Evaluating the Usability of Web-based Learning Tools

by

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Abstract

In recent years, more and more educators have expressed an interest in using new computer technologies to enhance face-to-face instruction and to deliver distance-learning courses.

Web-based learning tools are an attempt to provide integrated technologies to meet educators' needs. The primary purpose of these tools is to facilitate teaching and learning via the Internet. Unfortunately, few of the existing tools have been evaluated and there is little guidance for administrators and instructors when trying to select an appropriate tool.

This thesis reviews six existing web-based learning tools and comparatively evaluates two of them: Blackboard™ and WebCT™. The research study completed for this thesis employed the two tools in a classroom-based university course and examined the functionality and usability of each of the tools. Individual features of the tools such as navigation, assignment submission, and online quizzes were evaluated from the perspectives of students, instructors and administrators.

There was a significant difference found between Blackboard™ and WebCT™ in terms of the usability of the tools. Blackboard™ was rated significantly easier to use than WebCT™ overall. In particular, navigation, assignment submission and publishing course materials were considered to be easier in Blackboard™ than WebCT™. The strengths and weaknesses of the tools are presented and discussed.

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Dedication

To my husband Anthony-Xinghua

Chapter 1

Introduction

It is commonly thought that computer technology has the potential to create changes in education. However, to effectively apply computer technologies in an educational setting, an integrated set of tools is necessary. The first section of this thesis describes these emerging tools and research that has been conducted on them.

1.1 Web-Based Learning Tools and Distributed Learning

In recent years, more and more educators have expressed an interest in using computer technologies to enhance face-to-face instruction and to deliver distance- learning courses. Pioneers in this field started with making their course notes, reading lists and assignments available on the web for students to browse. They also employed collaborative technologies such as electronic mail, videoconferencing, and audioconferencing in their classes [1]. Although there are a variety of computer technologies that can be adopted by educators for enriching their teaching, no single technology provides all the necessary functions to meet their needs. To allow educators to use computer technologies effectively, to incorporate these technologies

for educational purposes is necessary. Web-based learning tools attempt to provide integrated technologies to meet educators' needs.

Web-based learning tools are computer applications that purport to facilitate teaching and learning via the Internet. Currently there are various terms used for these applications including Web-Based Learning Environments [2], Virtual Learning Environments [3], Web-Based Learning Systems [4], Web-Based Education Systems [5], and Network-Eased Education Systems [5]. Despite their different names, they all use Internet technologies to deliver instruction and supporting materials to learners via a web browser. They also provide the capability for interactions between instructors and students. In addition, they provide web-based tools for the assessment of students' performance. The term web-based learning tool was chosen for this thesis as it reflects the most important two characteristics of these applications. The modifier "web-based" implies that instructors and students use these applications via a web browser. The phrase "learning tools" suggests the purpose for which these applications were designed. In summary, a web-based learning tool is educational software that integrates the desirable features needed for teaching and learning processes.

The emergence of web-based learning tools is due in large part to the new demands of distance learning [3, 6, 7, 8]. The principal characteristic of distance learning is that students are not present in a classroom but are still able to participate in educational courses. Traditionally, the content of distance-learning courses is delivered via mail, audio broadcast and TV. While distance learning has been successful in a variety of educational programs, technology limitations have impeded the use of distributed learning in situations requiring collaborative learning. *Distributed Learning* is a type of distance learning that emphasizes the use of computer-based technologies to facilitate learning. By adopting a variety of computer technologies, learning methodologies, and facilitating on-line collaborations, it aims to achieve results not possible in a traditional classroom-based education. In particular, its goals are to provide a truly flexible, anytime, anywhere, at any pace, learning environment. Learning at any time means that course materials are available when

learners need to access them, not merely when classes are scheduled. Learners are able to access learning materials via the Internet at any convenient time: early morning, late night, after work, or on weekends. Learning at any place emphasizes that learning is available without any geographical restrictions. Learners can access the learning materials via the Internet at any convenient place, including homes, offices and libraries, even across continents. Learning at any pace means that learners can set their own pace to learn. Web-based learning tools are expected to provide new and empowering ways to achieve distributed learning goals.

1.2 Related Research

Some research work has been done to examine web-based learning tools. Several frameworks have been proposed for assessing web-based learning tools. For example, Bates' Action model [9] calls for a comparison of instructional delivery modes on the basis of access, costs, teaching functions, interaction and user-friendliness, organizational issues, novelty, speed of course development and course adaptation. Pantel [2] elaborated these criteria further. His framework compares web-based learning tools from seventeen dimensions covering a broad range of issues relevant to the adoption of a web-based learning tool. Since these two models structure the evaluation and comparison of competing web-based learning tools over a broad and abstract set of criteria, they could serve as a high level theory for comparing web-based learning tools.

Britain and Liber [3] adopted a different approach. Their evaluation framework is based on two models: one from an educational perspective called the Conversational Framework and the other from an organizational perspective called the Viable Systems Model. The Conversational model focuses on interactions between an instructor and an individual student while the Viable System Model focuses on how the software helps an instructor manage conversations and the construction of individualized activities for a large number of students. Used in conjunction, the two

models provide an evaluation framework for web-based learning tools based on pedagogic criteria for effective resource-based, collaborative learning. On the other hand, Ravitz [10], from a software engineering perspective, suggested a framework that encourages the assessment of software evolution through interactive discussion, continual record keeping, and documentation. These frameworks or models provide some guidance as to which factors one should consider and how they may be applied when evaluators assess web-based learning tools. However, there have been few attempts at applying these theories.

Even though several formal and informal case studies have been conducted, none of them have paid attention to both the usability of the tools and the impact on the potential users, such as students, instructors and course administrators. Britain and Liber [3] evaluated seven web-based learning tools from a pedagogical perspective. In their evaluation they differentiated the tools with respect to their use in different teaching and learning situations. They recognized that some tools were more suited to a traditional style of on-line course. Other tools, by contrast, were centered on collaboration. However, there was no consideration given to the usability of the tools in their evaluations.

Morss and Fleming [11], on the other hand, examined an existing web-based learning tool, WebCT™, from students' point of view. They found that most of the participants recommended continued use of WebCT™ and felt it was important for them to have the experience of using the latest computer techniques applied to their discipline. However, without comparing WebCT™ with other web-based learning tools, it is difficult to identify the strengths and weaknesses of the tool. Pavlik [12] did a comparative study with three web-based learning tools. He detected some of the strengths and drawbacks of each of the tools. Nonetheless, his analysis of the tools was mainly based on personal exploration of the tools in the absence of students' participation. As Britain and Liber [3] indicated, one of the problems with evaluating web-based learning tools is that few of them are currently being used by institutions. Consequently, data and feedback from real users is hard to collect. Another

comparative approach used by Marshall University's Center for Instructional Technology [13] is to put together a list of all available web-based learning tools and all features that each tool provides, such as assignment submission, online quizzes, and discussion board. However, these lists say nothing about how easy or difficult the tools are to use or how effective the tools are.

While there has been a great deal of research done on web-based learning tools, there have been few usability studies investigating these tools. Software usability is not a new concept. It is usually referred to as the degree to which computer software assists a user in completing a task [14]. The concept of usability encompasses such attributes as learnability, efficiency, memorability, handling of user errors, and user satisfaction [15]. Various methods can be employed to examine the usability of computer software, such as observation, interviews, questionnaires and expert reviews [16]. The results of usability studies are typically incorporated into several stages of the software life cycle, from early analysis and design through final testing and follow-up studies. From a software engineering perspective, usability concerns center on the user interface and the degree to which it meets various usability heuristics [15]. A user interface designed on sound principles will simulate a natural dialogue between the system and user that is clearly expressed in nontechnical terms [16]. In addition, features of the interface will be consistent, and the memory load on the user will be minimized [17]. User errors are prevented by good design, but when they occur, error messages should follow the guidelines for human-computer dialogues mentioned previously. And finally, the system should keep users informed about what is happening with appropriate feedback. When the software is designed for educational use, additional principles become important, such as the design of learning activities and the learner's ability to control sequence, pacing, presentation medium, and level of difficulty [18].

Although the emphasis on software usability has grown in the past fifteen years, some designers have suggested that concerns for usability are not truly integrated into

the design and development of educational software [12, 14]. To understand educational software better, more usability studies are needed.

1.3 Research Rationale and Goals

Many web-based learning tools have been developed and more are in production. Unfortunately, very few of the existing tools have been evaluated and there is little guidance for administrators and instructors when trying to select an appropriate tool. One of the goals of this thesis is to recognize the characteristics and examine the capabilities of the currently available web-based learning tools. Although a list of features provided by a tool could provide information for administrators and instructors about what the tool can be used for, the list provides no indication about how easy it is for different user groups to use. The main goal of this study is to identify the strengths and weaknesses of the existing web-based learning tools in terms of their usability. Currently, the university is looking for recommendations for adopting an appropriate web-based learning tool because they want to enhance students' experiences, faculty members' performance and institutional competitiveness through the use of innovative technology. This thesis attempts to gather relevant information useful for assisting the university in choosing effective web-based learning tools. Moreover, a usability study is an integral part of the software life cycle. It plays an important role in the overall quality assurance process that should optimally be part of every software product [19, 20]. A reliable and well-designed web-based learning tool would result in both instructors' and students' satisfaction with the tool. This study attempts to identify not only the bugs in the software implementation but also problems in the software design that make these tools difficult to use.

To discover the strengths and weaknesses of the existing web-based learning tools, the tools are compared on the basis of the features they provide. Although Pantel [2] cautioned that intuitive and ad-hoc comparisons between competing products were not likely to lead to adopting the optimal web-based learning tool, the objective of the

comparison is to spot the advantages and disadvantages of each of the tools rather than finding which tool is superior. Britain and Liber [3] also argued that one of the problems with an evaluation of software based on feature comparisons was that it was easy to focus on only individual components of the tools and lose sight of the tool as a whole. However, we believe that the tool would not be considered effective if its features were difficult to use when carrying out a particular task. Since the individual features together form a tool, it is necessary to compare the usability of the individual features when comparing the usability of the tools.

The study results serve three main audiences. The first audience consists of developers of web-based learning tools. They can benefit from the findings of this thesis as it identifies the strengths and weaknesses of their products. These findings will be useful in marketing and in planning future product releases. The second audience consists of instructors who use or intend to use web-based learning tools. Since students actually have no control over the choice of a web-based learning tool, instructors have to carefully consider the impact on the students when using the tool they have chosen. This study is also addressed to those considering technological innovations for their organization or institution. Their decision is important as it often involves a substantial investment for organizations and significantly impacts how instructors will teach and how students will learn.

1.4 Thesis Organization

Chapter 2 reviews six collected web-based learning tools currently available on the market and the characteristics of each of these tools. Chapter 3 discusses the design of the study. The study results are summarized in Chapter 4. Chapter 5 analyzes the results of the data collected. The final chapter proposes recommendations for the developers of web-based learning tools, instructors and the university. Future research is also discussed.

Chapter 2

Currently Available Web-based Learning Tools on the Market

The web-based learning tools that are currently available on the market originate from two main sources: commercial vendors and university-based projects. Commercial vendors offer different services to their customers. These services can be categorized as *full service*, *content specific service*, *tool specific service* and *portal service*.

The full service providers customize, implement and host a complete software solution via a private network. Some of these providers offer a choice of systems and design the courses. The full service is often very expensive. The content specific service providers license their content to an organization and provide a level of learning management services to that organization. The content specific service is usually less expensive than the full service. The tool specific service providers license and host their system for an organization. The organization has full control over its own server and is responsible for implementing course content and maintaining the learning system. The prices of the learning tools vary depending on the individual tool vendors. The portal service providers host a public or private portal site and maintain the learning system in the background. Because the customers who use the portal

service do not have to invest in the hardware, software, and staffing resources that would be required to deliver their education applications, the portal service is generally less expensive than the full service option. However, these customers have less control over their own services.

The diversity of the services in the market is a consequence of the availability of a variety of web-based learning tools. It is therefore important to be aware of the differences among the tools. Even though some tools have similar features, it does not mean that those features function in exactly the same manner. To recognize the differences, strengths and weaknesses of each tool, extensive usability studies need to be done. In the next section I present an overview of six web-based learning tools, three of which (Blackboard™, LearningSpace™ and WebCT™) are discussed in more detail in the next chapter.

2.1 Blackboard™

The Blackboard™ CourseInfo [21], developed by Blackboard™ Inc., is a commercial web-based learning tool based on a client-server architecture. All three different groups of end-users (students, instructors and course administrators) access a centralized server through a web browser. Different user interfaces are designed for each user group, reflecting their different responsibilities and tasks.

The user interface designed for students consists of two *HTML* frames (see Figure 3.2). On the left side of the screen there is a toolbar. On the right side of the screen is the course presentation area. The toolbar is designed for students to navigate through courses within Blackboard™. The features designed for students include an announcement board (Announcements), course and staff information (Course Information, Staff Information), a course document area (Course Documents), an assignment area (Assignments), communication facilities (Communication Tools) and student tools (Student Tools). The announcement board is designed to notify students about information related to a specific course. The course document area is designed

for viewing course content. The assignment area provides a place to view assignments. The communication facilities consist of both synchronous and asynchronous facilities such as a discussion board, electronic mail, chat and whiteboard. The student tools contain a calendar, a homepage editor, a grade-checking tool, a drop box for submitting assignments and the online quiz facility. The Change Your Information facility in the student tools allows students to change their passwords. All of the features designed for students are accessible from the toolbar. In addition, there is a course map and search tool providing support for navigation within Blackboard™.

The user interface for instructors (see Figure 4.17) contains six groups of buttons arranged by their functions. All facilities provided for instructor and teaching assistants, such as editing and posting announcements, lecture notes and assignments, making online quizzes, and online grading, can be accessed through the buttons provided on the central page. The communication facilities allow instructors to organize group activities and interact with students in both synchronous and asynchronous modes. The tool is designed for instructors who know little about *HTML* to create their own course website that combines their learning materials, class discussions, and online tests easily.

The user interface for course administrators is similar to that provided for instructors, with some additional tools. The course administrators have the highest authorization. They not only have all rights that an instructor has, but they are also responsible for course and student management.

As a tool specific service provider, the Blackboard™ company licenses its product to its customers so that they can set up their own Blackboard™ CourseInfo servers. As a portal service provider, the company also provides a portal site for customers to create their online courses.

2.2 LearningSpace™

LearningSpace™ Anytime [22], developed by Lotus Development Corporation (an IBM company), is a set of tools designed to support synchronous collaborative learning, asynchronous collaborative learning and self-paced learning. The application is based on the Lotus Notes client and Lotus Domino server. Lotus Notes is a database management system providing its clients with a Graphical User Interface (GUI). The Lotus Domino server is a web application server providing a variety of services, such as object store (database), security (authentication), web server, messaging server (electronic mail service), and billing service. The distinct characteristic of the Lotus Domino server is that by transforming Notes into an Internet applications server, the Lotus Domino server ties the Lotus Notes application environment to the Internet protocols and standards so that any web clients can participate in Notes applications using the Internet [23,24,25].

As a set of tools, LearningSpace™ Anytime consists of LearningSpace™ Forum and LearningSpace™ Live. LearningSpace™ Forum (Release 3.0) is a Domino application, and therefore it requires Lotus Domino server support. A LearningSpace™ Forum course consists of five interconnected modules, each of which is a Lotus Notes database. Students receive the Schedule, MediaCenter, CourseRoom and Profiles modules. Instructors receive these four modules plus the Assessment Manager module. Together, these databases provide an interactive environment for teaching and learning. Compatibility with Domino allows courses to be accessible over the Internet using web browsers as well as with Notes clients. In addition, LearningSpace™ Forum comes with a database called LearningSpace™ Central. LearningSpace™ Central is designed for streamlining the process of creating and administering Forum courses. Instructors can use it to create a new course as well as to administer a course. LearningSpace™ Central is the point through which students use web browsers to access courses [26,27,30].

LearningSpace™ Live supports real-time communication. It enables the creation and delivery of synchronous online learning in a standalone format. With LearningSpace™ Live, instructors and students participate in live, interactive, online sessions in a virtual classroom. In a Live session, instructors and students interact using real-time collaboration tools such as application sharing, a shared whiteboard, text chat, web follow-me, and question and answer assessments. A Live session can also include IP audio/video if all students connected to the session have installed Microsoft NetMeeting v2.1 and the other required software and hardware (such as microphones, sound cards, and cameras) [28,29,30].

LearningSpace™ supports three different groups of end-users: students, instructors, and institution administrators. Students are able to access the LearningSpace™ courses via a web browser. Instructors are able to access the courses via both a web browser and Notes. Administrators access the LearningSpace™ environment using Notes. Supported by the tool specific service provider, Lotus Development Corporation, customers are able to set up LearningSpace™ on their own servers.

2.3 DigitalThink™

DigitalThink™ [31], developed by the DigitalThink™ Inc., is a web-based learning tool that provides web-based training courses for programmers, developers, system administrators and other end users. DigitalThink™ works with other companies to customize courses or design courses for them on demand. Because the DigitalThink™ team takes the responsibility of instructors and course administrators, the tool has only one category of end user: students. The user interface of DigitalThink™ consists of two *HTML* frames. On the left side of the screen there is a toolbar. On the right side of screen there is the course presentation area. The features designed for students include course presentations, assessment facilities, course support resource and a communication facility.

The courses provided by DigitalThink™ consist of modules according to a particular topic or skill. Within each module the course content is broken into a numbered series of lessons. The numbers are designed to help students track their progress in the course. Within each course DigitalThink™ provides two ways to navigate: the header and footer navigation bars and the course syllabus. At the top and bottom of each lesson there are arrows that allow students to go back and forth through the course. These arrows provide a tool to navigate when students are progressing through the course from lesson to lesson. Another way to navigate within a course is to use the Syllabus. The Syllabus presents an outline of a course including the titles of all modules, lessons, quizzes and exercises and allows students to move about the course in a nonlinear fashion. The Syllabus is accessible from the Syllabus button on the toolbar. Each course also contains some combination of interactive activities, such as MouseOver, FlipBook and Simulation. A MouseOver applet displays an image or code when students move their cursor over any section enclosed in a red box. When activated, an explanatory text will pop up. A FlipBook applet presents a series of images students can flip through, forward or backward. The FlipBook can demonstrate a process or a cause-and-effect relationship. A simulation applet recreates an application or operating system environment, and allows students to complete a series of steps that reinforce the lesson material. At the end of many lessons there are exercises. The exercises give students the chance to do something such as write code, work with an application, match images with their definitions or put items in their correct order.

DigitalThink™ provides assessment facilities such as self-evaluation, online quizzes and scoring. There are two types of self-evaluation tools: Matching and Ordering applets. The Matching applet allows students to match one group of items to another. This self-evaluative tool enables students to verify their understanding of the course material. The Matching applet can either match text or images with their definitions or function. The Ordering applet is another self-evaluative tool that enables students to drag different elements of a process into the correct order. Online quizzes

are short multiple-choice tests. Once an online quiz is completed, a results page will show the correct answers and explanations. The Scores tool tracks students' performance in a course compared to others by viewing the Scores page, accessible from the Scores button on the toolbar.

The course support resource within DigitalThink™ offers a group of features: Glossary, Resources, Help, Orientation and Tutor. Glossary allows students to look up a term used in the course. The Resources page contains information about the recommended or required software, course downloads, optional books, and other information that may be necessary or helpful to successfully complete the course. The Resources page also provides a link to the PDF version of the course content (not available for every course), which allows students to download and read materials off-line. The orientation is an online tutorial introducing the core learning elements used in DigitalThink™ web-based courses. The Help page is an abridged version of the Orientation that provides easy access to common questions about navigation, tutor communication, the use of Java applets in the courses, and information on where to direct non-course related questions. Every course has access to tutors for additional information and assistance with the course. Tutors are the content experts who read and check students' exercises and provide feedback for every student. They are available to answer questions about the course via electronic mail. All of the features in the course support resource category are accessible from the corresponding buttons on the toolbar.

