Web Site Usability: A Case Study of Student Perceptions of Educational Web Sites

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Abstract

The purpose of this research study was to understand the construct of usability from the perspective of 74 students enrolled in six online courses offered by one online and distance learning program at a large, public university in the Midwest. Six courses, designed and developed by two different groups, professional and nonprofessional developers, were selected. The study used both quantitative and qualitative measures to record the experiences of students enrolled in the six online courses. First, the courses were evaluated using Nielsen's (1994, 2000, 2002) heuristics as operationalized by the *Xerox Heuristic Evaluation Checklist* (1995) as a standard measure of usability, then rank-ordered by heuristic evaluation score. Eachus and Cassidy's (2006) *Computer Use Self-efficacy Scale* was used as a pre-course survey to measure students' computer self-efficacy prior to beginning their online course. Stewart, Hong, and Strudler's (2004) *Quality of Web-based Instruction* was used as a post-course survey to measure student satisfaction with their online course experience. A subset of 29 students participated in usability testing sessions in the usability lab. A think-aloud protocol provided qualitative data in the form of verbal reports, eye-tracking recordings provided data confirming the think-aloud protocol data, and a time-error log provided "time to complete tasks," and "error rate" data as students completed seven typical tasks required to successfully participate in an online course. A summary, debriefing interview with each student was conducted to record any additional student comments and any student recommendations for improving the courses. Qualitative data were examined for themes and a coding scheme was created. This coding scheme, which

illustrated the issues specific to educational web sites, was compared to Nielsen's (1994, 2000, 2002) heuristics to evaluate whether Nielsen's (1994, 2000, 2002) heuristics, widely accepted as the standard for the design and development of business and commercial websites, also apply to educational web sites. Design and development guidelines for educational web sites were written by the researcher based on the study findings. These guidelines were mapped to Nielsen's heuristics as operationalized by the *Xerox Heuristic Evaluation Checklist* (1995).

The results of the quantitative and qualitative measures used were analyzed by course and course development type. The most significant results of this study came from the analysis of the variables according to course development type. The results of the study findings include that the course design type, professional or nonprofessional, was related to usability as measured by students' error rates, Nielsen's heuristic evaluation scores, and student satisfaction scores. The professionally-developed courses were found to be significantly higher in usability than the non-professionally-developed courses by task error rate, Nielsen's heuristic evaluation score and student satisfaction scores. The analysis of students' verbal reports resulted in three times as many positive comments for the professionally-developed courses when compared to the positive comments for the nonprofessionally-developed courses.

The results of the quantitative and qualitative measures used were also analyzed by course. When comparisons were made between courses using courses as the unit of analysis the findings were different. The rank-order of courses was mixed between course types when compared by error rates. The Nielsen's heuristic evaluation scores as

measures of usability for educational web sites were not consistent with students' judgments of course usability as measured by error rate scores. There was no relationship between the usability ranking of courses by Nielsen's heuristics and usability as judged by students' error rates. However, an analysis of students' verbal reports identified 52 common themes and confirmed the importance of Nielsen's heuristics in educational course design.

The correlation between the self-efficacy score and error rate means was non-significant. The correlation between self-efficacy and error rate was small; very close to zero. There was a small positive correlation between student satisfaction and usability as measured by error rates.

Based on the analysis of the study variables according to course development type, the results of this study found that Nielsen's usability heuristics, a respected evaluation tool used primarily to measure the usability of commercial web sites, can be used to evaluate instructional web sites and used to differentiate between levels of usability in the same way usability is judged by students.

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Chapter One

Introduction

> [T]he user, or, in other words, the master, of the house will even be a better judge than the builder, just as the pilot will judge better of the rudder than the carpenter, and the guest will judge better of the feast than the cook.
>
> —Aristotle *Politica*

As distance education has moved from traditional, correspondence courses to online educational web sites, it becomes important to look at the usability or "ease of use" of these instructional web sites from the student's perspective. This research explored what the construct of usability means for students taking online courses. Although, the construct of usability is not well understood, it is apparent that usability does not reside in software alone, but instead is a construct resulting from the interaction of software design and user expectations. This study sought to understand what usability means within the context of one online and distance learning program at one university. The question raised in this study was whether Nielsen's usability heuristics can be applied to instructional web sites to differentiate between levels of usability as judged by students.

