" 'default guest type
On Error Resume Next
Set obj_connect = Server.CreateObject("ADODB.Connection")
obj_connect.Open "DSN=\" & Application("tinkerDB")
str_currentUser = Request.Form("userName")
str_currentPass = Request.Form("password")
If str_currentUser = "" OR str_currentPass = "" Then
    Response.Redirect ".error/error_id.htm"
End If
Set obj_retrieve = Server.CreateObject("ADODB.Recordset")
'Check whether the user is a guest first
'---------------------------------------
str_SQL = "SELECT username, password, fname, lname FROM Guest WHERE username = "" & str_currentUser & ";"
obj_retrieve.Open str_SQL, obj_connect

'Check whether the user is in Tinker group
'-----------------------------------------
If obj_retrieve.EOF = True Then 'No such guest
    obj_retrieve.Close
    str_SQL = "SELECT username, password, type, fname, lname FROM TinkerUser WHERE username = "" & str_currentUser & ";"
    Set obj_retrieve = Server.CreateObject("ADODB.Recordset")
    obj_retrieve.Open str_SQL, obj_connect
    If obj_retrieve.EOF = True Then
        Response.Redirect "/error/error_id.htm"
    End If
    str_currentType = CStr(obj_retrieve("type"))
End If
str_first = obj_retrieve("fname")
str_last = obj_retrieve("lname")
'Verifying the password
'----------------------
If obj_retrieve("password") <> str_currentPass Then
    Response.Redirect "/error/error_id.htm"
End If
'Store info into cookies
'-----------------------
Response.Cookies("userName") = str_currentUser
Response.Cookies("userType") = str_currentType
Response.Cookies("firstName") = str_first
Response.Cookies("lastName") = str_last

If str_currentType = "3" OR str_currentType = "2" Then
    Response.Redirect ".../application/home_admin.asp"
Else
    Response.Redirect ".../application/home.asp"
End If
obj_retrieve.Close
obj_connect.Close
Set obj_connect = Nothing
Set obj_retrieve = Nothing
handleError(""
%>

***********************************************************************

Method to load Shockwave on the browser
***********************************************************************

<!-- #include virtual="includes/scriptheader.asp" -->
<%
'File Name: module_home.asp
'QueryString: "module", "lesson", "obj"
'Description:
'This file is to load the corresponding director shockwave file given the
'thumbnail, lesson, and objective. The path is constructed dynamically. In
'addition, it also stores the time as it loads the objectives.
'Comments:
Dim int_module, int_lesson, int_obj, str_userType, str_updateDBPath
Dim str_path, str_directorFile
str_updateDBPath = "http://" & Request.ServerVariables("HTTP_HOST") & "/tinker/application/passer.asp"
str_userType = Request.Cookies("userType")
checkCookie(str_userType)
int_module = Request.QueryString("module")
int_lesson = Request.QueryString("lesson")
int_obj = Request.QueryString("obj")

If int_obj = "" Then
    Response.Redirect ".../error/error_id.htm"
End If

str_path = "mod0" & int_module & "/Lesson" & int_lesson & "/"
str_directorFile = str_path & "obj" & int_obj & ".dcr"

storeTime()
convertUserType()

Sub storeTime()
    Dim temp
    temp = Request.Cookies("startTime")
    Response.Cookies("startTime") = now
End Sub

Sub convertUserType()
    If str_userType = "3" OR str_userType = "2" Then
        str_userType = "1"
    Else
        str_userType = "0"
    End If
End Sub

%</html>

<head>
<title>Tinker Online Training System</title>
</head>
<script language="JavaScript">
var popup;
function callMessage() {
    if (!opener || opener.closed) == false
        opener.message()
}
function MovieWin(MovName) {
    var MyArray = MovName.split("&");
    //alert(MyArray[1]);
    if (MyArray[1]!= "X"){
        if (MyArray[0]== "Right")
            {   var offsetx = 355;
                var offsety = 120;
        } else {
            var offsetx = 200;
            var offsety = 120;
        }
    var x = 0, y = 0; // default values
    if (navigator.appName=="Netscape"){
        //alert("Netscape");
        x = window.screenX + offsetx;
        y = window.screenY + offsety +20;
        popup = window.open(MyArray[1],"PlayMovie",'resizable=
no,width=240,height=196, top=+y+',left='+'x);
        focuspop = popup.focus();
    }
    else if (navigator.appName=="Microsoft Internet Explorer")
    { y = window.screenTop + offsety;
        x = window.screenLeft + offsetx;
        name=MyArray[1];
    }
</script>
if (popup) {
    closepop = popup.close()
}
popup = window.open(MyArray[1], "PlayMovie", 'resizable=no,
    width=240, height=196, top=' + y + ', left=' + x);
focuspop = popup.focus();
}
else {
    if (popup) {
        popup = popup.close()
    }
}
}

function closeMovieWin() {
{
    if (popup) {
        closepop = popup.close();
    }
}
}
</script>
<script language="vbscript">
sub vbcontrol(name,x,y)
    Dim newwindow
    msgbox(name)
    msgbox(x)
    msgbox(y)
    if (x=508)then
        parameters = "resizable=no, width=240, height=196, left=508, top=242"
    else parameters = "resizable=no, width=240, height=196, left=353, top=242"
end if
window.open name,"PlayMovie",parameters
end sub

</script>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
</head>
<body bgcolor="#FFFFFF" leftmargin="0" topmargin="0" marginwidth="0"
marginheight="0"onUnload="callMessage()">
<object classid="clsid:166B1BCA-3F9C-11CF-8075-444553540000"
codebase="http://download.macromedia.com/pub/shockwave/cabs/director/sw.cab#versi
on=8,5,0,0" width="640" height="480" name="MovieName" ID="MovieName">
<param name=src value=<%=str_directorFile %>>
<param name=sw1 value=<%=str_updateDBPath %>>
<param name=sw2 value=<%=str_userType %>>
<param name=swRemote value="swSaveEnabled='true' swVolume='true'
swRestart='true' swPausePlay='true' swFastForward='true' swContextMenu='true' ">
<param name=swStretchStyle value=none>
<PARAM NAME=bgColor VALUE=#FFFFFF>
<embed src=<%=str_directorFile %>> bgColor=#FFFFFF width=640 height=480
swLiveconnect="True" swRemote="swSaveEnabled='true' swVolume='true'
swRestart='true' swPausePlay='true' swFastForward='true' swContextMenu='true' 
swStretchStyle:none sw1=<%=str_updateDBPath %>> sw2=<%=str_userType %>>
type="application/x-director"
pluginspage="http://www.macromedia.com/shockwave/download/"
name="MovieName"></embed>
</object>
</body>
<html>