The communication facility provided by DigitalThink™ consists of a discussion forum, a chat room and a messenger. Within each course, the discussion forum allows students to participate in threaded discussions related to course-specific topics. The Discussion area is a place to post questions and responses to specific questions posed by other students. The Discussion area is accessible from the Discuss button on the toolbar. The Chat and Messenger are mechanisms which allow for real-time communication with others. They are accessible from the corresponding buttons on the toolbar.

Students access courses provided by DigitalThink™ first time via self-registration. As a full service provider, the DigitalThink™ company hosts, organizes, delivers, and maintains the server and all of the courses.

2.4 eCollege™

The eCollege™ tool [32] is a web-based learning tool developed by the eCollege.com company which partners with educators such as the California State University-Hayward, University of Colorado and University of Pennsylvania. It consists of a set of tools supporting web-based learning using a client-server architecture.

Within eCollege™ courses the main features designed for students include an interactive syllabus, course presentation and documenting facility, sharing documents facility and communication facility.

The Interactive Syllabus allows students to immediately access the content of their course by clicking on the corresponding topic or section in the Interactive Syllabus which is accessible from the toolbar on every page. Four styles of course presentations are supported by eCollege™: general reading materials, multimedia content, threaded discussion and online quizzes. General reading materials include lecture notes, readings, assignments, and slideshows incorporated into the course. To access the multimedia content students need additional multimedia software such as RealPlayer to play live and on-demand video, audio and animation over the Internet. The Threaded Discussion tool is designed to allow students and their classmates to share in ongoing dialogues. By posting each response as an individual link, this feature gives students the ability to respond to their class as a whole or to the ideas of a particular classmate. The online quizzes can consist of a combination of the following types of questions:

- True/False
- Multiple Choice
- Many Multiple Choice

- Matching
- Short Answer
- Essay
- Fill In the Blank

If specific dates are set, online quizzes cannot be accessed outside of the specified allotment of time and can only be entered once. The documenting facility refers to Notebook, Journal, and Webliography. The Notebook feature provides students with a place to record their notes and ideas electronically. It allows students to store and retrieve information from within their online courses. The Journal is designed for use between students and their instructor. Students can post comments in the Journal and the instructor can respond through the Gradebook tool. Document Sharing gives both students and instructors the ability to upload and download documents, images, spreadsheets, *HTML* pages and small programs. It allows students to share and view these files and then rebuild, revise, or recreate them. The Webliography is an annotated bibliography of World Wide Web sites, allowing students and instructors to build a virtual library of Web links. Use of the Webliography is unique for each particular course, but in every case both students and instructors have the ability to submit sites.

The communication facility supported by eCollege™ includes an Online Chatroom, Message Center, and Electronic Mail. The Online Chatroom allows students to join in real-time synchronous discussions. The Message tool is designed to mimic the function of a bulletin board. In the Message Center the instructor can post important dates, reminders, revisions, or any important information that comes up over the course of the semester. The Email Class feature allows students to send messages to their instructor and classmates without having to leave their online course. This feature gives students the option of sending an email to the entire class, selected members of the class, the instructor, or any combination thereof. With the communication facility, students are able to form online clubs and communities in which they can exchange information and ideas.

From the eCollege™ package, the eTeaching Solutions set is designed for instructors to set up a single course on the Internet and the Campus Solutions set is designed to be suitable for campus-wide use. The major application of eCollege™ is CampusPortal. It provides an institution's administrative services, such as course catalog, registration system, online admission forms, library and career counseling. It can be used in combination with eCourse to create interactive courses.

As a portal service provider, the eCollege.com company hosts, delivers, and maintains the server and the courses for its educational partners in a single, central web location. Universities or organizations using the tool have to host their online educational offerings remotely.

2.5 WebCT™

WebCT™ [33], developed by the department of computer science at the University of British Columbia, is a web-based learning tool. It is designed to facilitate the creation of sophisticated web-based educational environments by non-technical users. Like Blackboard™, all three different groups of end-users (students, instructors and course administrators) access a centralized server through a web browser. WebCT™ provides specific user interfaces and facilities for each of the different user groups.

The user interface designed for students is a single web page containing different icons (see Figure 3.3). Each of these icons stands for a single feature or a group of features. The basic features designed for students in WebCT™ can be summarized into four categories: the course presentation facility, assessment facility, course support resources, and communication facility.

The course content presented within WebCT™ is a sequence of *HTML* pages or PDF files. Both presentation formats permit images to be combined with text. Students access the course materials by clicking on the corresponding icon on the main page.

The assessment facility includes the assignment tool, online quiz tool and grade-checking tool. The assignment tool allows students to view and download available

assignments. The Student Drop Box within the assignment tool allows students to submit their assignments online. The online quiz tool allows students to do either timed or untimed quizzes, depending on how instructors choose to set them up. The checking grades tool allows students to view their own marks.

Other features such as the course map, search engine, calendar, and student homepage tool belong to the course support resource.

The communication facility, consisting of the bulletin board, chat room, whiteboard and electronic mail, supports both synchronous and asynchronous communications. WebCT™ uses its own built-in electronic mail facility.

The instructor interface for WebCT™ is similar to the interface provided to students, but with extra buttons on the toolbar (see Figure 4.20). Each of the buttons on the toolbar stands for different features that instructors can use to create on-line courses, or to simply publish materials that supplement existing courses. The features designed for instructors include the Course Welcome Page tool, course content creation facility, creation of online quizzes, and student access control. There is also a facility supporting student group work. Instructors access features via a web browser. WebCT™ also provides a set of administrative tools to assist the administrator in the process of student and course management. Administrators also use the tools via a web browser.

2.6 Web Lecture System

The Web Lecture System (WLS) [34] was originally developed by the Regional Training Center for Parallel Processing at North Carolina State University, Raleigh, as a research software product. It is a web-based learning tool providing support for constructing, editing, presenting, and managing web-based multimedia presentations. The main characteristic of WLS is that it implements methods for automatically generating and serving web-based multimedia presentations based on live versions of the presentations [5]. The presentations include *HTML* documents and streaming

synchronized audio and video. WLS supports three user categories: students, instructors and system administrators. With the tool, students are able to read or print online lecture slides via a standard Web browser, such as Netscape, and listen to or watch the accompanying multimedia streams via a RealNetworks audio/video player [27]. Instructors are able to prepare slides using the built-in online editor and construct lectures by selecting individual slides, or groups of slides, from the available slide sets. System administrators are responsible for installing, configuring and maintaining WLS, including the underlying file and database structure.

2.7 Summary

In summary, each of the tools has its own distinct characteristics. Some of them support multimedia course content, while others do not. Some tools offer support for three types of end-users, while others support only one type of end-users. Some tools can be set up on local machines, while others can only be used remotely. This review alerts instructors and administrators to the characteristics and features the individual tools possess. However, to choose the appropriate web-based learning tool to match the personal and institutional requirements of instructors and administrators, it is also important for these users to know how easy, effective and efficient the tool and its features are to use. To answer these questions, it is crucial to study the usability of web-based learning tools. The following chapter describes our usability study evaluating two of these tools.

Chapter 3

Research Methods

To investigate innovative web-based learning tools further while avoiding the limitations of the case studies described in Chapter 1, we compared two web-based learning tools from the perspectives of students, instructors and course administrators by deploying the tools in an actual course. The study was conducted during thirteen weeks of the Spring semester 2000 at the University of Victoria. Student participants were asked to use and assess three different course websites. The first was generated with standard *HTML*. The second and third were generated with the web-based learning tools Blackboard™ and WebCT™. Three questionnaires were distributed during four time periods of the study. Both quantitative and qualitative data was collected through the questionnaires. Further qualitative data was gathered from the experimenters' logs and observations.

This chapter is composed of three main sections. Section 3.1 describes the participants and our reasons for choosing them. Section 3.2 summarizes the materials used in the study, including the criteria for selecting the web-based learning tools used in the study, the system requirements for the selected tools, and the experimental settings. The final section explains the design and procedure of the study.

3.1 Participants

Fifty-four students enrolled in a course on Human Computer Interaction (HCI) were recruited for the study at the beginning of the course. Most of the participants were third and fourth year students in Computer Science. Students were chosen because they represnt the intended end-users of web-based learning tools (other users include instructors and administrators). Their participation is essential to evaluating these tools because of their experience in traditional classroom learning and their knowledge of educational processes. The objective of the HCI course was to help students understand human behavior as it applies to user interfaces and to assist them in the design and evaluation of human-computer interfaces. The students were therefore able to apply the theories they were learning to the research study and the course helped them assess the tools in a more informed way. Since the participants in the study were predominately third and fourth year students in Computer Science, they had the ability to solve general problems caused by the tools. Consequently, their performance in the course would not be as affected by any difficulties in the use of the tools as it may have been for students with less computer experience. It was hypothesized that if Computer Science students had difficulties with these web-based learning tools, or some of the features provided by the tools, other students with less expertise with computer technology would feel even more uncomfortable with the tool or find it more difficult to use.

Students' participation in this project was entirely voluntary and they could withdraw from it at any time. CGI (Common Gateway Interface) scripts were used to guarantee that whenever students wanted to withdraw from the study they would be able to access the course website generated with the standard *HTML*, ensuring that their performance in the course not be affected. They were also told that if they chose to withdraw, the data collected from them would have been destroyed. Participants also had the right to refuse to answer any of the usability questions they did not wish to answer. We designed the study such that students would not suffer any negative

consequences, whether participating or not, and their decision would not affect their grade for the course. Students who did not participate in the study did an extra assignment which was related to the study. Hence, students not participating in the study still had an opportunity to learn about web-based learning tools.

The benefits from participating in this study were that students would gain experience in using web-based learning tools and that they would gain experience being the "user" in a usability study. The study also provided an environment in which students were able to apply concepts and techniques learned in the classroom directly to their study situations. The costs of participating may have been the inconvenience of learning how to use each of the tools.

3.2 Materials

As there are many web-based learning tools available, it is impractical to study all of them. The criteria for selecting the web-based learning tools for this study are based on the tool's scope of use, whether it has enough features to meet the course's needs, and its similarity with other tools.

3.2.1 Tool Selection

One criterion for the selection of web-based learning tools was that it should be functional enough that it could be used in a wide variety of classes across a university. This criterion was included because the research was partly supported by the Learning and Teaching Center at the University of Victoria and the university was seeking a well-designed web-based learning tool to be used within the university. If a web-based learning tool provides university-wide use, then all faculty members would be able to share resources through using the tool and management for the university would be easier. A university-wide tool creates some convenience for students as well. When students register for more than one course, they will be able to use the same tool for all of their courses. To be chosen for this research study, the web-based learning tool

selected must also provide a means of managing students, instructors and administrators access as well as course catalogues and registration. Since the tools selected were to be deployed in a Human Computer Interaction course, they need to provide enough features to meet the needs for the course. We determined that the course needed the following features:

- News/Announcements

  The instructor needed to be able to post news or announcements somewhere on the course website so that students would be informed of important news, even if they miss a class.

- Course Notes

  The instructor should be able to create course content using the tools and migrate the existing course materials into the tools as well. The tools should, at a minimum, accept both *HTML* and *PDF* file formats.

- Course Information

  The instructor needed this place to post information about the instructor, teaching assistant, course outline, etc.

- Electronic mail

  The instructor needed the electronic mail facility to communicate with students, and students also needed the facility to communicate with each other.

- Assignment Submission

  Students needed the assignment submission facility to submit their assignments electronically.

- Online Quiz

  The instructor needed to be able to create online quizzes so students would be able to do interactive exercises.

- Reference Area

The instructor needed a place to post interesting links, related materials, as well as the course references.

Of course, some synchronous and asynchronous communication facilities such as chat, discussion board, or bulletin board, are desirable features of a web-based learning tool. However, using these communication facilities was not mandatory in the course. To allow direct comparisons, the web-based learning tools selected should be comparable in terms of available features.

By applying the selection criteria, three web-based learning tools were chosen. The tools included in the study were Blackboard™, LearningSpace™ and WebCT™. Table 3.1 summarizes the main features provided by each tool.

Table 3.1: Main features of the selected tools

	Blackboard™	LearningSpace™	WebCT™
Scope of Use	Campus Wide	Institution Wide	Campus Wide
Main Features	• Content Creation Facilities • Synchronous and Asynchronous Communication Facilities • Assessment Facilities • Student Management Facilities	• Content Creation Facilities • Synchronous and Asynchronous Communication Facilities • Assessment Facilities • Student Management Facilities • Support for Multimedia Content	• Content Creation Facilities • Synchronous and Asynchronous Communication Facilities • Assessment Facilities • Student Management Facilities
Popularity	Used by 3,300 institutions	Used by universities and companies	Used by 1,350 institutions
Cost	(US)$5,000.00/year /per institution	(US)$10,500/per server	(US)$3,000.00/year /per institution

3.2.2 System Requirements

Blackboard™, LearningSpace™ and WebCT™ are all client/server applications. The system requirements for each of the tools for the server are different. However, for the

client, the three tools have very similar system requirements. Table 3.2 lists the minimum client system requirements for each of the three tools.

Table 3.2: Minimum system requirements for the client

	Blackboard™	LearningSpace™	WebCT™
Hardware	• Processor: Intel 486 or better • RAM: 16 MB or greater • Modem Speed: 14.4 or faster	• Processor: Pentium 133MHz or comparable • RAM: 16 MB or greater • Modem Speed: 14.4 or faster	• Any computer capable of running Netscape 4.0 or higher • Modem Speed: 14.4 or faster
Browser	• Netscape: 4.x • Internet Explorer: 4.0 or higher	• Netscape: 4.x • Internet Explorer: 4.x or 5.x	• Netscape 4.x • Internet Explorer 4.x, 5.x
Other		Student and Instructor clients: • Windows 95/98/NT • Notes 4.6.x Administrator clients: • Windows 95/98/NT • Notes 4.6.x	
Options	• Plug-ins	Audio and Video requirements: • RAM: 32MB • Sound Card • Microphone • Speaker • Software: NetMeeting 2.1 DirectX5.0	• Plug-ins

The server system requirements for each of the three tools are quite different in both hardware requirements and supporting platforms. Table 3.3 depicts the minimum server hardware requirements and supporting platform of each of the tools.

Table 3.3: Minimum hardware requirements for the server

	Blackboard™ Server	LearningSpace™ Forum and Live Server	WebCT™ Server
Supporting platform	• Windows NT/98/95 • Unix and its variants	Windows NT	• Windows NT • UNIX and its variants
Processor (Windows version server)	Pentium II 300	Pentium 166MHz	Pentium class
RAM	256MB	128MB	128 MB
Disk space	75MB for the software about 20MB per course	57MB for Forum database files; 57MB for Forum temporary installation files; about 23MB for empty Forum courses; Forum course disk space requirements increase significantly as content is added to courses; 300MB for Live courses and 64MB for disk swap space.	depending on the number of courses and students served

3.2.3 Experimental Settings

The Linux version of Blackboard™ and WebCT™ were adopted. When the experiment started, only CourseInfo 4.06 (Blackboard™) was available. Later, it was updated to version 4.07 and then to version 4.08. WebCT 2.0 was also used in the study. The Microsoft Windows NT version of LearningSpace™, LearningSpace™ Anytime 3.0, was donated for the study. Table 3.4 shows the software settings for the experiment.

Three computers served as the servers in the experiment. The server distribution was as follows: both the Blackboard™ and WebCT™ server were installed on computer A; the LearningSpace™ Forum server was installed on computer B and the LearningSpace™ Live server was installed on computer C as it was required that the

LearningSpace™ Forum server and LearningSpace™ Live server be installed on different physical machines. Table 3.5 depicts the hardware settings of the experiment.

Table 3.4: Software settings of the experiment

	Blackboard™	LearningSpace™	WebCT™
OS	Linux 2.0	Windows NT 4.0	Linux 2.0
Server Application	• CourseInfo 6.0 (later updated to CourseInfo7.0 then CourseInfo 8.0)	• Domino 4.6.2a • Forum 3.0 • Live 3.0	• WebCT 2.0

Table 3.5: Hardware settings of the experiment

	Computer A	Computer B	Computer C
CPU	PC Pentium III 400	PC Pentium III 450	PC Pentium III 400
RAM	256MB	256MB	256MB
CACHE	128KB	128KB	128KB
Hard Drive	2GB	2GB	2GB

The course was taught on a face-to-face basis. However, the course materials and course related information were on the course website. To differentiate the course website generated by the standard *HTML* with the websites generated by the three tools, the term *generic course website* will be use in this thesis. Figure 3.1 shows the screen shot of the home page in the generic course website.

To not affect students' performance within the course, the exact course content in the generic course website was reused within the three tools. In addition, to minimize the workload caused by using the tools, the structure of the course websites produced by Blackboard™, LearningSpace™ and WebCT™ followed the structure of the generic course website as much as possible without making the tools unusable. For example, in the generic course website, there were the Course Notes, Interesting Links, News and Readings components, etc. (see Figure 3.1). All of these components were created within the tools as well. Figure 3.2, Figure 3.3, and Figure 3.4 show the screen shots of the home pages in Blackboard™, WebCT™ and LearningSpace™.