Background and Rationale

"Designing interactive computer systems to be efficient and easy to use is important so that people in our society may realize the potential benefits of computer-based tools" (Card, Moran, & Newell, 1983, p.1). In 1989 Tim Berners-Lee created the World Wide Web, an Internet based hypermedia initiative for global information sharing. The World Wide Web was originally conceived as an "electronic notebook" or information space where particle physicists could share research findings and work on an expression of their shared knowledge (Berners-Lee, 1996, 1999). In recent years World Wide Web usage has surged through all strata of society along with the adoption and penetration of personal computers (Barbules & Callister, 2000; Carroll, 1995; Crystal, 2001; Friedman, 2006; Negroponte, 1995; Nielsen, 1993; Winograd & Flores, 1987). Globally, anyone who has a computer, network access, and browser software can access web resources. Thus, the Web has been transformed from a hypertext-based tool designed for a select scientific community into a global medium widely used by many citizens of all socio-economic and educational backgrounds for e-commerce, publication, communication, and education (Barbules & Callister, 2000; Bonk & Zhang, 2008; Crampton Smith & Tabor, 1996; Eachus & Cassidy, 2006; Friedman, 2006; Harasim, Hiltz, Teles, & Turoff, 1996; Hiltz & Turoff, 1994; Röuet & Levonen, 1996; Swiss & Horner, 2000; Weinreich, et al., 2008, Winograd & Flores, 1987). As Shneiderman (1998) aptly states, "hypertext has become a mainstream interface paradigm" (p. 554).

This "digitization revolution" (Friedman, 2006, p.70) began with the development of the personal computer and the Windows operating system, a graphical user interface.

The graphical user interface enabled non-computer experts to easily use the computer to access and use files without knowledge of computing languages or programming skills. This increased access to computers demonstrated to users the value of digitizing materials so they could be manipulated on the computer (p. 69). The push for digitization gained additional power and momentum with Microsoft's free distribution of its web browser, Internet Explorer, which was bundled with its dominant Windows operating system. These two events, according to Friedman (2006), "resulted in everyone wanting everything digitized as much as possible so they could send it to someone else down the Internet pipes" (p. 70). Digital files, once the domain of researchers and computer scientists, are now commonly used.

Both educational institutions and businesses now use the World Wide Web for educational purposes (Bonk & Zhang, 2008; Driscoll, 1998; Horton, 2001, Katz, 2008; Landauer, 1996; Naidu, 2003; The New Media Consortium & Educause Learning Initiative, 2006, Weinreich, et al., 2008). Global access to web resources allows the possibility of anytime, anywhere learning to occur, and allows students and companies to save on travel time and costs. The development of new technological tools that support computer-mediated communication, (i.e., the Web and the proliferation of increased, faster telecommunications networking capabilities), has brought about a "new, unparalleled willingness for mainstream academicians to consider the benefits of using the Web to teach outside the classroom and beyond the campus in the twenty-first century" (Moore, 2003, p. ix). Thus, non-traditional distance education, once defensively struggling to prove its parity with traditional education, is becoming more mainstream

(Katz, 2008; Rovai, 2002; Saba, 2003; Thompson & Irele, 2003). In the recent Sloan Consortium report, *Staying the Course: Online Education in the United States* Allen and Seaman (2008) report that online enrollments have continued to grow at a rapid annual rate of 12.9%, a rate that is much greater than the annual rate of increase in the total higher education student population, 1.2%. The most recent data demonstrates no signs of this trend slowing down. In the fall of 2007, over 20% of higher education students were taking at least one online course (p. 1).

The evolving economy has become increasingly global (Agre & Rotenberg, 1998; Bowers, 2000; Friedman, 2000, 2006) and knowledge based in recent years (Brown & Duguid, 2000, Castells, 2001; Romiszowski, 1997; Twigg, 2002). With the downturn in the U. S. economy post 9/11/01, thousands of manufacturing jobs have been cut and American jobs have been outsourced overseas as companies seek to slash costs, take advantage of lower foreign labor costs, and improve the bottom line (Friedman, 2006). This change in corporate practice is transforming the higher education market from primarily serving the traditional 18-22 year old student to serving a non-traditional older, adult student as workers seek retraining (Allen & Seaman, 2007, 2008; Bonk & Zhang, 2008; Katz, 2008; Laurillard, 2002). In addition, the skills needed to compete in the high tech job market continue to evolve with technological advances. As computer technology has become a ubiquitous tool to accomplish tasks in business, “companies are asking employees to do new and more complex jobs for which they have neither the experience nor training” (Dumas & Redish 1994, p. 10). Thus, student demographics and student needs have evolved as increasing numbers of adult, non-traditional students return to school (Allen & Seaman, 2007, 2008; Laurillard, 2002; Taylor, Marienau, & Fiddler, 2000; Twigg, 2002). Examples of the evolving needs of non-traditional, adult, employed distance students include time savings and comfort, two factors that have never played any role in traditional pedagogy (Peters, 2003). The return of non-traditional students to higher education for additional training, certificates, and degrees has also resulted in an educational generation gap between these two groups of students—traditional and non-traditional—who have different educational and technological experiences and different expectations (Bonk & Zhang, 2008).