Figure 3.1: Home page in Generic course website

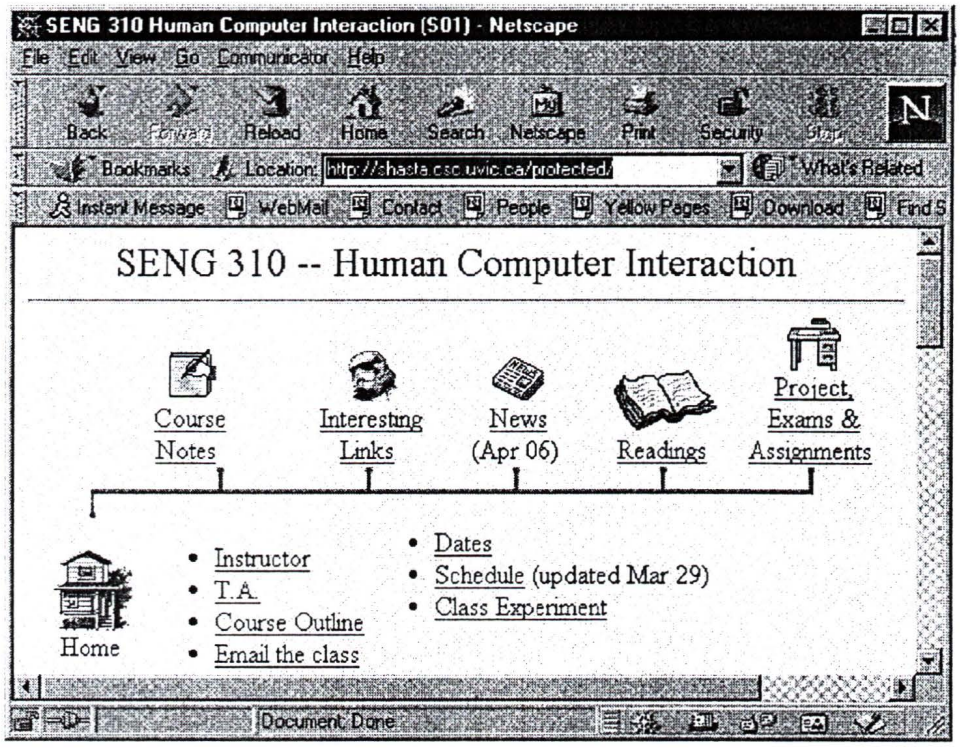


Figure 3.2: Home page in Blackboard™

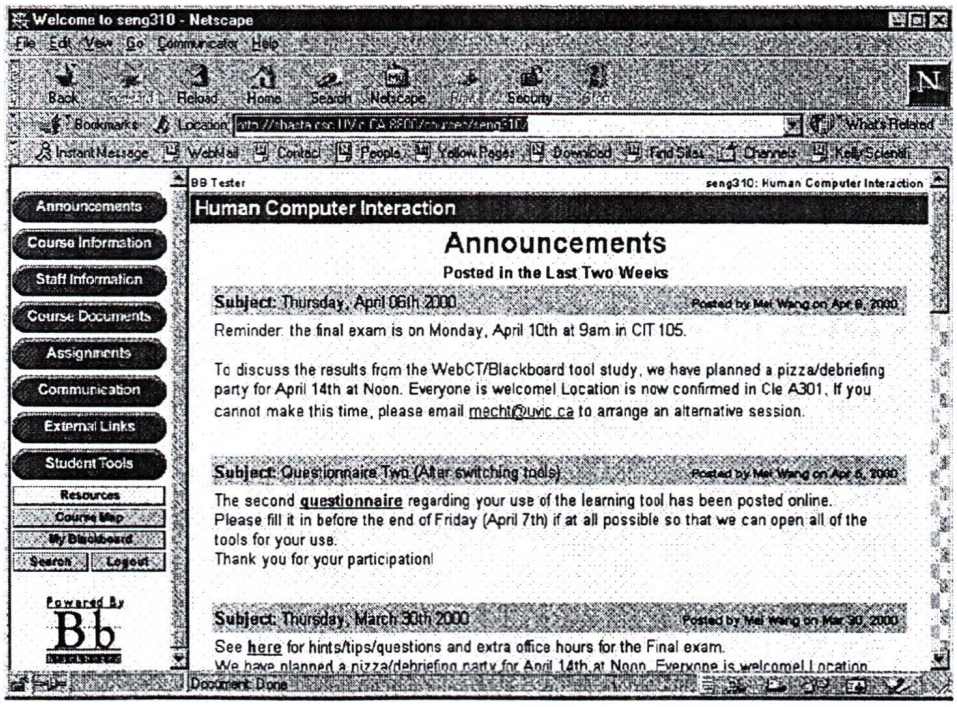


Figure 3.3: Home page in WebCT™

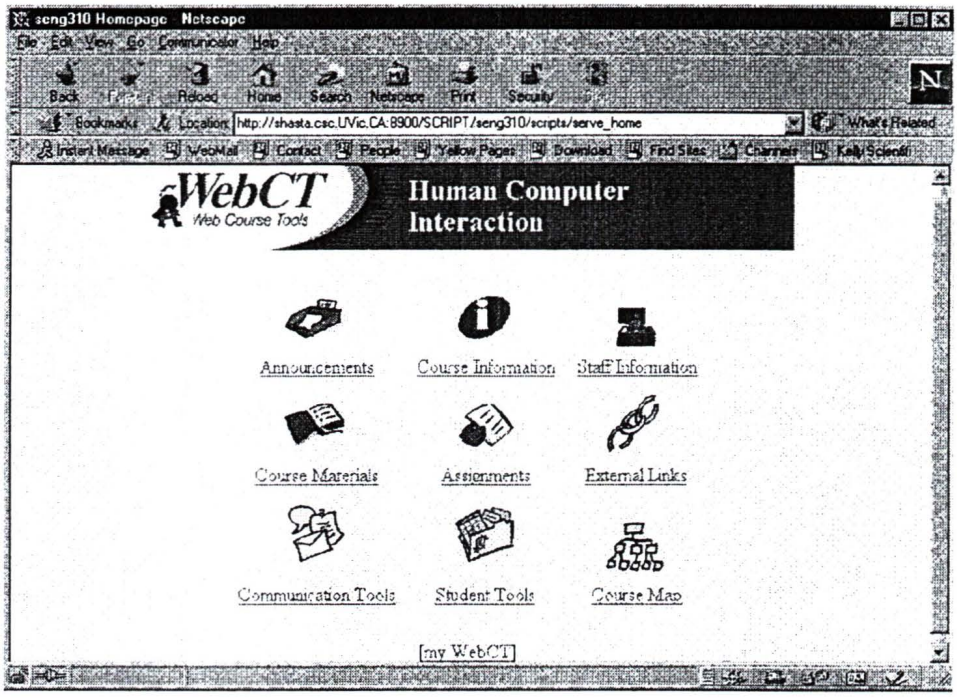
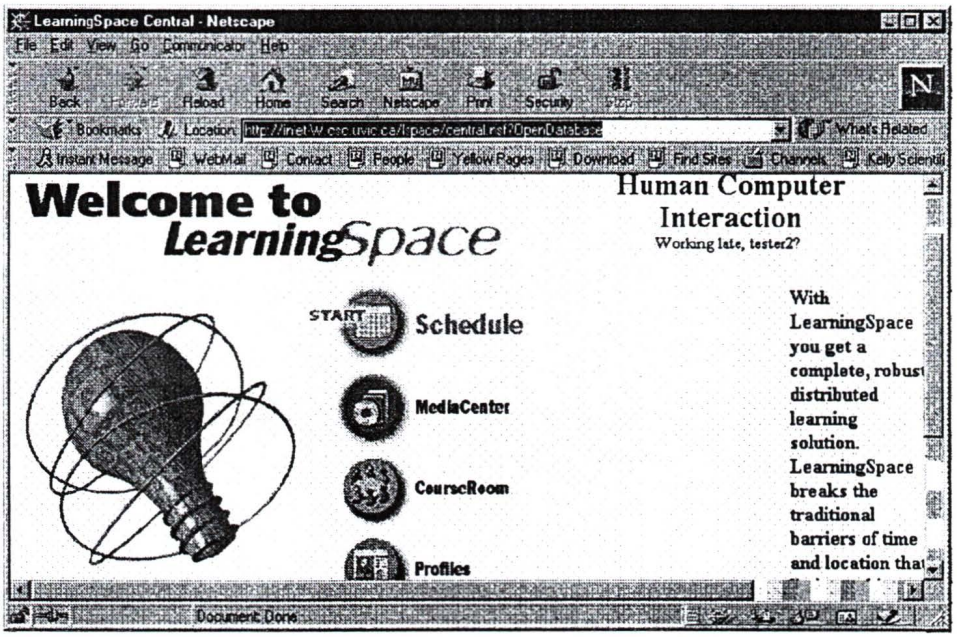
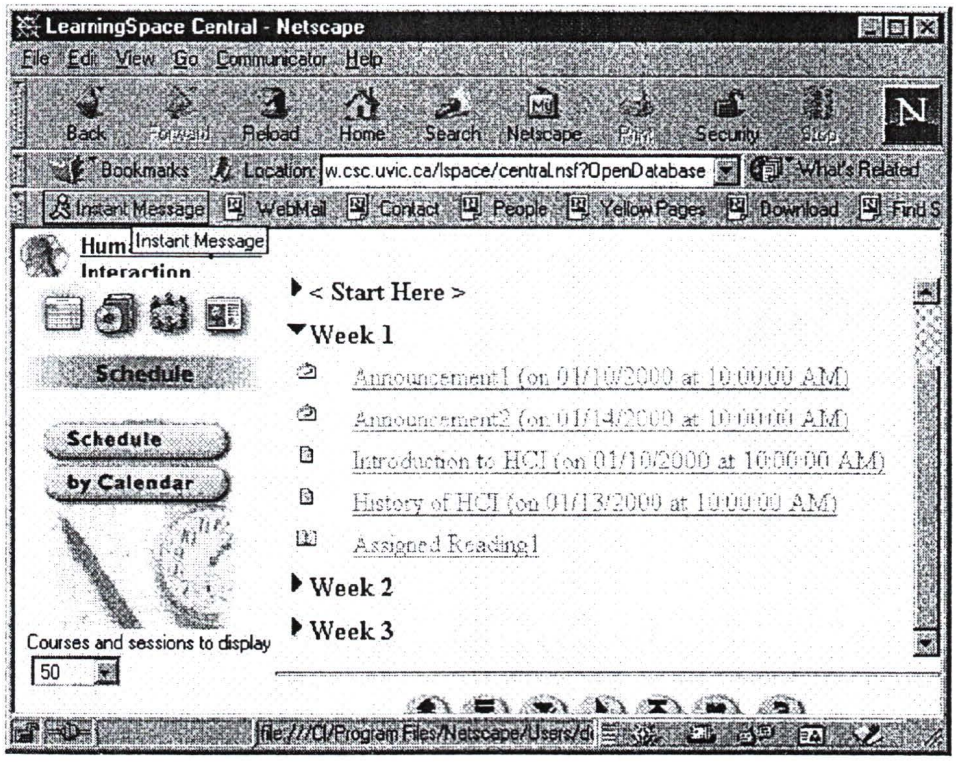


Figure 3.4: Home page in LearningSpace™



In Blackboard™, the Announcements, the Course Documents and the External Links corresponded to the News, the Course Notes and the Interesting Links respectively in the generic course website. The Readings in the generic course website was placed under the Assignments in Blackboard™. Similarly in WebCT™, the Announcements, the Course Materials and the External Links corresponded to the News, the Course Notes and the Interesting Links in the generic course website. The Readings in the generic course website was also placed under the Assignments in WebCT™. However, for LearningSpace™ it was very difficult to organize the course structure to be similar to the structure of the generic course website. In LearningSpace™, courses are typically structured in terms of the time schedule instead of the topics covered in the courses. Figure 3.5 shows the screen shot of the schedule page in LearningSpace™. Because LearningSpace™ did not provide enough flexibility for setting up the course as the instructor desired, it was not included in the study.

Figure 3.5: Schedule page in LearningSpace™



3.3 Design and Procedure

We determined sets of criteria for comparing the web-based learning tools. Based on Pantel's comparison framework [2], which consists of seventeen dimensions, the assessment criteria used in the study were narrowed to aspects which students, instructors and administrators are most likely concerned with when using a web-based learning tool.

3.3.1 Evaluation Criteria

Four evaluation criteria were used in assessing Blackboard™ and WebCT™. These criteria were: ease of use, learning curve, effectiveness, and flexibility. The following explains each of the criteria in detail.

a. Ease of use

There are four factors affecting the ease of use of a web-based learning tool.

- Ease of navigation within the tool

  Ease of navigation within the tool refers to how easy students can find the information they want and how easy instructors and administrators can find the specific features required for performing the tasks they need.

- Ease of use of specific features provided by the tool

  For example, students are particularly concerned about how easy it is to submit assignments, how easy it is to use online quizzes, and how easy it is to communicate with each other using the tool. Instructors are typically concerned with how easy it is to organize their courses, to reuse the existing materials, and how easy it is to use other facilities provided by the tool. Administrators are likely to be concerned about ease of use of the student and course management features.

- Ease of finding technical support for using the tool

Students, instructors and administrators are concerned with getting technical support when they encounter problems with the tool. Technical support may include printed user guides, online documentation, online tutorials, and access to technical experts.

b. Learning curve

The learning curve of a web-based learning tool is usually measured by the time users spend learning to use the tool. It is related to the ease of use of the tool. However, sometimes it is hard to track the amount of time students spend learning to use the tool. Instead of measuring time; therefore, we used the following four options on our questionnaires to assess students' perception of their learning curve with each of the tools:

- Easy to learn and easy to use
- Easy to learn but difficult to use
- Difficult to learn but easy to use
- Difficult to learn and difficult to use

c. Effectiveness

The effectiveness of web-based learning tools will definitely have a positive or negative impact on students. This factor refers to how well web-based learning tools facilitate learning.

d. Flexibility

Like most computer applications, web-based learning tools should offer a certain degree of customizability. In Pantel's comparison framework [2], he considered customization from three distinct levels: end-user customizations, system administrator customizations and vendor customizations. Systems that provide the most customizability tend to be the most flexible but they may also be more complex. In our evaluation only the first two levels of customization were considered. As the end-users, students are likely concerned about whether the tool provides preferences from which they can select, while instructors are likely to be concerned with whether there are built-in facilities they can use to meet

their course needs and whether the tool allows them to organize the courses as they desire. There is also a wide array of variables that end-users might be able to customize, such as user interface preferences and security options. Except for concerns with installing and managing a web-based learning tool, administrators may also be able to customize the tool's behavior and appearance for their particular organization.

3.3.2 Design of Questionnaires

To accomplish the evaluation, three questionnaires were used in the study. Each questionnaire consisted of three types of questions: multiple choice questions, scaled-answer questions and open-ended questions. The first questionnaire (Q1) (Appendix A) was designed to gather information concerning the ease of learning and ease of use of the tools. It included a total of eight questions, one multiple-choice question, six scaled-answer questions and an open-ended question. The multiple-choice question was designed to detect how students learned to use the tool. Several scaled-answer questions were designed to collect statistical data regarding the ease of use of the tools. Figure 3.6 shows an example of the scaled-answer questions used in the first questionnaire.

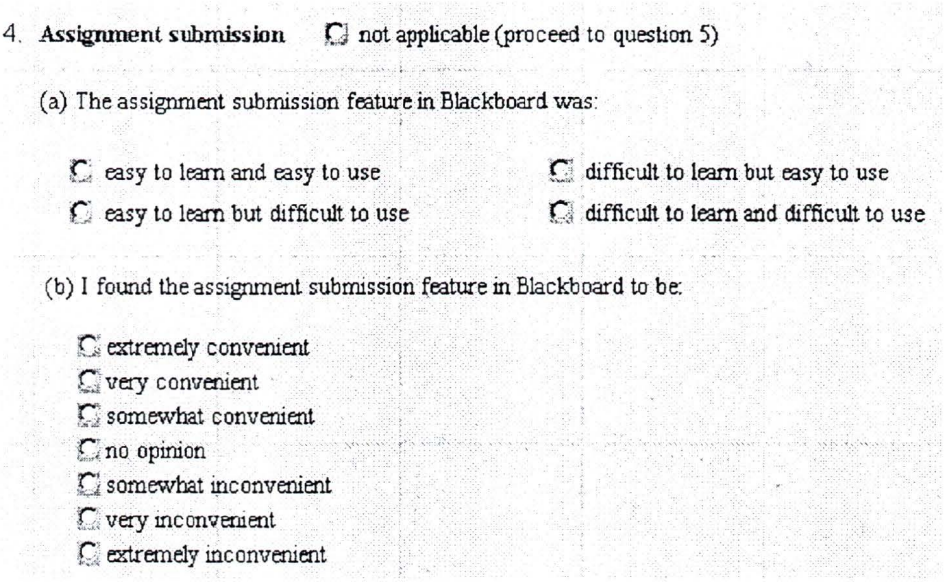
Figure 3.6: Q1 - A sample question

2. How easy is it to use the online quiz?	
O	extremely easy
O	very easy
O	Easy
O	Middle
O	Difficult
O	very difficult
O	extremely difficult

The open-ended question in the first questionnaire was designed to identify the technical difficulties students had when using the tool.

The second questionnaire (Q2) (Appendix B) was designed to gather information about the students' learning curve for the tool and their assessment of the tool by the individual features they used. It contained a total of twelve questions. The first eight questions were divided into two parts. Part A was concerned with the learning curve of individual features provided by the tool and part B was concerned with the impact on the students. Figure 3.7 shows an example of these questions.

Figure 3.7: Q2 - A sample question

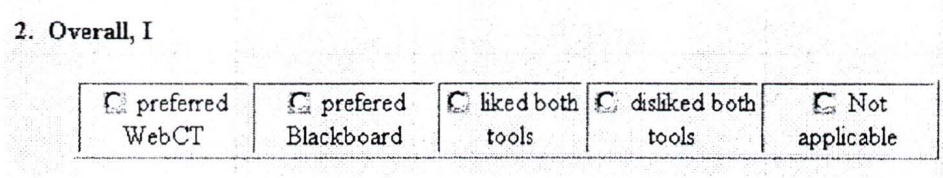


There were also four open-ended questions concerning students' assessment of the tool. Questions such as "Which features of Blackboard™/WebCT™ did you consider useful? Why?" and " Which features of Blackboard™/WebCT™ did you consider useless? Why?" were asked.

The third questionnaire (Q3) (Appendix C) was designed to compare the two tools with each other and with the generic course website. Figure 3.8 shows an example of these questions. There were also several questions on the third questionnaire (Q3) concerning students' recommendations for using web-based learning tools as a teaching and learning aid. Questions such as " How could the

University best enhance your learning through the use of a web-based learning tool?" were asked. A total of seven questions were included in Q3.

Figure 3.8: Q3 - A sample question

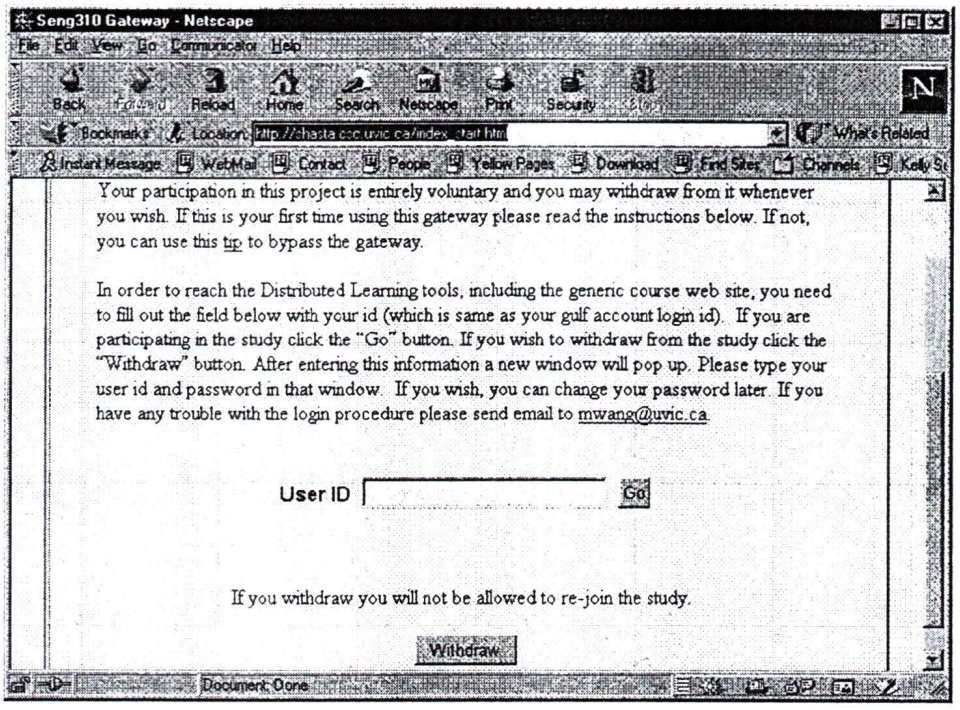


All of the questionnaires were designed as online forms and both quantitative and qualitative data from students were gathered electronically through the completion and submission of the online questionnaires. Further quantitative and qualitative data was collected from the experimenters who kept an informal log about installation time and the difficulties caused by using the tools from both instructors' and course administrators' perspectives.

3.3.3 Tool Access Control

To help the students access the right tools in the different stages of the study, we built a gateway to the tools. Figure 3.9 shows the screen shot of the gateway. When students logged onto the gateway they were automatically redirected to the tool to which they were assigned. If they clicked the "Withdraw" button, they would withdraw from the study and were automatically granted access to the generic course web site. If they chose to withdraw from the study, they would not be allowed to access the tools again. Students who were not participating in the study were also granted access to the generic course web site.

Figure 3.9: Gateway

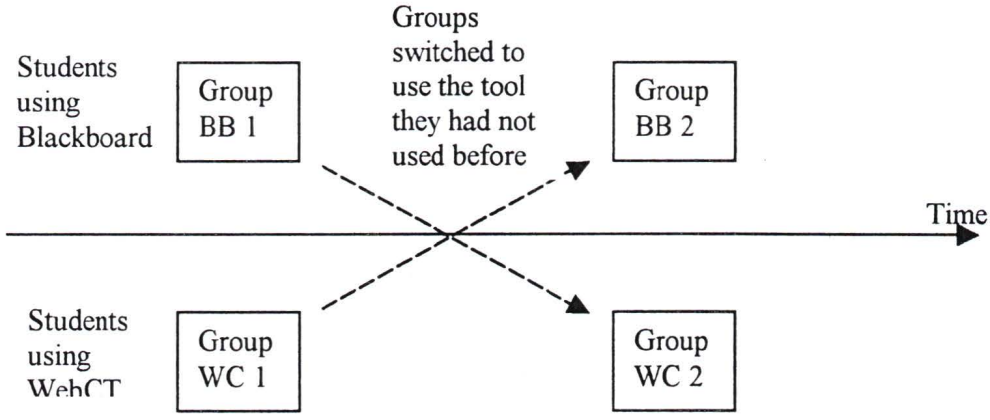


3.3.4 Procedure

Participants were randomly divided into two groups of twenty-seven. Each group of students used each tool for four weeks. The thirteen-week experiment was divided into four time periods according to the distribution of the tools. During the first three weeks (T1) all students used the generic web site. During the following four weeks (T2) Blackboard™ and WebCT™ tools were assigned to the student groups in a counterbalanced order. The groups of students who used Blackboard™/WebCT™ in the second time period T2 were called BB1 and WC1 respectively. At the end of T2 students switched tools. This means that students who initially were using Blackboard™ began using WebCT™ and vice versa. The following four weeks after switching tools was the third time period (T3). The groups of students who were using Blackboard™/WebCT™ in T3 were called group BB2 and WC2 respectively. Note that groups BB1 and WC2 encompass the same students, while groups WC1 and BB2

encompass the same students. Figure 3.10 illustrates the definition and movement of the two student groups.

Figure 3.10: Definition of student groups



During both time periods (T2 and T3) students were required to complete activities such as submitting assignments and completing online quizzes so that they had the opportunity to use the different features provided by each of the two tools. The two questionnaires (Q1 and Q2) were administered in the middle and at the end of each of the two time periods. In the last week of the experiment, which was the fourth time period (T4), all students were free to access Blackboard™, WebCT™ and the generic course website. Therefore, students could choose the tool they preferred to use. At the end of T4 all students were given the third questionnaire. Perl scripts were designed to collect data and monitor the students' responses to each of the questionnaires. Table 3.6 gives an overview of the experimental timeline, the students groups, their access to the course websites and researcher actions.

Table 3.6: Experimental time line

Time Period of Study	Student Groups	Access to Tools	Actions Taken
First time period (T1) Weeks 1, 2, 3	All students	Generic Course Website	Recruitment of Participants Explanation of Study Consent Procedures
Second time period (T2) Weeks 5, 6, 7, 8	BB1 WC1	Blackboard™ WebCT™	Q1 (at the end of week 6) Q2 (at the end of week 8) Q1 (at the end of week 6) Q2 (at the end of week 8)
Third time period (T3) Weeks 9, 10, 11, 12	BB2 WC2	Blackboard™ WebCT™	Q1 (at the end of week 10) Q2 (at the end of week 12) Q1 (at the end of week 10) Q2 (at the end of week 12)
Fourth time period (T4) Week 13	All students	Generic Course Website, Blackboard™ and WebCT™	Q3 (at the end of week 13) Debriefing session at the end of the school term

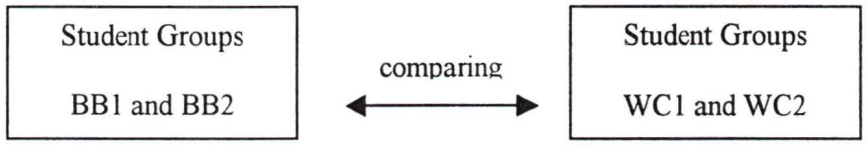
Note: BB1=WC2, WC1=BB2

Chapter 4

Results

The first comparison was between Blackboard™ and WebCT™ groups (see Figure 4.1).

Figure 4.1 Comparison of Blackboard™ and WebCT™



When comparing individual tool features, we found significant differences found between Blackboard™ and WebCT™. Participants' overall assessment of the tools indicated that Blackboard™ was easier to use than WebCT™. Detailed results from the comparison of Blackboard™ and WebCT™ are reported in section 4.1 of this chapter.

The other comparison dimension was between the student groups who used the same tool but in different study time periods. We compared the student group who used Blackboard™/WebCT™ in T1 with the student group who used Blackboard™/WebCT™ in T2 (see Figure 4.2 and Figure 4.3).

Figure 4.2: Comparison of Blackboard™ groups

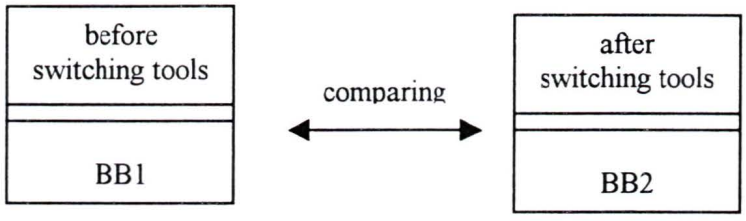
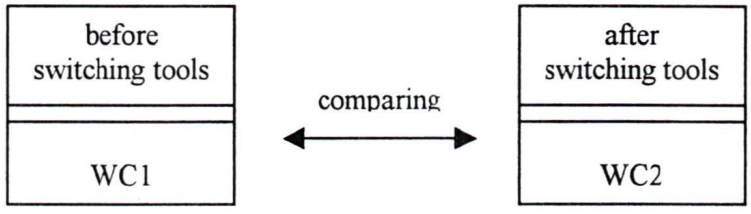


Figure 4.3: Comparison of WebCT™ groups



There was no significant difference found between the BB1 group and the BB2 group for their rating of how easy it was to use Blackboard™, while there was a significant difference found between the WC1 group and the WC2 group for their rating of how easy it was to use WebCT™. The detailed comparison results are reported in section 4.2 of this chapter.

The results from the course instructor and administrator's assessment of the tools are reported in section 4.3 of this chapter. It was discovered that some features, such as reusing course materials and student registration, were easier to use in Blackboard™ than in WebCT™. However, other features such as course access control and customizability was easier in WebCT™ than in Blackboard™.

Although it is difficult to measure a tool's ability to enhance students' learning, students were asked whether they believed the tools facilitated their learning. The impact a web-based learning tool has on students' learning are summarized in section 4.4 of this chapter.

4.1 Comparison of Blackboard™ and WebCT™ groups

In this section the response rate for each questionnaire is presented followed by an analysis of the tool features evaluated and the overall rating of the tools. All quantitative and qualitative data presented in the section were collected from five questionnaires. To present the research results statistically, the scales used in the questionnaires have been converted to numbers. Table 4.1 shows how we performed the conversion.

Table 4.1: Numerical presentation of the scales

1	2	3	4	5	6	7
extremely easy	very easy	easy	Middle	difficult	very difficult	extremely difficult
extremely quickly	very quickly	quickly	no opinion	slow	very slow	extremely slow
extremely effective	very effective	somewhat effective		somewhat ineffective	very ineffective	extremely ineffective
extremely convenient	very convenient	somewhat convenient		somewhat inconvenient	very inconvenient	extremely inconvenient

In addition, we have made, when appropriate, small grammatical changes in the comments provided by the participants such as capitalization, punctuation, spelling errors and extra white space so that the data are more readable.

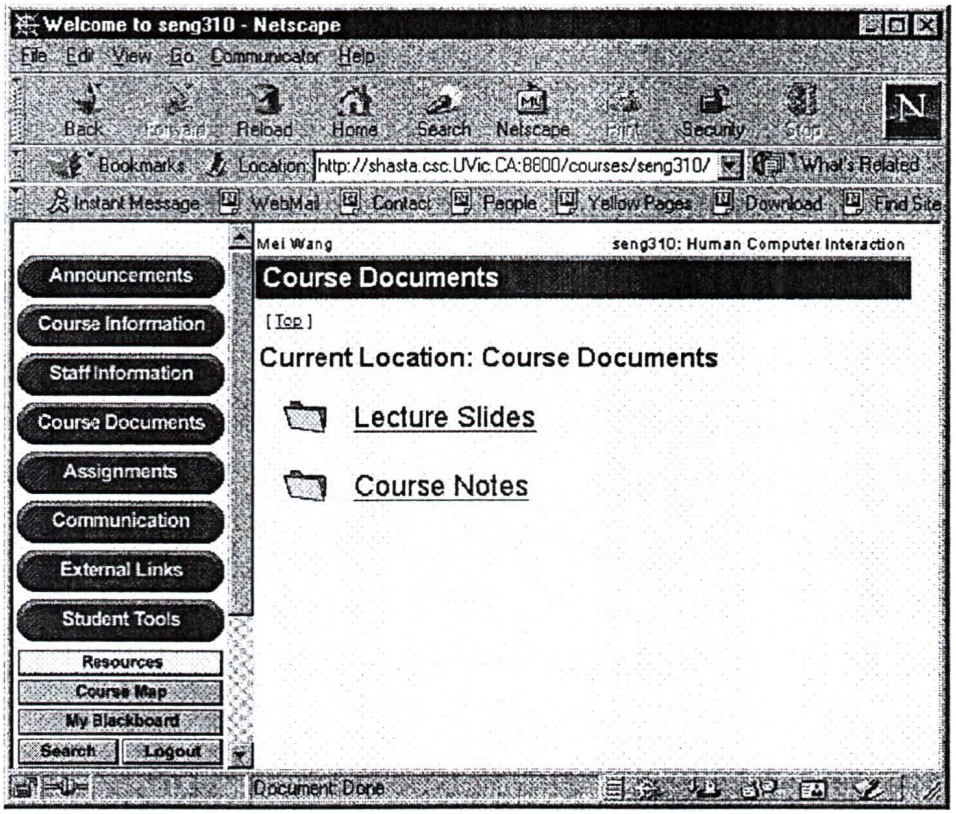
4.1.1 Response Rates to the Questionnaires

Blackboard™ and WebCT™ groups had response rates of 100% and 85.19% for Q1 and response rates of 88.89% and 77.78% for Q2 respectively. After switching the tools, Blackboard™ and WebCT™ groups had response rates of 81.48% and 92.59% for Q1 and both had a 77.78% response rate for Q2. The third questionnaire, Q3, had forty-three responses from fifty-four participants, making the response rate 79.63% for the final questionnaire.

4.1.2 Navigation

When logging onto the Blackboard™ course website students were greeted with the Announcements page first. This informed them about what was new and what had been updated without their having to actively seek for it (see Figure 3.1). The left frame contains the navigational toolbar. The eight oval shape buttons on the toolbar are persistent so that students were able to access them wherever they were in the course website. By clicking on the button <Course Documents> on the toolbar, students were able to access the Course Documents page (see Figure 4.4).

Figure 4.4: Course Documents page in Blackboard™



If students wanted to find assignments, they could just click on the button <Assignments> (see Figure 4.5). To view the Reading assignments, they could then click on the <Readings> link on the right side of the page. Figure 4.6 shows the Readings page.

Figure 4.5: Assignments page in Blackboard™

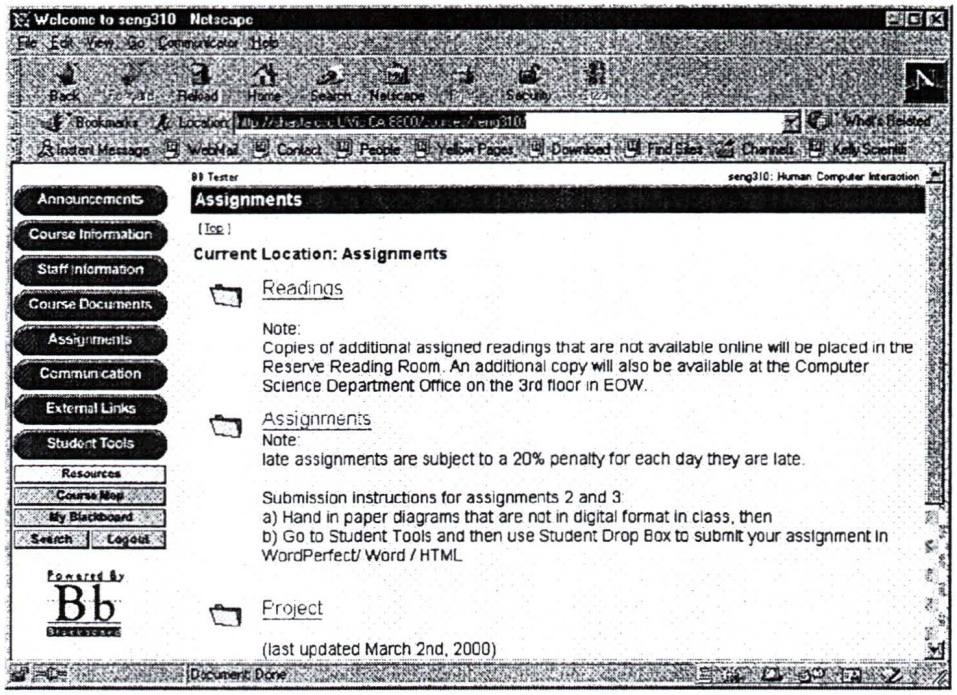
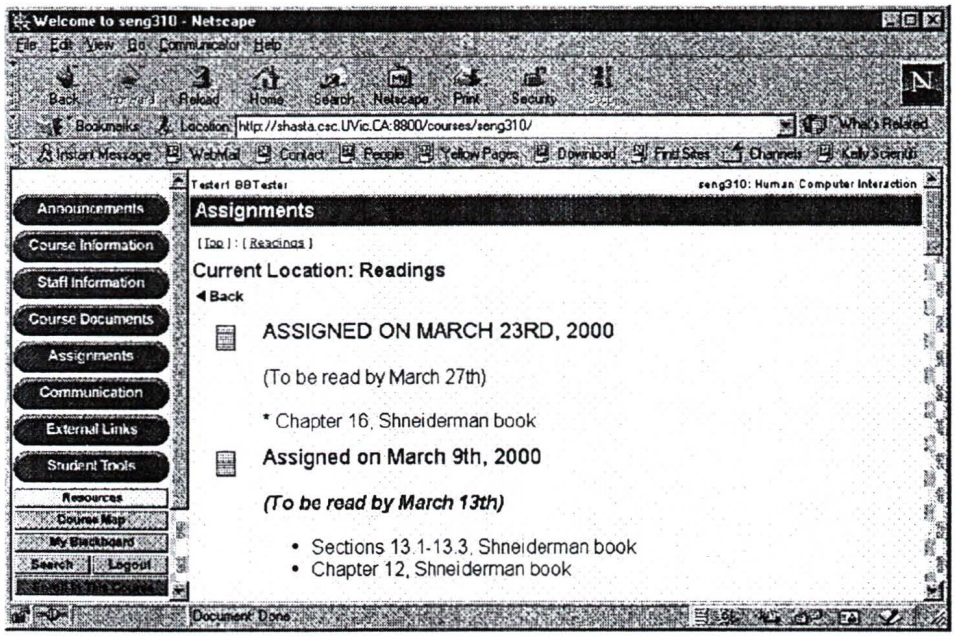
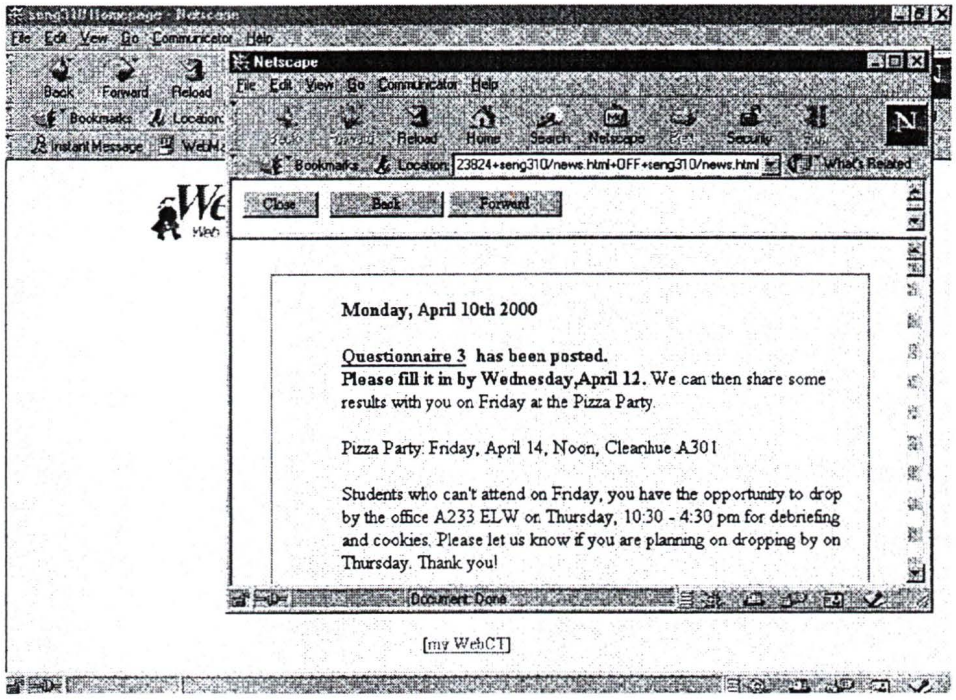


Figure 4.6: Readings page in Blackboard™



When logging onto the WebCT™ course website, students would see a list of icons (see Figure 3.2). If they wanted to know what had been updated, they had to click on the <Announcements> icon, which would pop up a new window shown in Figure 4.7.

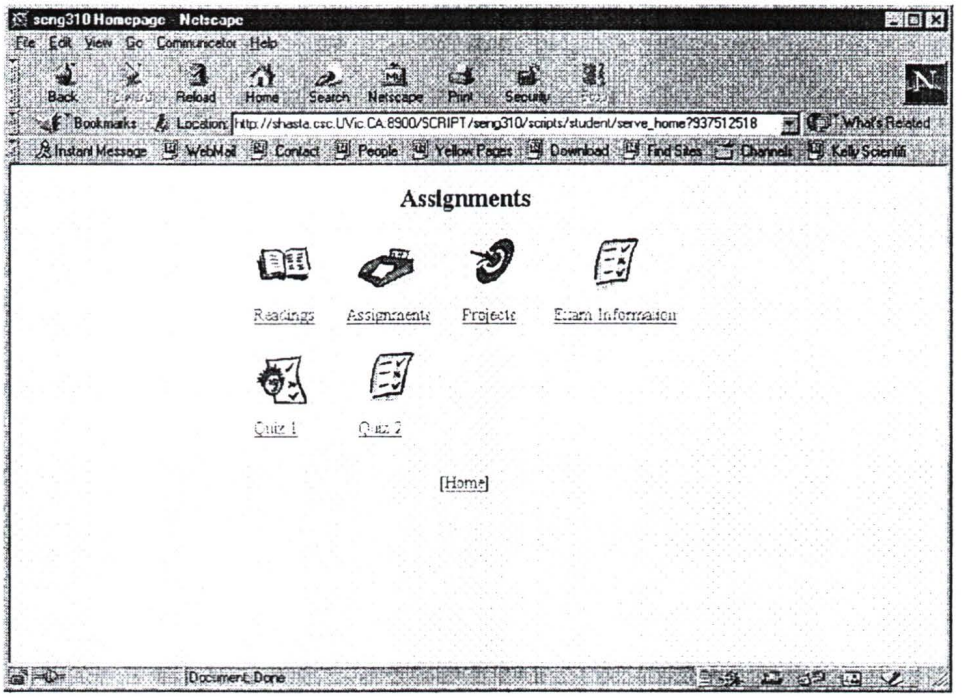
Figure 4.7: Announcements page in WebCT™



The new window was popped up for displaying the Announcements page because we chose the "display in a new window" option when we set up the course in WebCT™. Sometimes, the <Back> and <Forward> buttons in the new pop-up window (see Figure 4.7) did not allow student to go back or forth when they clicked on these buttons (a bug in WebCT™). If students clicked on <Assignments>, they could also see different kinds of assignments (see Figure 4.8). However, if they wanted to access the course notes from there, they had to click on <Home> at the bottom of the Assignments page to go back the home page. The home page refers to Figure 3.2 and from where clicking on <Course Documents>, students then were able to access the Course Documents page. Because the home page is the central point from where

students were able to access other pages such as the Course Documents page, Assignments page, and the Communication Tools page, students had to go back to the home page in order to access other pages. Therefore, it takes at least one more step to access other pages in WebCT™ than in Blackboard™.