Eachus and Cassidy (2006) note that the ubiquitous nature of the Internet has made Internet access and possession of Internet skills a social assumption for 21st century citizens. However, they also observe that although the Web is becoming increasingly intuitive, it still poses challenges for inexperienced users. In particular, the hypertext format of the Web continues to pose problems for learners. Any difficulty students may have using this technology compounds and increases the learner's cognitive load above and beyond learning the course content.

The increased expectations for web-based instructional opportunities heighten the need to ensure that such systems are designed in ways that promote learning and the accomplishment of intended purposes. To create a site that is effective for teaching and learning, designers need to understand users and their tasks (Barnum, 2002; Dourish, 2001; Flores, Graves, Hartfield & Winograd, 1988; Garrett, 2003; Hackos & Redish, 1998; Hackos & Stevens, 1997; Jonassen, 1982; Rogers, 2000; Sano, 1996). This involves designing an interface that provides access to its functions and features in a way that reflects *users'* (rather than designers') ways of thinking about the task that is being supported. This type of interface design means that users are able to interact with the interface in a manner that is natural or intuitive to them (Dourish, 2001; Flores, Graves, Hartfield, & Winograd, 1988; Hackos & Stevens, 1997; Wood, 1998). For users, not designers, "create and communicate meaning" (Cockton, 2009, p. 2223; Dourish, 2001; Flores et al., 1988; Winograd & Flores, 1987). As Laurillard (2002) states, "the aim is to design a user interface that never intrudes on the task at hand" (p.194), in this case, learning.

Research Questions

This study is concerned with determining:

1. What does the construct of usability mean from a student's perspective?
2. How do Nielsen's usability heuristics compare to students' judgments about instructional web sites?
3. Is computer self-efficacy related to students' perceptions of web site usability?
4. Is web site usability related to student satisfaction with online courses?
5. Is computer self-efficacy related to student satisfaction with online courses?
6. Is course development type related to task error rate, Nielsen's heuristic evaluation score and student satisfaction?

Answering the above questions requires asking what the construct of "usability" is, how this construct is defined for instructional web sites through the experiences of the students, and comparing students' perceptions of usability to the definition of usability as described by Nielsen's guidelines.

Research Hypotheses

It is hypothesized that students' perceptions about web site usability will be affected by the computer self-efficacy they have at the outset of taking an online course. Self-efficacy is important because students' beliefs about their ability to successfully use computers to complete an online course regulate their aspirations, choice of behaviors, mobilization and maintenance of effort, and affective reactions (Bandura, 1997). It is also hypothesized that student satisfaction will be related to web site usability. It is inherent in Nielsen's (1993, 2004) guidelines that usability is related to satisfaction. According to research conducted by Kurosu and Kasahimura, (1995); Norman, (2002; 2004); and Tractinsky (1997, 2004, 2005), our reaction to the aesthetics of a product is related to our perception of how well the product works. McCarthy and Wright (2004) extend this relationship of interface aesthetics to satisfaction to also include the user's experience and engagement. They ask whether a technology's aesthetics enhance the quality of engagement, a concept particularly important to educators who strive to engage the student with instructional content, instructors, and with each other in discussion whether the course meets face-to-face in the classroom or online in a course web site.

Need for the Study

Although many articles and books have been published about web-based learning, only limited empirical research has emerged to inform the development and design of educational course sites. Further, the guidelines in the education research literature tend to be either too general or too prescriptive, thus, consequently of little help as professors begin to design their online courses (Alley & Jansak, 2001). Tallent-Runnells, Thomas, Lan, and Cooper (2006) reported in their review of the teaching online courses literature, the emergence of four main themes including

- course environment,
- learners' outcomes,
- learners' characteristics, and
- institutional and administrative factors.