Figure 4.8: Assignments page in WebCT™



Obviously, Blackboard™ and WebCT™ adopted two different navigational mechanisms. There was a significant difference found between Blackboard™ ($\underline{M}$=2.98) and WebCT™ ($\underline{M}$=4.04) for the participants' rating of ease of navigation (Appendix A, Question 2). Blackboard™ was rated significantly easier to navigate than WebCT™, $\underline{t}(94)=4.16$, $\underline{p}=.00$. These findings are reflected in participants' open-ended comments about the navigation of these systems. Students in the Blackboard™ group commented:

> *Navigation is quite easy. I appreciate the navigation bar on the left that stays there the whole time, making it easy to jump to any subsection of the program. I like how the default screen upon logging is the "announcements" screen. This*

allows the user to be immediately informed of the latest news without having to actively seek it out.

The menu along the left side of the screen provides fast navigation.

The consistent layout helped speed up navigating, although it didn't make it any easier, and it was aesthetically pleasing.

I liked the blue menu buttons on the side bar. Their headings detailed exactly what I might find under each one.

Layout implies usage - I can't use things if I don't know how to go about it logically arranged information - easy to find what I was looking for.

I liked the fact that announcements always shows when I logon. I can see most updated information all the time. I liked the list of buttons on the left side. I can go to any pages I want any time.

Tool is well laid out, easy to navigate. Liked being able to see all buttons at side, gave a feeling of consistency.

Students in WebCT™ group commented:

The layout of WebCT is very very very poor. This is the worst tool I have ever used. The web page from the beginning of the class is way better and if anything my mark is suffering from using this tool...

I did not like the layout of the screen. I found it confusing.

The organization of the system is poorly done (difficult to navigate through the system). I found I didn't know what were sub-links under the links on the main page. Thus I ended up using the course map to navigate through the system.

Slower than previous course page. I don't like that I need to go back to main page every time I want to go to other page.

Navigation of WebCT has been a nightmare, at least three different interfaces used within the tool (eg. close, back, forward buttons; my WebCT;

communication tools - bulletin board, course notes, etc....) made it very confusing.

I don't like the idea that I need to open every link to find out what is updated.

I like the idea of forcing all courses to use one standard interface - I find the current system counter-productive and confusing - yet I wouldn't imagine WebCT solving this - there seems to be a surfeit of pages and windows for such relatively small amount of material.

Lots of screens, lots of white space, lots of buttons to push for each action, many of which didn't work. Many times the whole window should be closed and the "Back " or "Forward" buttons don't mean anything.

In general, students appreciated the consistent navigation bars in Blackboard™ and had problems with the layouts in WebCT™.

An important tool in navigating these systems is the Course Map. Figure 4.9 and Figure 4.10 show screen shots of Course Map in WebCT™ and Blackboard™ respectively.

Figure 4.9: Course Map in WebCT™

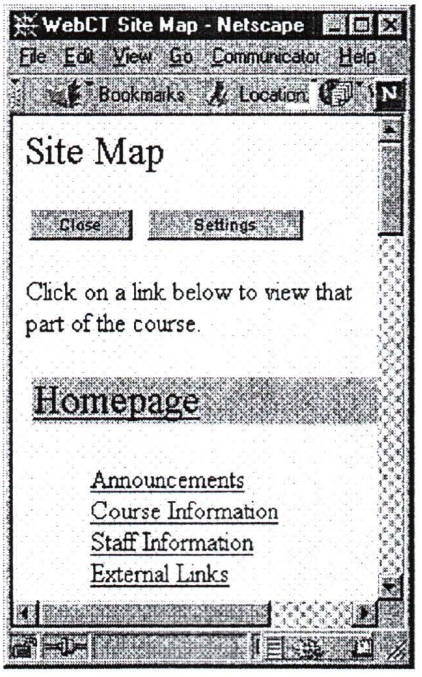
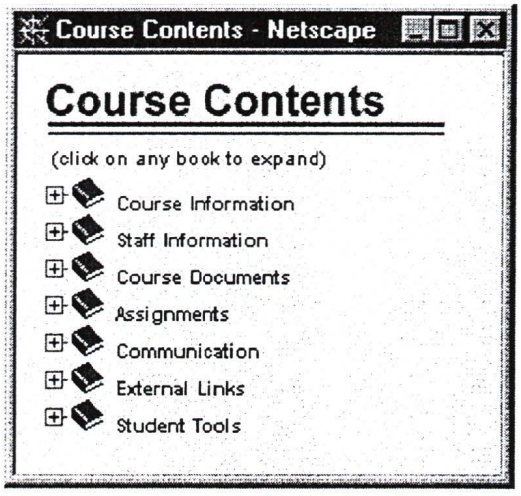


Figure 4.10: Course Map in Blackboard™



However, 47% participants did not use this tool in Blackboard™ and 32% participants did not use it in WebCT™ (Appendix B, Question 2a). Figure 4.11 and Figure 4.12 show the results from Blackboard™ and WebCT™ groups respectively (Note, if a student chose "not applicable", it meant that the student had not used it yet).

Figure 4.11: Blackboard™ Course Map Usage

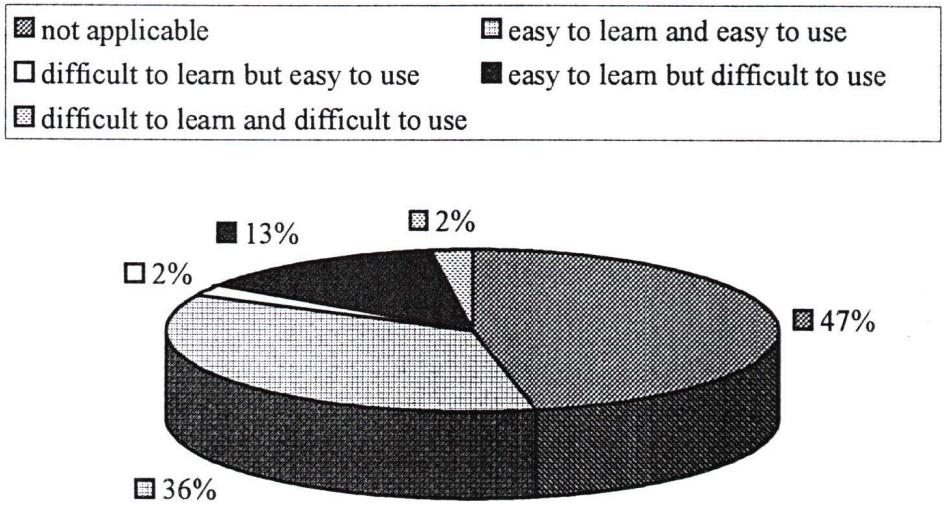
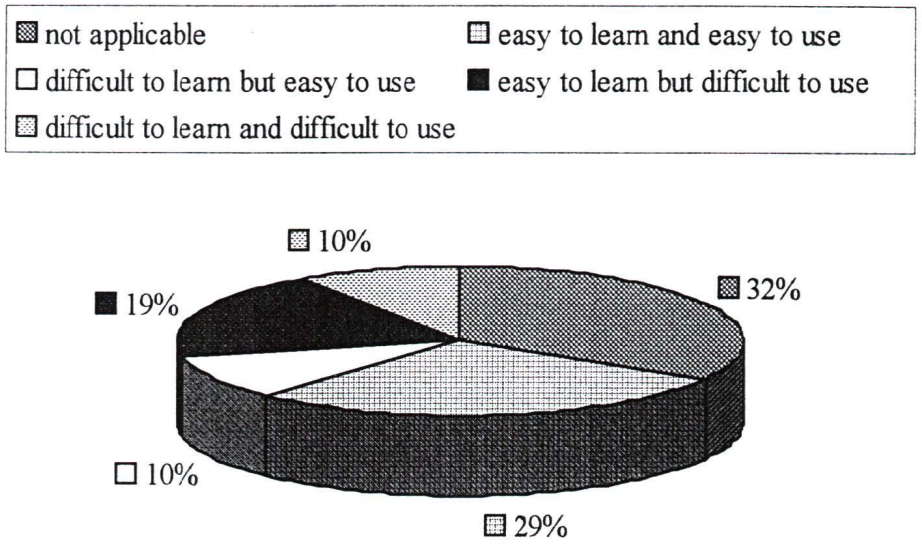


Figure 4.12: WebCT™ Course Map Usage



Both Blackboard™ and WebCT™ included a search tool to help navigate and find documents. Few participants used this tool (Appendix B, Question 3a). Figure 4.13 and Figure 4.14 show the results from Blackboard™ and WebCT™ groups.

Figure 4.13: Blackboard™ Search Usage

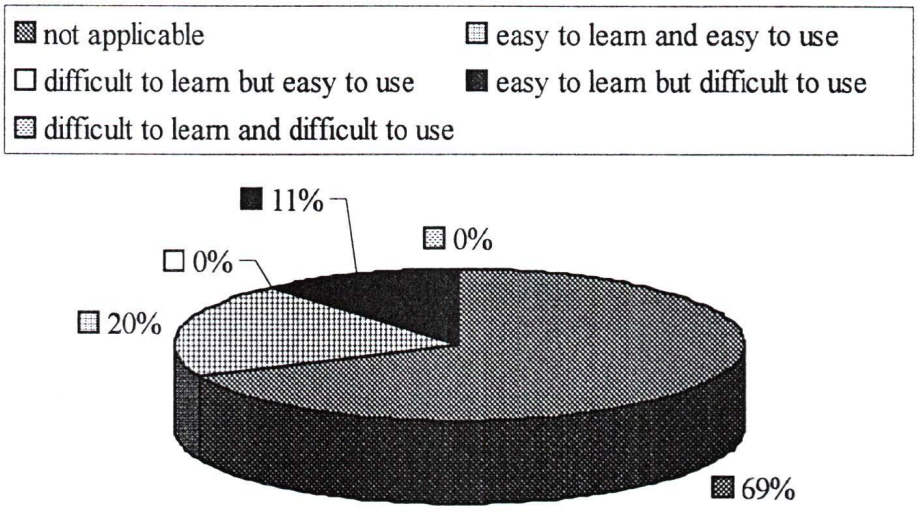
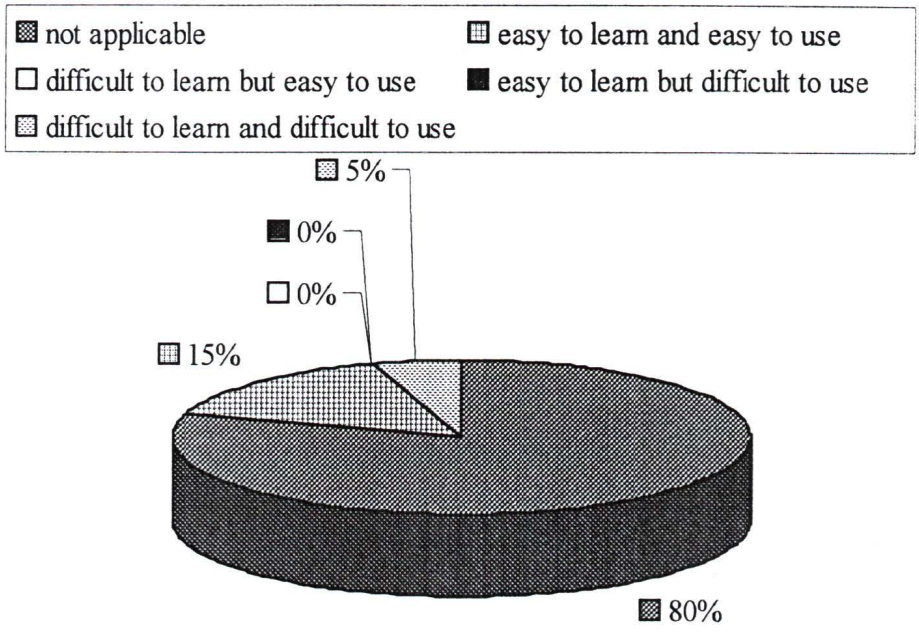


Figure 4.14: WebCT™ Search Usage



These findings are reflected in participants' open-ended comments about the Course Map and Search tool. Students in Blackboard™ group wrote:

Course Map was a repetition of the normal interface.

The course map seemed a little ambiguous to me since all the relevant info is already in the blue boxes above.

I found the search feature to be mostly useless. But that's really a good thing, because the navigation of the site is quite easy, meaning I didn't need to use the search function.

It doesn't hurt having course map or help/tutorial/documentation, but this was so easy to use and I didn't really need them.

Students in WebCT™ group wrote:

The Course Map was a useful feature because it allowed me to navigate through the system effectively.

> *Course map: since I found it difficult to find information through the screen icons, for example, exam info.*
>
> *Course Map was useful, because I could see what kind of information I can find.*
>
> *The map feature could be eliminated by laying out the different sections in a better manner, perhaps in a collapsible hierarchy or tabular interface.*

There are basically two attitudes towards the Course Map and Search tool. Students in Blackboard™ group thought they were redundant while students in WebCT™ group thought they were helpful.

4.1.3 Online Quiz

Because the self-test tool in WebCT™ did not provide as many features as Blackboard™ did, only part of the features provided by the Blackboard™ online quiz tool were used so that students were able to do the same exercises using the two tools. There was no significant difference found between Blackboard™ ($\underline{M}$=2.31) and WebCT™ ($\underline{M}$=2.66) for participants' rating of ease of use of the online quiz (Appendix A, Question 3), $\underline{t}$ (63) = 1.41, $\underline{p}$=.16. There was also no significant difference found for their rating of the effectiveness of the tools for helping them study the course materials (Appendix B, Question 6c), Blackboard™ ($\underline{M}$=1.93) and WebCT™ ($\underline{M}$=1.95), $\underline{t}$ (85) = 0.059, $\underline{p}$=.95. On average, the participants felt the online quiz facility was easy to use and effective in helping them study. These findings are reflected in participants' open-ended comments about the online quiz. Students in Blackboard™ group commented:

> *(It is) Effective because it also checked questions I had missed to answer gave me a chance to go back and answer them.*
>
> *I liked the level of interactivity in the Blackboard quiz. The one that was set up before using WebCT (?) was maybe too interactive. I usually like to answer all questions and then check my answers.*

By far the best feature we've used yet. I only wish we had more.

The quiz was really useful as a revision technique.

Quiz was helpful because I can use them to review what I learned. Also, it's more fun than looking at the course notes, but I don't think it was because it provided me with detailed responses nor it was interactive.

(The online) quiz very useful. This could be the killer app of the Web learning field.

(The) online quiz (was useful), because it gives you a brief review on what you have done.

Students in WebCT™ group commented:

Online quiz was great, really useful feature. Liked the immediate feedback.

The on-line quiz was a useful feature because it helped me to understand the material better and prepared me for the midterm.

It is good to get the correct answer back.

I liked the fact that it provided the answers for questions one at a time and right below the question so it was convenient to compare my responses and the right answer.

The effectiveness or usefulness of the online quiz feature also depends on how it to be used. As some of the participants suggested:

Usefulness of this feature (online quiz) was highly dependent on the effort of the site maintainer i.e. the questions weren't WebCT dependent. The interface was good.

Some answers were simply "right" or "wrong" while others gave explanations on that answer was wrong or why a different answer was right. All questions should have detailed comments to help students learn.

The online quiz was nice, but could be improved to be more effective in helping students determine which areas need more study.

(Online quiz) Can be a very effective tool as a study aid, provided enough questions are used. The quiz used for our first midterm was somewhat helpful, but the questions were limited in number and substance, and so wasn't as helpful as it could have been.

Most students had positive attitudes towards the online quiz tools provided by Blackboard™ and WebCT™ because of their appropriate interfaces and interactive characteristics.

4.1.4 Assignment Submission and Grades Checking

Both Blackboard™ and WebCT™ provide an assignment submission tool. However, the interfaces and behaviors of the assignment submission tool in Blackboard™ and WebCT™ are quite different. Figure 4.15 and Figure 4.16 show the screen shots of the user interface of the assignment submission tool in Blackboard™ and WebCT™ respectively.

Figure 4.15: Blackboard™ assignment submission tool

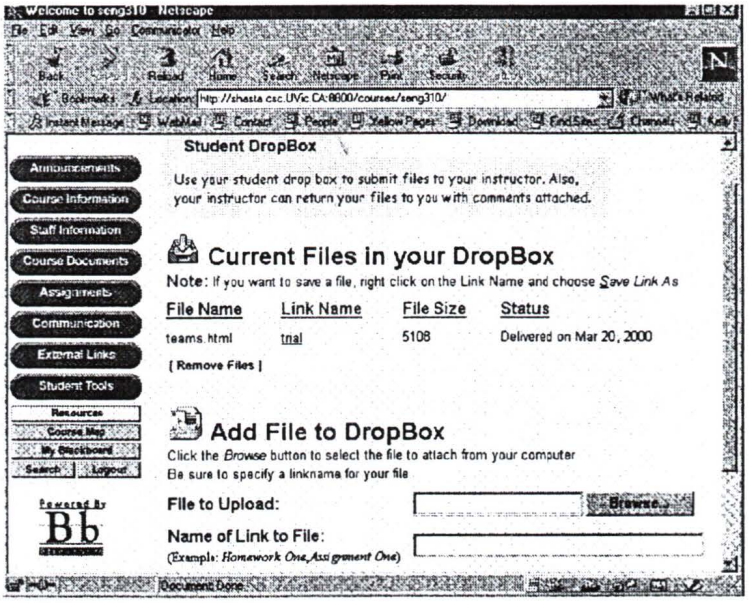
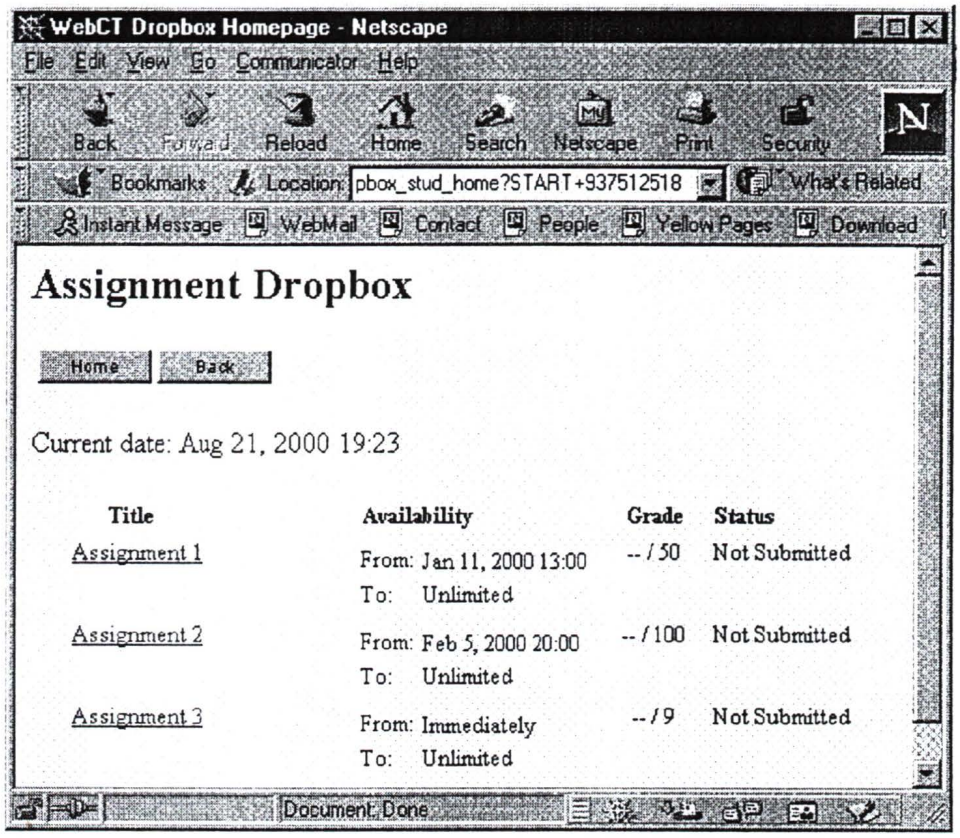


Figure 4.16: WebCT™ assignment submission tool



There was a significant difference found between Blackboard™ (M=2.91) and WebCT™ (M=4.43) for the participants' rating of ease of use of the Assignment Submission tool (Appendix A, Question 4). Blackboard™ was rated as significantly easier for submitting assignments than WebCT™, t(90)=5.64, p=.00. Blackboard™ (M=2.22) was also rated significantly more convenient for submitting assignments than WebCT™ (M=4.02), t (85)=4.76, p=.00 (Appendix B, Question 4b). These findings are reflected in participants' open-ended comments about the assignment submission feature. Students in Blackboard™ group commented:

> *Dropbox for assignment submission (is useful). No gzip!! and tar!! commands to type in.*

> *Assignment submission is easy and fast.*

Online submission (is) quick, easy, and useful.

On line submission is pretty much standard, but I couldn't remove or replace a file; other submission programs have been better.

Students in WebCT™ group commented:

The assignment submission seemed to have one too many steps when I was doing it (I don't know what step though).

I had a really difficult time submitting an assignment. The whole process was very different than what I had expected the process should be. I still don't really know how I did it, but I managed to submit my assignment. It took me probably 15 minutes to get it submitted. However, when I used Blackboard, I had no problems figuring it out.

When I was uploading a file to submit, the student files page wouldn't automatically reload itself. So it would always say that there I have no files uploaded. I would have to press refresh myself to have it show up. That was very annoying. WebCT seems too mickey-mouse for a university to use.

Some serious lags in refresh times for instance submitting assignment 2 took me three tries due to it not updating my record to show as submitted (although it was).

There was also a significant difference found between Blackboard™ ($\underline{M}$=2.29) and WebCT™ ($\underline{M}$=3.45) for the participants' rating of the convenience of using the Grades Checking tool (Appendix B, Question 5b). Blackboard™ was rated as significantly more convenient for checking grades than WebCT™, $\underline{t}(85)=2.40$, $\underline{p}=.02$. These findings are reflected in participants' open-ended comments about the check grades feature. Students in Blackboard™ group commented:

I like being able to look up my grade privately. Many teachers post the entire class list of grades by student number (minus the first two digits). Posting grades in this way is somewhat private, but with a little ingenuity, almost anyone can

figure out other students' grades. Blackboard allows students to view grades privately, which is really nice.

Checking grades, this was convenient (even if the midterm mark was missing).

Students in WebCT™ group commented:

There was no point to having a marks section.... there is no marks in it.

The checking grades site was useless because it never showed any grades.

The assignment submission tool was another feature welcomed by most students. However, if students took more time to submit an assignment than they expected, they were not happy with using the tool. On other hand, students in WebCT™ did not indicate that the Grades Checking tool was inconvenient, but they complained the tool did not work.

4.1.5 Communication Tools

Various communication tools, such as electronic mail, Chat Room and Discussion Board (Bulletin Board) are available in both Blackboard™ and WebCT™. However, 49% of Blackboard™ users and 52% of WebCT™ users reported that they did not use these tools (Appendix B, Question 7). These findings are reflected in participants' open-ended comments about these communication tools. Students in Blackboard™ group commented:

I use ICQ to talk to other people in my group, so I don't need the chat, and same goes with email.

Communication tools... everyone already has email and/or ICQ set up for efficient communication with teammates. Setting up yet another place to communicate gives more possibility for a loss of information.

> *I didn't really see the need to have all those communication tools. I mean no one actually used them. They just seemed to be in the way.*

> *Communication tools were neat but more people would be encouraged to use them if it was optional to have you name identified on every message.*

Students in WebCT™ group commented:

> *The communication features were useless... everyone has email set up the way they like it, with web page space available to them. The whiteboard might be useful, but all of our team collaboration was done in person.*

> *The "chat" feature was quite useless because it was almost impossible to find anybody. Firstly, it did not show the number of users in each room before one entered the room. Secondly, there were no pre-determined chat times for certain topics.*

> *Communication tools, since it was extremely slow. (esp, if it is slow, I would bother using whiteboard function.). I don't feel comfortable using chat program. I rather use e-mail. I prefer to use my e- mail, instead of using private mail function. It's troublesome that I need to check many mailing accounts everyday. But bulletin board might be useful.*

> *Message board, messaging, White board, these were completely useless. The only time I saw a potential use for them was in the group meetings, but half the group was in a different tool, so I never had a chance to use them. Also, other programs that students have exceed the capabilities of WebCT, ie, email, ICQ, Netmeeting.*

Students did not use the communication tools because they thought the communication tools were useless. There are basically two factors which may have effected these results. One of the factors is that some students had their favorite substitutes for the communication tools, so they thought there were no needs for the communication tools. Another factor is that no specific course activities were arranged to use the communication tools. Consequently, students were not encouraged to

communicate with each other using the communication tools. In the next chapter, this will be discussed further.

4.1.6 Overall Rating

There were several questions designed to capture participants' general feelings about the tools. With these questions we wanted to assess participants' feelings about how easy the tools were to learn, how easy they were to use, and how effective they were for learning the course material.

Questions six and seven on Q1 (Appendix A) were designed to capture participants' assessment of how easy the tools were to learn and their assessment of the ease of use of the tools after they had used the tool for two weeks. Participants rated Blackboard™ ($\underline{M}$=2.81) as being significantly easier to learn than WebCT™ ($\underline{M}$=4.02), $\underline{t}(93)=4.23$, $\underline{p}=00$. Blackboard™ ($\underline{M}$=2.85) was also rated significantly easier to use than WebCT™ ($\underline{M}$=4.08), $\underline{t}(94)=5.53$, $\underline{p}=00$.

In addition, there was a significant difference in participants' overall assessment of the effectiveness of the tools after they had used them for four weeks (Appendix B, Question 8B). Participants rated Blackboard™ ($\underline{M}$=2.79) as being more effective for learning the course material than WebCT™ ($\underline{M}$=4.62), $\underline{t}(83)=6.25$, $\underline{p}=00$.

Furthermore, there were several questions on the final questionnaire designed to capture participants' satisfaction with the tools. When Blackboard™ was compared with WebCT™ (Appendix C, Question 2), it was found that 79.1% participants preferred Blackboard™, 9.3% participants preferred WebCT™, 2.3% participants liked both tools and 9.3% participants disliked both tools. When Blackboard™, WebCT™ and the generic course website were compared (Appendix C, Question 4), it was found that 55.8% participants preferred Blackboard™, 4.7% participants preferred WebCT™, 37.2% participants preferred the generic course website and 2.3% participants liked all of them equally.

When commenting on their overall satisfaction with Blackboard™, students wrote:

In general, I found Black Board an easy and convenient tool to use. Labels used for the various functionalities eg. assignments, communication, announcements were clear and not ambiguous so it was easy to know where to start and navigate around.

I found this tool easy to use. I'm sure that in future courses I would use a lot more features of the tool since it offers so many features that could greatly help in a course.

I thought the program was a good idea. It would be good to ensure that a standard is found for use throughout the entire school. It would only be an effective tool if it were used for more than a couple classes at the same time.

I think overall it's a good tool, and the layout and features are very effective.

Overall, I liked Blackboard very much. Most of its features were intuitive and easy to use. I did not have any major problems at all.

Did not see any advantage over "simple" html based course page, of the functionality that we used.

When commenting on their overall satisfaction with WebCT™, students wrote:

MyWebCT was useful since I can find out how many days I have for assignment due dates, etc.

Quizzes, course info, notes, slides conveying of information about the course was easy to find and use (but no more so than the regular web site.)

In general I found the tool very annoying to use, having to be constantly opening up other windows and closing them. There was a lot of white space which really caused me not to remained focused on the task at hand. Things were much harder to find using WebCT as opposed to Blackboard.

I prefer to use previous course page (normal course page we used). (WebCT wasn't extremely bad, but I did not like it that much.) I had hard time locating where I can find out the information I want. (Ex: why exam information under Assignments?) For new window, why every window has "Forward" and "Back" buttons when I cannot press them. (Or does not take me to forward or back)? I

entered "Not Applicable" for checking grade, since I could not see my grade using the function. I think it was not working, but otherwise, I don't think it's not difficult to use and I think it's a useful function.

I found WebCT to be awkward in both its design and navigation functions. I was not fond of windows popping and creating new windows. I also did not like having to backtrack to the main page to go to a different section. A navigation panel would be more appropriate. Blackboard is much better.

Most tools were very hard to find but once found were easy enough to use the check grade feature did nothing except tell me my name - which was pointless (I know my name).

Students' comments indicated that the difficulties of using a tool were caused by navigation problems and because some of the specific components of the tool, such as the search engine, assignment submission tool and grade-checking tool, were not working properly. These findings confirm that if the individual features a tool possesses were difficult to use when carrying out a particular task, the tool would become difficult to use overall.

4.2 Comparison of groups before and after switching tools

The statistics presented in this section were derived from the data collected through the two questionnaires, Q1 and Q2 (Appendix A, B). The two questionnaires were distributed twice. One was given during the second study time period T2 for the BB1 and WC1 groups and another one was given after switching tools for the BB2 and WC2 groups.

There was no significant difference found between the BB1 group ($\underline{M}$=2.69) and the BB2 group ($\underline{M}$=2.95) for the students' rating of how easy it was to learn Blackboard™, $\underline{t}(46)$=0.74, $\underline{p}$=0.46. There was also no significant difference found between the BB1 group ($\underline{M}$=2.85) and the BB2 group ($\underline{M}$=2.86) for their rating of ease of use, $\underline{t}(46)$=0.6, $\underline{p}$=0.95 (Q1, Question 6 and Question 7). In addition, there was no significant difference in the two groups' overall assessment of the effectiveness of the

tool after they had used them for four weeks (Q2, Question 8B). The BB1 group rated Blackboard™ (M=3.04) as being as effective for learning the course material as the BB2 group did, (M=2.50), t(41)=1.58, p=1.22.

There was a significant difference found between the WC1 group (M=3.43) and the WC2 group (M=4.58) for the students' rating of how easy it was to learn WebCT™, t(45)=2.70, p=0.01 (Q1, Question 6). There was also a significant difference found between the WC1 group (M=3.57) and the WC2 group (M=4.56) for the students rating of ease of use of WebCT™, t(46)=3.31, p=00 (Q1, Question 7). Moreover, there was a significant difference in the two groups' overall assessment of the effectiveness of the tool after they had used them for four weeks (Q2, Question 8B). The WC2 group rated WebCT™ (M=5.10) as being less effective for learning the course material than the WC1 group did, (M=4.09), t(41)=2.25, p=0.03.

In the next chapter, I will discuss why there was a significant difference between the WC1 group and the WC2 group for their rating of how easy it was to learn and use WebCT™.

4.3 Instructors and administrators' perspectives

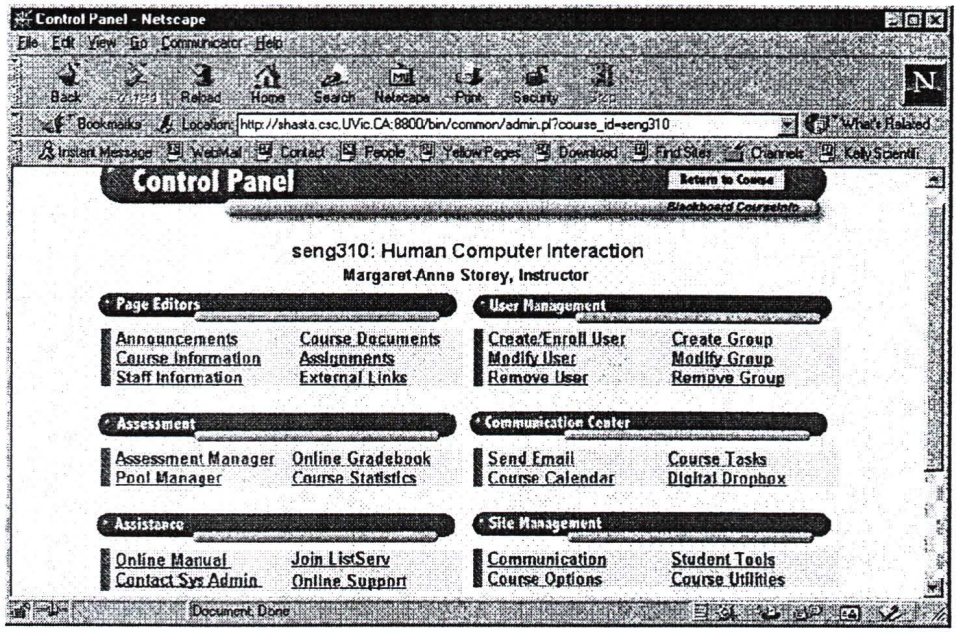
The experimenters had both instructor and administrator roles in the experiment. Overall, Blackboard™ was considered to be easier to use than WebCT™ from both the instructors' and administrators' points of view. There were some bugs found in both of the tools as well during the experiment. More detailed assessments of the tools are reported in the following sections. The assessments are based on the experimenters' experience, observations and working log.

4.3.1 Navigation

Both Blackboard™ and WebCT™ provide special tools for instructors and administrators to perform particular tasks. Blackboard™ uses the Control Panel as the

navigation start point from which instructors are able to find a particular tool they need. Figure 4.17 shows the screen shot of the Control Panel in Blackboard™.

Figure 4.17: Blackboard™ Control Panel



Most labels used for the various components in the Control Panel were clear, so it was easy to find the information needed. For example, it was intuitive to click on the Course Documents link when trying to post or edit the course content, to click on the Assignments link when intending to post or edit an assignment, and to click on the Online Gradebook link when attempting to post or edit students' grades. In addition, most of the components in the Control Panel provided a consistent user interface for navigation (see Figure 4.18 and Figure 4.19). Furthermore, most of the administrative tasks, such as posting course content and assignments, or making online quizzes, required fewer steps in Blackboard™ than WebCT™.

WebCT™ did not use a specific page as the navigation start point. In contrast, the tools for instructors are distributed on the toolbar, which is located at the bottom of every page (see Figure 20). The toolbar in WebCT™ caused confusion. The labels used for the various components were ambiguous.

Figure 4.18: Blackboard™ Course Documents Editor

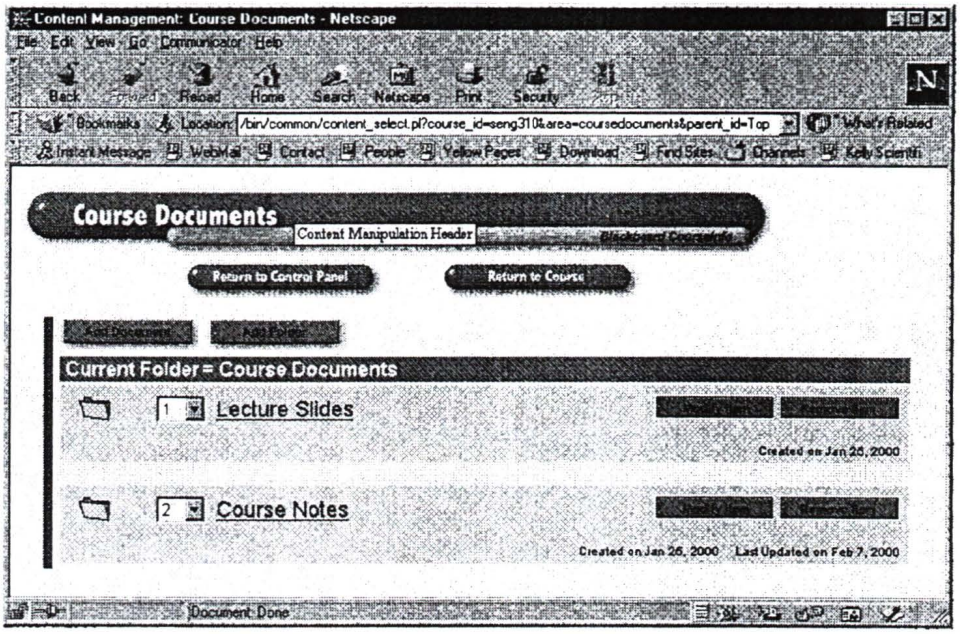


Figure 4.19: Blackboard™ Assignments Editor

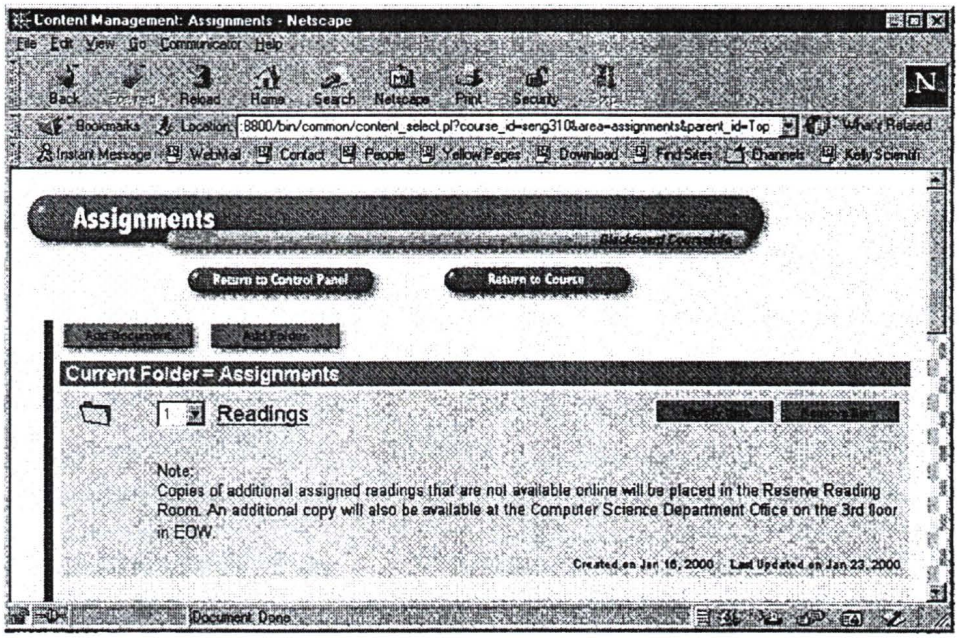
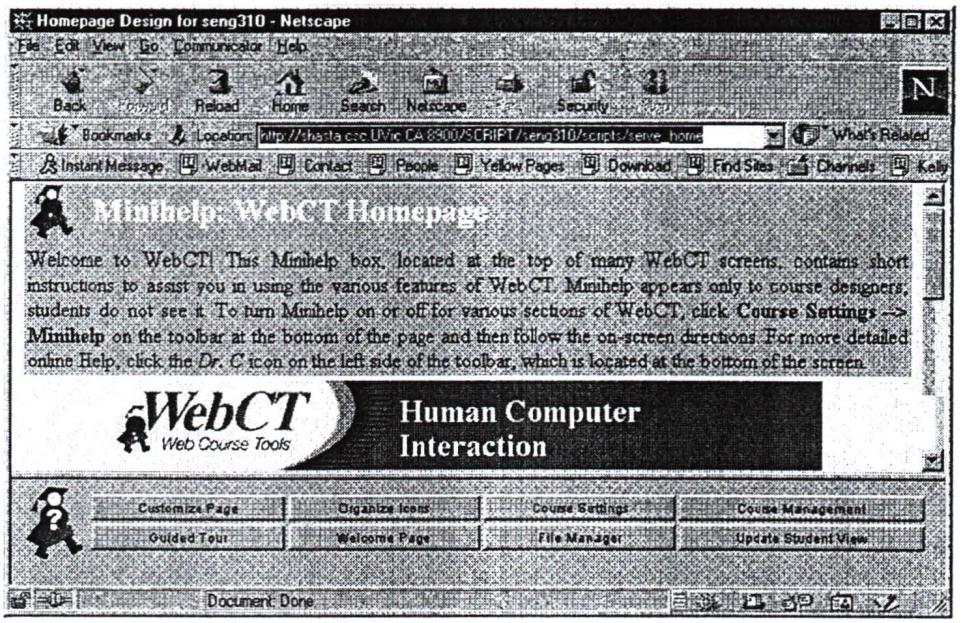


Figure 4.20: WebCT™ toolbar on the Homepage



The bottom frame in Figure 4.20 is the toolbar, which was only visible for instructors. The toolbar contains eight components, or buttons. There were two major problems detected in the toolbar. The first was that the labels on the buttons were not descriptive enough to provide clues as to what they referred to. It was hard to guess which button should be clicked when instructors wanted to post or edit course content, to post assignments, or to make online quizzes. The other problem was that there were too many modes in the toolbar to remember. Figure 4.21, Figure 4.22 and Figure 4.23 show the screen shots of three different modes of the toolbar in WebCT™. There was so much information hidden behind these buttons and modes that it took multiple steps to perform a task. Consequently, it was easy to get disoriented. The administrative tasks did not get easier with practice as it was hard to remember the sequence of steps needed to perform these tasks.