They report that further research is needed in "appropriate and excellent course design and development" (p. 117) due to the role course design and development plays in student success in the online environment.

In a literature review conducted by Bonk and Wisher (2000), key research areas included:

- instructor's roles in online learning,
- online moderators,
- learner perceptions,
- methods for online collaboration,
- interaction schemes,
- collaborative tools,
- online communities, and
- learning styles.

Usability, as a key area of research in online education, is conspicuously absent. Hall, Watkins, and Eller (2003) note that the usability studies of “Usability Guru” Jakob Nielsen have focused on corporate web sites, which have different goals from educational sites; and therefore, “his views are not completely germane with respect to web-based learning” (p. 370).

There are few research-based guidelines concerning how to enhance the usability of a course site and how to effectively use the online tools (i.e., individual, group or class discussion areas, self-tests, surveys, and quizzes) available for web-based courses (for example, see Bonk & Dennen, 2003; Duffy & Kirkley, 2004; Hannafin, Hill, Oliver, Glazer & Sharma, 2003). This lack of research-based guidelines continues to the present (for example, see Abrami, Bernard, & Lou, 2004; Moos & Azevedo, 2009; U. S. Department of Education, 2009). In his recent report, *Where is the new learning? The tower and the cloud*, Woolsey (2008) notes that there has been little specific investment in the areas of teaching and learning that takes full advantage of the digital opportunities to enhance education. Bonk and Wisher (2000) describe the tools available in higher education and training courseware today as “crude” (p. 52). The lack of guidelines and strategies has left many educators unsure of how to proceed (Alley & Jansak, 2001; Bonk & Zhang, 2008; Katz, 2008)—resulting in a wide continuum of course interfaces, structures, and content (Oblinger & Hawkins, 2006). The lack of research-based guidelines has also resulted in poorly designed courses that students find difficult and confusing to use (Barbules & Callister, 1996; Duffy & Kirkley, 2004; Hall, Watkins & Eller, 2003; Hara & Kling, 2000; Shotsberger, 1996), which causes breakdowns in task completion (Flores et al., 1988; Winograd & Flores, 1987).

Cress and Knabel (2003) discuss users' difficulties navigating through educational hypertexts. They describe the "structural disorientation" students experience when they are unable to specify their location within the hypertext (p. 518), while Dias and Sousa (1997) discuss students' "conceptual disorientation" their inability to interrelate and connect the different concepts presented in a complex hypertext. Surprisingly, their research concluded that using a map as an aid did not help students' navigation (p. 184). Otter and Johnson's (2000) research identified and studied two metrics of user "lostness." They suggest a new approach to designing hypertext learning environments, basing the design upon the users' mental models (p. 35).

Empirical Evidence of a Problem

In their research study of student's distress with distance education, Hara and Kling (2000) found that students cited course content (i.e., confusing web content and ambiguous instructions on the web pages) as a source of difficulty in an online class. They also noted that while most distance education literature emphasizes its positive opportunities, "only a few scholars examine its important limitations and pervasive problems" (p. 22).

The student population studied in this research was comprised primarily of working adults. For these students, flexibility and convenience are critical elements for the online and distance learning program to meet student needs. Currently, over 200 courses are offered by this online and distance learning program both synchronous (face-to-face) and asynchronous (web-based) formats. Face-to-face classes are offered in the evening on the university campus, and at various community colleges in the state. Asynchronously, many online and distance learning program courses are offered via the Internet so students can learn from home or work. In recent final evaluations of an online and distance learning program course at this university collected Fall 2004 from enrolled students at the end of the course, comments concerning the design of their online web course were:

- “confusing web design”
- “really unorganized”
- “hard to quickly navigate around site”
- “takes a lot of time to find the details”
- “parts of instructions are in different places”
- “feels like there is no communication between the web designer and the teacher”
- “total confusion finding things on the course web site”
- “better organized web design with ALL instructions in one place”
- “sent instructor a posting about the confusing layout, difficulty following and finding assignment information on the class web site”

These comments illustrate these students’ issues with the course design. They provide evidence of the need for usability testing to elucidate the students’ experience of these courses so that, in Gall, Borg, and Gall’s (1996) words, more effective and efficient courses may be designed and it can be determined how the current courses may be improved. By evaluating the usability of selected online and distance learning program courses, it is anticipated that the source of students’ difficulties may become explicit and guidelines might be developed to improve the design of these instructional web-based courses.

The need for providing consistent guidance for instructional web-based course development can be derived from several sources of dissatisfaction. Differences between designers and users have already been identified as causing learning disorientation and reducing satisfaction because web site design has not focused primarily on user needs. There is a need to examine the quality of instructional web sites from the perspectives of both adherence to accepted design principles and the perspective of students who inevitably, upon entering an online course, have differing levels of prior knowledge, computer experience and expertise.

The online and distance learning program courses offered at one large public university in the Midwest were selected because they fulfill several research needs. First, because of my professional role as an instructional designer in one college at this university, I had access to these courses and the registered students' public data, including their names, and e-mail addresses, data necessary for recruiting participants. Second, it was important that the courses selected have commonalities so I could limit the number of factors that affect the research (i.e., content area, types of students, student background). Students in the online and distance learning program are primarily adult, working professionals seeking to complete their undergraduate degree. The content areas of online and distance learning program courses are varied. While some courses are geared to support students in their professions (i.e., project management, new product development), other courses offered by the program are in academic subjects such as writing, social work and science. Third, the courses were developed and offered through the WebVista course management system. Fourth, this online and distance learning program is stable. Approximately 200 courses have been offered over the past five years, and they continue to be offered to a large audience of students.

Chapter Two

Review of the Literature

The focus of this study is the analysis of the construct of usability as it applies to six online courses offered by one online and distance learning program at a major university. Usability has often been the subject of research conducted by usability and marketing experts on business web sites as it relates to customer behavior. The construct of usability in educational web sites, specifically online courses taken for credit toward degree completion, has not been researched to the same extent. This study focuses on defining the construct of usability as perceived by students observed completing course-related tasks. Usability of the selected web sites is also measured by several instruments including two surveys, a think-aloud protocol analysis, a time/error log, and a heuristic evaluation.

This chapter reviews the literature applicable to the study of usability as it relates to web-based instruction. It begins by building the conceptual framework of the study and defining usability and its characteristics. Then, the chapter specifically relates the construct of usability to web-based instruction. Next, the relationship between web-based instruction and instructional design is discussed. A brief description of the history of the field and definitions of instructional design begin a section on the importance of instructional design for web-based instruction. This section is followed by a discussion of the need to evaluate the design and quality of web-based instruction. The next section answers the following questions: Is designing a course to be delivered via the Web different from designing a course to be delivered face-to face in the classroom? If so, how is it different? Why is there a need for usability? There have been multiple research studies that examine the relationship between usability and aesthetics, a quality that affects not only the computer interface, but other items we use in our daily lives. How does usability affect computer use? Then, research-based usability guidelines for interface design are described. Finally, recent studies evaluating distance learning courses are discussed. The chapter concludes with information specific to this research and the data sources and variables used in this research.

Theoretical Framework

The purpose of this research study is to understand the construct of usability as perceived by students in online courses. It is based on theories drawn from the fields of human-computer interaction, psychology, distance education, and instructional design.

The first segment of the theoretical framework of this study is based on the concept of usability. Usability is drawn from the field of human-computer-interaction. To understand this segment of the theoretical framework requires understanding the concept of usability as defined in the literature, what usability means for students, and what role usability plays in web-based instruction. To understand what usability is and how it is judged also requires the examination of existing heuristics, or “rules of thumb” that guide the design of usable interfaces. The most widely accepted guidelines are Nielsen’s (1994, 2000, 2002) Heuristic Evaluation. In this study these heuristics are operationalized by *The Xerox Heuristics Evaluation: A System Checklist* (1995). The question raised in this study related to this segment of the theoretical framework is whether Nielsen’s (1994, 2000, 2002) heuristics, which have been widely applied to commercial web sites, can also be applied to the design and development of educational websites. This question is answered by comparing students' judgments about instructional web sites with Nielsen's usability heuristics.

The second segment of the theoretical framework of this study is drawn from the field of psychology. Bandura's (1997) self-efficacy theory relates an individual's belief about their ability to accomplish tasks to their success at accomplishing these same tasks. The questions raised in this study related to this segment of the theoretical framework is the hypothesis that students' computer self-efficacy will be related to students' perceptions of web site usability as measured by the pre-course, *Computer User Self-efficacy Scale* (CUSE) and post-course, *Student Evaluation of the Quality of Web-Based Instruction* surveys.