From the instructors and administrators' point of view, navigation within Blackboard™ was much easier than within WebCT™.

Figure 4.21: WebCT™ toolbar in "Organize Icon" mode

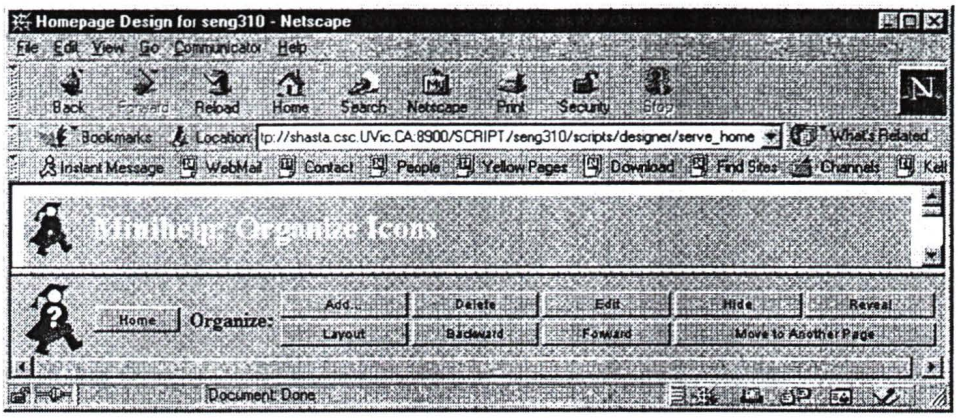


Figure 4.22: WebCT™ toolbar in "Course Settings " mode

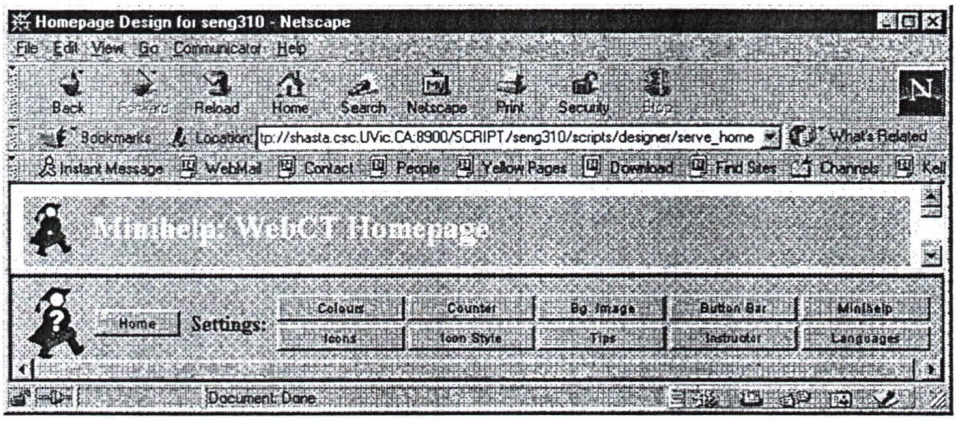
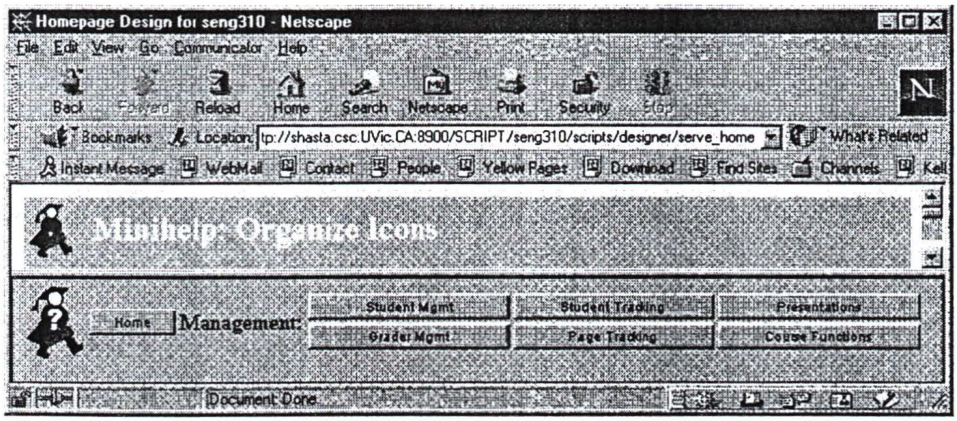


Figure 4.23: WebCT™ toolbar in "Course Management " mode



4.3.2 Content Creation

There were two ways to create course content in Blackboard™ and WebCT™. One of them was to use the built-in editors of the tools to construct course content. The other one was migrating existing course materials to the tools. Since the editors within both of the tools provided limited features, the built-in editors were not used very often in the study. Moreover, most of the course content was already posted on the generic course website. To maintain consistency with those not participating in the study we wanted to use the same pages from the generic course website in the web-based learning tools. The migration of the course materials from the generic course website to Blackboard™ was well supported. It was very easy to upload *HTML* and *PDF* format files. However, support for this task was not effective in WebCT™. When a *HTML* formatted file with internal links was uploaded, the internal links were broken. When a *PDF* formatted file was uploaded, the file was damaged so that it could not be read later (these were bugs found in WebCT 2.0). The File Manager in WebCT™ was also difficult to use. There were at least seven steps to upload a file into WebCT™.

4.3.3 Assessment Facilities

Blackboard™ and WebCT™ both provide facilities for creating online quizzes. Creating an online quiz is an easy task in both Blackboard™ and WebCT™. However, there was some confusion and difficulty experienced using the question pool feature in Blackboard™, which is designed for easily reusing questions when creating online quizzes. The self-test tool and quiz tool in WebCT™ also caused confusion. Initially, the distinctions between the self-test and quiz creators were unclear. It was later discovered that the quiz tool allowed for creating a quiz with more complex questions while the self-test tool created a quiz with multiple-choice questions. The function of the self-test tool appears to be redundant.

4.3.4 Customization

The user interface in WebCT™ was more customizable than in Blackboard™. Instructors were able to add any elements they wanted, such as "News", "Interesting Links" or "Supplementary Readings", while Blackboard™ provides a standard noneditable user interface. Consequently, everything instructors wanted to add to the tool must be placed within the preexisting eight categories on the left of the home page (see Figure 3.1). For example, in the generic course website, there was an element called "Interesting Links", which was a web page containing different links related to the course. It was easy to add this page to WebCT™ with the same name, but it was difficult to add the "Interesting Links" page to Blackboard™ because there was no such category. The best place to put the "Interesting Links" page is under "External Links" in Blackboard™. However, the original page could not be reused under "External Links" as there was a specific format to follow to edit the " External Links" page. For the same reason, the "News" page in the generic course website could not be reused in Blackboard™ if it went to the "Announcements" category.

4.3.5 Student Management

The registration procedure in Blackboard™ was straightforward with filling in the forms provided by the Create User Profile tool. If students registered a course, they could use their IDs and passwords to access all other courses they registered later. Blackboard™ also provided the batch registering of students feature. In WebCT™, however, the "Global ID" caused confusion. The administrators had to assign a unique " Global ID" for each registered student so that students were able to access all courses they had registered with the assigned "Global ID". Otherwise, students would use different IDs and passwords for their different courses within WebCT™. For administrators, assigning a unique "Global ID" for each registered student was a tedious task. WebCT™ also provided the batch registering of students feature.

Administrating the control of access to a course was more difficult in Blackboard™ than in WebCT™. For example, enabling and disabling students at the tool switching time was problematic in Blackboard™. Initially, it was assumed that making them "invisible" meant that students did not have access to the course. However, students soon pointed out they still could access the tool. There was no easy way to disable students' access to a course while still keeping their information in the system. WebCT™ was more straightforward and allowed a temporary restriction of a student's access to the course with a one step procedure.

4.3.6 Documentation

Blackboard™ provides three types of documents: Administrator Manual, Instructor Manual and Student Manual. The Administrator Manual is online but password protected. Only authorized people who have a license for Blackboard™ can access the manual. The Instructor Manual and Student Manuals are free to access online [42, 43]. All of the documentation is also printable. They are detailed and clear.

WebCT™ does not provide formal documentation. However, administrators and instructors can go through the online tutorial [44] to get help. The online tutorial contains seventeen topics. Each topic presents the basic procedure of using one or more specific features of the tool. For example, there is a topic about Homepage Design. The online tutorial for this was not very helpful because it was lengthy and contained very little useful information. To illustrate, instructors need to go through five tutorials to get started and then go through six more tutorials to learn how to use the "Homepage" in WebCT™. Although there were about ninety tutorials, finding specific information, such as how to use the Global IDs or WebCT™ Paths, was not an easy task. The WebCT™ help material did not provide a useful resource for students either.

4.3.7 Technical Support

During the experiment, both of the tool providers gave adequate technical support. A specific technical support team member of Blackboard™ could be contacted via email or telephone since a research license fee for using Blackboard™ was paid. They usually responded within twenty-four hours during business days. The WebCT™ support team could also be contacted via email. However, if the email messages were sent to the support team without specifying a person, there was a significant delay before there was a response. If email messages were sent to a specific member of the support team, they usually responded within a week.

4.4 Impact on Students' Learning

The purpose of the study, as mentioned earlier, was to assess the usability of web-based learning tools from a student's perspective. To ensure the students' performance with the course was not affected, the tools were carefully applied. For example, the exact content in the generic course website was reused within the tools. We replicated the structure of the generic course website in both of the tools, and access to the tools from different platforms (Unix, Windows NT, Machintosh) was examined. Most students had positive attitudes about using a well-designed web-based learning tool. However, if students struggled with using a tool, the tool would not aid their learning. These findings are reflected in the students' open-ended comments. When they were asked how they feel about using a web-based learning tool to provide course support and enhance learning (Appendix C, Question 5), students commented:

> *I think it's a good idea. I would welcome the opportunity to use one again. If many courses adopted this the need to learn and develop a new website for each course would be removed which would be a good thing.*

> *I couldn't imagine life without it.*

essential for today's environment. glad to stop having to be a scribe and start learning in class

Likely because I have had the pleasure of course web sites as a rule in Computer Science, I have come to expect a course web site for distributing notes, assignments, and other course-related information for all my courses. If I take a course outside the department, and that course does not have a web site as a distribution medium, I get annoyed.

I think that they can be very useful if they are well designed, and although I found Blackboard the best of the three, I found the layout of notes and learning tools to be very annoying to browse.

A good tool enhances learning.

I definitely got a lot out of it. I especially liked the bulletin boards and the assignment submission

I like them as long as it does not take me twice as long to find a particular item.

It is great because information can be accessed from any location without the need for special software.

I think it is a great idea since it gives students flexibility in terms of their physical proximity and can be ideal for long distance learning. The virtual chat would also encourage more teacher student interaction on a one to one basis plus discussions among students.

I think that it is great because if you happen to miss a class or need to refer back to something, you can have access to it.

I think they definitely aid my learning, especially if I have to miss class. It makes it much easier to keep up to date.

It's a nice supplement to lectures.

Students in WebCT™ group commented:

> *Major interface improvement needed before I would happily use this tool. I found that I spent most of my time learning WebCT and not course material. A "learning" tool should not be making life more difficult for me.*

> *I found the entire application so difficult to use that I avoided logging into the system to avoid the frustration with getting my information. A course website should provide a fast way for students to look up due date and other information that is important for the course.*

> *I did not like the fact that every time I wanted to take a look at something a new window would pop up. I got so frustrated with that. I stopped using this tool as much as I could.*

> *The pop-up windows are annoying. I have actually avoided logging into the course website simply because of the hassle with WebCT.*

In summary, web-based learning tools did bring convenience to the students and assist their learning with respect to the availability of course information and without geographical restrictions. On the other hand, there were some problems with each of the tools and these problems undermined the effectiveness of the tools. The causes of these problems are discussed in the next chapter.

Chapter 5

Discussion

The study results suggest that the usability of a web-based learning tool can be traced to two sources: the interface for the tool itself and the way the instructor uses the tool to arrange the course materials. This chapter diagnoses the problems traced from the two sources. An analysis of the problems with the interfaces for Blackboard™ and WebCT™ is presented followed by some issues arising from the study. For example, how well web-based learning tools are designed to match instructors' teaching methodology and how instructors could use web-based learning tools to facilitating their teaching. The last section of the chapter discusses the limitations of the study.

5.1 Analysis of the Problems with Blackboard and WebCT

Several problems with the Blackboard's interface were detected during the study. First, Blackboard™ did not use screen space efficiently. As Figure 3.2 shows, the navigation bars took so much screen space that the student working space was limited. When a document could not be displayed completely, students had to perform tedious scrolling from left to right and from top to bottom to read the whole document. Except for the eight navigation bars (Figure 3.2), the rest of buttons below the navigation bars

were redundant and took away the valuable screen space. As the students in the Blackboard™ groups suggested:

> *Make the main part of the screen bigger (give the ability to extend the size of the main window just as the Netscape or Internet explorer does and get rid of the menu on the right hand side if some one wishes). Also, make it more colorful.*

> *The arrangement of the buttons on the nav-bar on the left side could be different. The most-used buttons should be higher up, and the less used buttons should be lower down. For example, Course Information is not used on a regular basis, and so should be lower down. Assignments and Course Documents would be used more often, and should be moved up.*

Second, the labels used in Blackboard™ were somehow ambiguous. As the students in Blackboard™ groups commented:

> *The titles on the buttons (the navigation bars) didn't always lead to what I expected.*

> *Most of the features that I most commonly wanted to use could not be seen on the left view bar and I had to select one of the blue or gray boxes before I could get to the feature which meant that I had to remember where it was.*

> *More clarification (was needed) as to the location of choices. (It is) not always clear where a feature is located within the 8 buttons (navigation bars) on the site map.*

> *It is not clear exactly what the "Logout" button does. After clicking on it, it asks the user to close the web browser. It is not known what happens if the user does not close the web browser and continues surfing the internet, or if the user does not click on the Logout button at all before exiting or moving on to another web site. Also, having a link to "Home" in the navigation panel would be helpful. At first, it is not obvious that the "Announcements" page is the home page.*

> *Also make it (label) more meaningful what some things mean. For example the "Link" which is referred to in the drop box section* (the Student Drop Box, see Figure 4.15) *is not informative and I still don't know what it is used for.*

Third, the Student Drop Box in Blackboard™ also violated the usability guideline requiring systems to provide informative feedback [16]. As the students in Blackboard™ groups indicated:

> *Yeah, there is no feedback for the online submission letting you know that it is processing your submission. I was unsure whether it was having refresh problems.*
>
> *Design a better way for giving feedback and comments on assignments instead of giving comments and feedback separately from the assignment.*

Although the Remove function in the Student Drop Box in Blackboard™ was designed as the reversal action of submitting files, it did not work at all. Due to the violations of the usability guidelines, some students felt nervous with the submission facility. Their anxiety was reflected in their comments:

> *The removing of files from the assignment submission part was useless because it didn't work. As a result I have two files listed there.*
>
> *Assignment submission online made me nervous. What if it never got there? How would I be able to prove I had it done? It also took me hours to get my little old comp to accept putting pictures into a word file without crashing! I assume this feature (online submission) would be even more daunting to a novice computer user.*
>
> *Assignment submission was very useful, but I would have liked some email feedback regarding the acceptance of my files - something on paper to show the instructor in case something goes wrong.*

The problems with WebCT™'s interface lie on the violation of the four usability guidelines: strive for consistency, offer informative feedback, permit easy reversal of actions and reduce short-term memory load [16]. First, the inconsistent interfaces provided by WebCT™ caused difficulties. As the students in WebCT™ groups pointed out:

> *There is a severe lack of consistency through different sections of the system... the submission program behaves/looks different from the main pages looks different from the communications sub-sections. This makes the system much harder to learn, and somewhat difficult to use.*

> *Navigation of WebCT has been a nightmare, at least three different interfaces used within the tool (eg close, back, forward buttons; my WebCT; communication tools - bulletin board, course notes, etc....) made it very confusing.*

> *Put consistency in it. Sometimes it takes three steps to get to something, where other things are only two. The navigational buttons on the different pages are different.*

Second, lack of informative feedback made the Student Drop Box, which is a facility for submitting assignments online, less effective. Also, if students did not refresh their web browser every time, the Student Drop Box did not update automatically. Consequently, students were given false feedback. For example, after uploading their files to Student Files, the students were still given the indication: "no files" in Student Files. As the student in the WebCT™ groups indicated:

> *Make submission feedback as immediate, and clear as possible.*

> *The online submission program was definitely well presented, efficient, and intuitive for the most part, although the flow wasn't as smooth as it could have been. It would good to have some way to get feedback, though.*

> *Too much navigation and no confirmation for successful submission*

> *When I was uploading a file to submit, the student files page wouldn't automatically reload itself. So it would always say that there I have no files uploaded. I would have to press refresh myself to have it show up. That was very annoying. WebCT seems too mickey-mouse for a university to use. (repeated)*

Third, the Student Drop Box did not permit easy reversal of actions. When students submitted their assignments, there was no way to delete the wrong or out-of-date files.

This caused students anxiety when using the Student Drop Box. To explore how the Student Drop Box works, the students tried to submit something else before they actually submitted their real assignments. As a result, the instructor received many garbage files. And fourth, WebCT™ put more short-term memory load on the end users. Either finding desired information or submitting assignments, students were required to go through more steps than they thought was necessary. As the students in the WebCT™ groups complained:

> *Lots of screens, lots of white space, lots of buttons to push for each action, many of which didn't work. Many times the whole window should be closed and the "Back " or "Forward" buttons don't mean anything.*
>
> *Going from one screen to the other just for getting to the required page. I found there are lots of intermediate pages there. Also I didn't find the icons too comprehensive to which we should click in order to get where.*
>
> *The assignment submission seemed to have one too many steps when I was doing it (I don't know what step though).*

Due to the lack of adherence to usability guidelines, both Blackboard™ and WebCT™ suffer from cumbersome design, such as requiring complex and tedious procedures (submitting assignments in WebCT™, scrolling on displays in Blackboard™), inadequate functionality (Back and Forward buttons in WebCT™, Remove function in Blackboard™), inconsistent sequences of actions (in WebCT™), and insufficient informative feedback (Student Drop Box in both of the tools). As Shneiderman stressed, these design problems generate stress and anxiety that lead to poor performance, frequent minor and occasional serious errors, and dissatisfaction [16].

The results from our comparison of the groups before and after switching tools revealed that students suffered more frustration and annoyance when moving from Blackboard™ to WebCT™. After tool switching, the students intuitively compared the tool they were using with the one they used previously. They expected the tool

(WebCT™) they were using to be as easy to use as Blackboard™. When their expectation was not met, they rated the difficulty level higher than the previous WebCT™ group did. Students' frustration and annoyance after tool switching also caused mush stronger emotional response to the questionnaires.

5.2 Instructors as Designers

Another important factor affecting the usability of the web-based learning tools was the way instructors chose to organize their courses. Since instructors play different roles as designers and as teachers of online courses, as Gillette [47] pointed out, their design of courses using a web-based learning tool has significant influence in the students' use of the course web site. Inadequate arrangement of course materials will lead to difficulties in finding information. For example, the exam information was put into the Assignments category in both Blackboard™ and WebCT™. Consequently, the students encountered difficulties in finding the exam information. The methods used to display course materials would also affect the students' use of the course web site. For example, there was an option in WebCT™ for displaying a web page either in the same window or in a pop-up window (see Figure 4.7). A pop-up window was chosen in the study. However, students found the pop-up windows were very irritating. As they complained:

> *DO NOT open more browser windows when certain links are selected. If a user wants another browser window, they can always use "Shift+click" or press their middle mouse button depending on the browser they are using. This feature was especially annoying for Linux users because of a bug in Netscape for Linux that sometimes causes all Netscape windows to close when just one is closed. This would have been very useful due to the poor organization of the website. A lot of times, it was impossible to find anything.*

> *The main menu idea is very good, but then opening everything in a new window makes it almost pointless. This would be better in a frame down the left side of the screen or buttons across the top. The extra windows were also just very annoying, especially since it opens smaller and has to be resized to be useable.*

> *In general I found the tool very annoying to use, having to be constantly opening up other windows and closing them. There was a lot of white space which really caused me not to remained focused on the task at hand. Things were much harder to find using webCT as opposed to Blackboard.*
>
> *I really hate how nearly every time you click on a link in WebCT that it opens another window. This is REALLY ANNOYING!!!! Getting rid of all the extra windows would greatly improve the interface. I also think that having a common navigation bar on the top or left side would help. Currently, there is a main menu screen, but there is no easy way to jump to other parts of the interface.*
>
> *Things such as Announcements pop up in a new window, couldn't it just switch to the page? Also, I get annoyed at all the windows and sometimes close the wrong ones!*

From the student perspective, the effectiveness of using the online quiz tool to study course content really depends on how instructors design the questions. If instructors do not design the proper questions for the online quiz, it will reduce the effectiveness of the online quiz feature. As some of the students commented:

> *The quiz, although helpful in learning material wasn't at all relevant to most of the information on the midterm and thus as a study guide specifically for the midterm, didn't help at all.*
>
> *The quiz was not very representative of the test... was more misleading.*

Similarly, despite the fact that communication tools in both Blackboard™ and WebCT™ provide a means of communicating with students and the instructor for collaborative learning, it was ineffective and useless without relating the communication features to the specific course activities (see the students' comments in Chapter 3).

Of course, the design of a web-based learning tool does affect the way instructors use it to construct their course web sites. For example, WebCT™ provides an option such as the pop-up window option which allows instructors to construct a web page displayed in a new pop-up window. However, the different options are

offered by WebCT™ while in which situation these options should be considered for use is not clarified. In our study, the pop-up window option was chosen and it greatly affected the usability of the tool. In Blackboard™, instructors have to consider how their content fits into the pre-existing categories since a proprietary interface was used. Sometimes it is difficult to fit content to the pre-existing categories. When content was not easily fitted into a category, students had trouble with the tool. In summary, both the tools constrain how easily instructors can move their course instruction to the Web.

5.3 Limitations of the Usability Study

One of the major limitations of the study lies in the limited features used within each of the tools we evaluated. Although both Blackboard™ and WebCT™ provide a rich set of features to enhance students' ease of learning, the tools were tailored to fit to the needs of the course. Also because not all students enrolled in the course Human Computer Interaction participated in the study, the group work facilities, such as communication tools, were not effectively used in the course activities. It would not have been fair to those students who did not participate in the study if we made the group work facilities mandatory.

Another limitation is that both of the tools were used such that they complied with the structure of the generic course web site. For example, there were basically seven components in the generic course web site: Course Notes, Course Schedule, Staff Information, News, Interesting Links, Readings and Assignments which included the Exam Information and Projects (see Figure 3.1). To correspond with the generic course web site, all of the seven components were put into both of the tools. This may not have been the best way to use the tools.

To detect potential problems with the two tools, minimum instructions for using the tools were provided to the students in the study. Certainly, computer science students do not represent the general student population in a university. The instructors

and administrators' assessment of the tools was done by the experimenters and they also may not be representative of the general course instructors and administrators.

Chapter 6

Conclusion

Web-based learning tools are still quite primitive. As the study shows, there is a lot of room for improving and refining the existing web-based learning tools. Throughout the study, it was found that there were several ways to improve the usability of Blackboard™ and WebCT™. There are also issues arising from the study which stress instructors' designer roles when instructors implement a course using web-based learning tools. Since the usability of a web-based learning tool has great impact on the effectiveness of the tool, universities should be concerned about how easy it is to use the tool from the perspectives of the different user groups.

6.1 Recommendations

6.1.1 Recommendations for the Developers of Web-based Learning Tools

The developers of web-based learning tools should be concerned about these problems with Blackboard™ and WebCT™ and should strive to improve the usability of the tools.

The user interface in Blackboard™ could be improved in several ways. First, the screen space could be used more efficiently by decreasing its size of the toolbar on the left of the screen (see Figure 3.2) so that the user screen space would have more room. Second, feedback should be provided after students submit their assignments. For example, sending a confirmation email to students after their successful submission. Third, make all features function as documented. Fourth, bugs should be avoided as much as possible. For WebCT™, students were not satisfied with the tool and suggested that it should be re-designed following usability design principles and guidelines.

There were some inadequacies in both Blackboard™ and WebCT™. For example, although the grades checking facility in both of the tools allowed students to view their grades privately, students would like to have a whole list of grades to judge their own performance. The tools' developers should consider providing a mechanism to show not only the personal grades but also the comparison of grades with others. Since the evaluation of courses is important to instructors to improve their teaching, web-based learning tools should provide a facility allowing students to evaluate the courses they took.

Other features software developers should consider providing are support for delivering multimedia content and "virtual labs". Ideally, a web-based learning tool should provide all features to meet the diversity of educational activities. However, the more features a tool provides, the more complicated the tool tends to be and therefore, the more difficult to use the tool tends to be. To solve this problem plug-ins may be an adequate choice for extending the capability of a web-based learning tool. On the other hand, to be assured that their tools are being used as they envision, tool developers should pay attention to usability studies.

6.1.2 Recommendations for Instructors

In addition to the concern about which features a web-based learning tool provides, instructors should also consider the usability of the tool. The difficulties caused by

using a web-based learning tool put a heavy burden on instructors when they implement their course. Instructors should also realize that their design of a course web site using a web-based learning tool has significant impact on how students will learn. To keep a web-based learning tool simple to use for students, remove features provided by the tool that are irrelevant to the course. To promote the effectiveness of a web-based learning tool, instructors should bind every chosen feature of the tool to the specific course activities.

6.1.3 Recommendations for Universities

When adopting a web-based learning tool, universities should not only be concerned with the cost of the tool but also the effectiveness of the tool. In the study, students suggested that a web-based learning tool should be deployed across campus. Otherwise, it is not worth the effort. Although more students preferred Blackboard™ over WebCT™, they would like to use one which was better than both. Because web-based learning tools are still quite primitive, neither of the tools used in our study matched the instructor' and students' work-flows both technologically and pedagogically. Therefore, we recommend that it is not advisable to adopt an existing web-based learning tool for the university at present. Some researchers [5] have indicated that inappropriate and hasty use of web-based learning tools can make matters worse. Due to the complexity of combining pedagogy and computer technology, ongoing training and support are necessary to address the various difficulties students and instructors encountered in this study. Universities should provide sufficient continued support, both technical and human-based, for using web-based learning tools.

6.2 Future Work

The study was conducted with computer science students. Although the students found that some of the features provided by the two tools were easy to use, the study does

not provide any evidence of how the general student population would rate and assess these two tools. In addition, as the study revealed, instructors play an important role in using web-based learning tools. How they use these tools directly affects how students use the tools. Therefore, their participation in the usability study of web-based learning tools is crucial. In any case, a follow-up study with different user groups such as students and instructors from outside the department of computer science should be considered.

To get a complete assessment of the two tools, those features which have not been examined in the study, such as the communication tools, should be studied. In fact, the power of web-based learning tools lies in their capability to support collaboration via the Internet. Hence, it is important to evaluate these communication features in the future. And also to examine the productivity of these web-based learning tools, setting up the tools in the campus-wide use would help evaluators identify the problems with institutional level management.

The pace of development of web-based learning tools is very fast. With the progress of the study, the Blackboard™ developers kept updating their product. The Blackboard™ CourseInfo was updated from version 4.06, to version 4.07, and finally to version 4.08. With every new version, the bugs detected throughout the study were fixed. Now the latest version of CourseInfo, Blackboard™ 5, is on the market. Similarly, the new version of WebCT™ is available. It is unclear if all problems detected from our study have been solved in these latest releases. Our study results could be used for verifying if the new released products fixed the problems we encountered.

As demands for using computer technologies continue to grow, the need for research also expands. One of the issues which should be considered for using web-based learning tools is the accessibility of these tools. As Hill [47] pointed out: "with a heavy reliance on a computer, modem and network connection, access to hardware is a substantial issue." Without access, using a web-based learning tool is not possible. In addition to frustrations created from a lack of knowledge in relation to hardware and

software [48], and poor usability of web-based learning tools, frustration can also mount from an inability to connect to the network, inability to print certain formatted materials within a web-based learning tool, and having to wait for an applet to load or wait for information to download to the desktop. To facilitate web-based learning processes, studying the accessibility of web-based learning tools is important.

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Appendix A: Questionnaire One

Experimenter: Mei Wang
Tool: **Blackboard/WebCT**
Date: Feb. 21, 2000

Questionnaire One

This questionnaire asks you for information concerning the ease of learning Blackboard. You have the right to refuse to answer any of these questions.

1. How did you learn to use this tool?

   ☐ going through the tutorial

   ☐ reading online documentation

   ☐ exploring by myself

   ☐ with help of friends or other students

   ☐ carrying on my previous experience

   ☐ other

2. How easy is it to navigate in Blackboard (For example, how easy is it to find course notes, find assignments, etc.) ?

   ○ extremely easy ○ very easy ○ easy ○ middle ○ difficult ○ very difficult ○ extremely difficult

3. How easy is it to use the online quiz ?

   ○ extremely easy ○ very easy ○ easy ○ middle ○ difficult ○ very difficult ○ extremely difficult

4. How easy is it to submit your assignments using Blackboard?

   ○ extremely easy ○ very easy ○ easy ○ middle ○ difficult ○ very difficult ○ extremely difficult

5. How easy is it to use the communication tools, such as email, discussion board, virtual chat ?

○ extremely easy ○ very easy ○ easy ○ middle ○ difficult ○ very difficult ○ extremely difficult

6. How quickly did you become comfortable using Blackboard ?

○ extremely quickly ○ very quickly ○ quickly ○ middle ○ slow ○ very slow ○ extremely slow

7. Overall, how easy is it to use Blackboard ?

○ extremely easy ○ very easy ○ easy ○ middle ○ difficult ○ very difficult ○ extremely difficult

8. Please describe any technical difficulties you have had using Blackboard:

Submit Reset

Appendix B: Questionnaire Two

Experimenter: Mei Wang
Tool: **Blackboard/WebCT**
Date: Mar. 2, 2000

Questionnaire Two

This questionnaire asks you for information about your assessment of Blackboard. **If you have not used the feature before, please select the "not applicable" option.** It will take you approximately 10 minutes to complete. You have the right to refuse to answer any of these questions. Thank you!

1. **Online documentation and/or tutorial** ○ not applicable (proceed to question 2)

   (a) The online documentation or tutorial was:

   ○ easy to learn and easy to use
   ○ difficult to learn but easy to use
   ○ easy to learn but difficult to use
   ○ difficult to learn and difficult to use

   (b) When learning how to use this tool, I found the online documentation and/or tutorial in Blackboard to be:

   ○ extremely effective
   ○ very effective
   ○ somewhat effective
   ○ no opinion
   ○ somewhat ineffective
   ○ very ineffective
   ○ extremely ineffective

2. **Course map** ○ not applicable (proceed to question 3)

   (a) The course map in Blackboard was:

   ○ easy to learn and easy to use
   ○ difficult to learn but easy to use
   ○ easy to learn but difficult to use
   ○ difficult to learn and difficult to use

   (b) When navigating the course web site, I found the course map in Blackboard to be:

- ○ extremely effective
- ○ very effective
- ○ somewhat effective
- ○ no opinion
- ○ somewhat ineffective
- ○ very ineffective
- ○ extremely ineffective

3. **Search tool** ○ not applicable (proceed to question 4)

(a) The search tool in Blackboard was:

- ○ easy to learn and easy to use
- ○ difficult to learn but easy to use
- ○ easy to learn but difficult to use
- ○ difficult to learn and difficult to use

(b) When searching for specific information, I found the search tool in Blackboard to be:

- ○ extremely effective
- ○ very effective
- ○ somewhat effective
- ○ no opinion
- ○ somewhat ineffective
- ○ very ineffective
- ○ extremely ineffective

4. **Assignment submission** ○ not applicable (proceed to question 5)

(a) The assignment submission feature in Blackboard was:

- ○ easy to learn and easy to use
- ○ difficult to learn but easy to use
- ○ easy to learn but difficult to use
- ○ difficult to learn and difficult to use

(b) I found the assignment submission feature in Blackboard to be:

- ○ extremely convenient
- ○ very convenient
- ○ somewhat convenient
- ○ no opinion
- ○ somewhat inconvenient
- ○ very inconvenient
- ○ extremely inconvenient

5. **Checking grades** ○ not applicable (proceed to question 6)

(a) The checking grade feature in Blackboard was:

- ○ easy to learn and easy to use
- ○ difficult to learn but easy to use
- ○ easy to learn but difficult to use
- ○ difficult to learn and difficult to use

(b) I found the facilities for checking my grades in Blackboard to be:

- ○ extremely convenient
- ○ very convenient
- ○ somewhat convenient
- ○ no opinion
- ○ somewhat inconvenient
- ○ very inconvenient
- ○ extremely inconvenient

6. **Online quiz** ○ not applicable (proceed to question 7)

(a) The online quiz in Blackboard was:

(note you can select more than one option from the following selection)

- ☐ helpful because it provided me with detailed responses
- ☐ not helpful because only multiple choice and true/false questions were asked
- ☐ helpful because it was interactive
- ☐ not helpful because it was difficult to access

Other comments:

(b) As a tool to help me study the course material, I found the online quiz feature in Blackboard to be:

- ○ extremely effective
- ○ very effective
- ○ somewhat effective
- ○ no opinion
- ○ somewhat ineffective
- ○ very ineffective
- ○ extremely ineffective

7. **Communication tools** ○ not applicable (proceed to question 8)

(a) The communication tools, such as email, discussion board and chat, were:

- ○ easy to learn and easy to use
- ○ easy to learn but difficult to use
- ○ difficult to learn but easy to use
- ○ difficult to learn and difficult to use

(b) As a tool for interaction with other students in the class, I found the communication tools in Blackboard to be:

- ○ extremely convenient
- ○ very convenient
- ○ somewhat convenient
- ○ no opinion
- ○ somewhat inconvenient
- ○ very inconvenient
- ○ extremely inconvenient

(c) As a tool for my learning, I found the communication tools in Blackboard to be:

- completely effective
- very effective
- somewhat effective
- no opinion
- somewhat ineffective
- very ineffective
- completely ineffective

8. (a) After using Blackboard for four weeks, I found Blackboard overall to be:

- easy to learn and easy to use
- easy to learn but difficult to use
- difficult to learn but easy to use
- difficult to learn and difficult to use

(b) For my learning of the course material, I found Blackboard to be:

- extremely effective
- very effective
- somewhat effective
- no opinion
- somewhat ineffective
- very ineffective
- extremely ineffective

9. Which features of Blackboard did you consider useful? Why?

10. Which features of Blackboard did you consider useless? Why?

11. What suggestions do you have to improve Blackboard features?

12. Please add other comments, ideas, suggestions, difficulties, frustrations...

Submit Reset

Appendix C: Questionnaire Three

Experimenter: Mei Wang
Date: April 10, 2000

Questionnaire Three

This questionnaire asks you for information comparing Blackboard and WebCT and for recommendations when adapting a web-based learning tool within the University. It will take you approximately 10 minutes to complete. You have the right to refuse to answer any of these questions. Thank you!

If you have not used a feature in either of the tools, please select the "not applicable" option.

1. a) In which tool did you prefer using the following features?

	WebCT	Blackboard	No preference	Not applicable
Online Documentation	C	C	C	C
Search Tool	C	C	C	C
Course Map	C	C	C	C
Discussion Board	C	C	C	C
Email	C	C	C	C
Virtual Chat	C	C	C	C
Assignment Submission	C	C	C	C
Online Quiz	C	C	C	C
Checking Grades	C	C	C	C

b) If you were to design the perfect web-based learning tool, what features of the following would you include?

Online Documentation	☐
Search Tool	☐
Course Map	☐
Discussion Board	☐
Email	☐
Virtual Chat	☐
Assignment Submission	☐
Online Quiz	☐
Checking Grades	☐

c) What additional features would you include?

2. Overall, I

○ preferred WebCT	○ prefered Blackboard	○ liked both tools	○ disliked both tools	○ Not applicable

3. The impact of the tool on my learning was:

	positive	negative	no effect	not applicable
WebCT	○	○	○	○
Blackboard	○	○	○	○
Generic Website	○	○	○	○

4. Including the generic web site (ie. the website constructed by Dr. Storey), I preferred using:

○ WebCT	○ Blackboard	○ Generic Website	○ All of them equally	○ None of them	○ Not applicable

5. **In general, how do you feel about using a web-based learning tool to provide course support and enhance learning?**

6. **The University is considering adopting a web-based learning tool such as WebCT, Blackboard or others.**

a) **What tools would you recommend?**

b) **How could the University best enhance your learning through the use of a web-based learning tool?**

c) **What further recommendations would you have for the University if they were to set up a campus wide web-based learning tool?**

7. **Any other comments?**

Submit Reset

Appendix D: Consent Form

Consent Form For Participation in the Study Entitled:
"Evaluating Distributed Learning Technologies"

Purpose of the Study

This research project is being conducted to evaluate Distributed Learning technologies. We will be deploying two or three Distributed Learning tools during SENG310 (Human Computer Interaction), taught by Dr. Storey. The three Distributed Learning tools are Blackboard™ (Blackboard™ Inc.), LearningSpace™ (IBM) and WebCT™ (University of British Colombia).

The resources for conducting this study are being provided by an Innovative Teaching Grant from the Learning and Teaching Center.

Procedure

There are four sections to this experiment, with each section lasting approximately three weeks. During each section you will be asked to access the course materials via one of the distributed learning tools. At the midpoint and at the end of each section you will be asked to complete a short questionnaire. For the final three weeks in the course you are free to choose any one of the tools to access the course materials, and you will be asked to complete a post-study questionnaire.

The benefits from participating in this study are that you will gain experience using Distributed Learning tools and you will experience being the "user" in a qualitative usability study.

The costs of participating may be the inconvenience of learning how to use each of the three tools. It will take two hours or less to become comfortable with each tool.

Your rights

Your participation in this project is entirely voluntary and you can withdraw from it at any time. You also have the right to refuse to answer any questions you do not wish to answer. If you choose to withdraw, the data collected will be destroyed immediately. Your decision to participant (or not) will not effect your grade received for SENG310.

Your confidentiality will be protected by not using your name on any records. The identities of the participants/non-participants will be kept from the instructors until the grades for the course are filed with the registrar.

At the conclusion of the study, all of the raw data (i.e. answers to the questionnaires) will be kept in a secure office in a locked cabinet and destroyed within 2 years. The statistical data (from which the subjects will not be identifiable) may be published at a later date in a conference or journal. Following the experiment, the initial results will be described in a class.

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Having understood the above information and have been given an opportunity to have my questions answered, I agree to participate in this study:

Print your full name: _____

Signature of Participant: _____ **Date**: _____

VITA

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Title of Thesis:

Evaluating the Usability of Web-based Learning Tools

Author: [redacted]

Mei Wang

November 7, 2000