The third segment of the theoretical framework of this study is drawn from the field of distance education. The penetration of technology through all strata of society in recent years, in particular, the use of the World Wide Web for the design and development of educational web sites has created consumer demand for online courses. This increased demand for anytime, anywhere learning has resulted in the evolution of distance education from print-based correspondence courses to online web-based instruction. This evolution requires asking, does this change in media affect what type of learning materials students perceive as usable? The question raised in this study related to this segment of the theoretical framework is, What does the construct of usability mean from a student's perspective?

The fourth segment of the framework is drawn from the field of instructional design. What is effective, efficient design for student learning in online courses? This part of the theoretical framework is related to the distance education segment of the framework. The questions raised in this study related to this segment of the theoretical framework are What does the construct of usability mean from a student's perspective? Is web site usability related to student satisfaction with online courses? Is web site usability related to course development type?

Usability

Usability is a construct inherent in human-computer interaction because the user is separated from the tools needed to complete their tasks by the computer screen. Whether usability is explicitly recognized by the user as a characteristic of a course site or whether the user simply has a difficult, unpleasant experience as they try to accomplish their assigned tasks, usability is always a factor in the design of online course sites. It is always a factor due to the separation between the physical environment, the student, and the virtual environment, the course content and course management system tools that the student uses to interact with the content and participate in class activities. In the following sections, the construct of usability will be defined. Next, the relationship between usability and web-based instruction and the consequences of unusable course sites are explored. Finally, a discussion of the relationship between web-based instruction and instructional design prepares the reader for the next section of the paper which addresses the topic of instructional design.

Defining Usability

Usability or “ease of use” is fundamental to site design (Dillon & McKnight, 1995; Hackos & Redish, 1998; Nielsen, 1993, 2002). Site usability is defined as the way that the user *actually* navigates, finds information, and interacts with the site (Goto & Cotler, 2002; Wood, 1998). According to Dumas and Redish, (1994), “usability means that *people who use the product* can do so *quickly and easily* to accomplish *their own tasks*” (p. 4; italics added.) Their definition rests on four assumptions concerning users:

1. Usability means focusing on users
2. People use products to be productive
3. Users are busy people trying to accomplish tasks, and
4. Users decide when a product is easy to use. (p. 4)

Nielsen (2002), states that “ease of use is the first priority” of interface design. He (1993) defines usability in terms of five characteristics:

1. learnability,
2. efficiency,
3. memorability,
4. errors, and
5. satisfaction (p. 26).

Building on definitions of usability, Rosson and Carroll (2002) identify three perspectives that contribute to the general concept of usability:

1. Human performance, time, and errors
2. Human cognition, mental models of plans and actions

3. Collaboration, group dynamics, and workplace context (p.10).

Usability and Web-based Instruction

To succeed in web-based instruction, students need an interface that has a high degree of usability. Relating Rosson and Carroll's (2002) perspectives to an online course site, first, students need an interface that facilitates human performance and makes good use of students' time while minimizing errors. A usable course site allows students easy access to course information so they can locate the materials and documents they need to facilitate learning. Students should be able to see their options, how to achieve their goals, and how to accomplish desired tasks (Barnum, 2002; Brown, 1986; Cooper, 1999, 2002; Garrett, 2003; Hackos & Redish, 1998; Hackos & Stevens, 1997; Horton, 2001; Johnson, 1998; Laurillard, 2002; Norman, 1988, 1993; Shneiderman, 1998, 2002; Tufte, 1997, 2003; Wood, 1998). Second, students need to be able to make a mental model of the site and plan their studies (Amadieu, van Gog, Paas, Tricot, & Mariné, 2009; Berge, Collins & Dougherty, 2000; Brown, 1986; Dillon & Greene, 2003; Garrett, 2003; Hackos & Redish, 1998; Johnson-Laird & Byrne, 2000; Laurel, 1993; Norman, 1988, 2002; Otter & Johnson, 2000). Third, students need to feel part of the class, whether through discussion or group activities (Bastiaens & Martens, 2000; Bonk & Dennen, 2003; Bonk & Zhang, 2008; Fisher, 2000; Laurillard, 2002; Palloff & Pratt, 2001).

Why is usability important to students? Numerous research studies have documented that users become disoriented and "lost in hyperspace" (Barrett, 1988; Conklin, 1987; Hackos & Stevens, 1997; Hannafin, Oliver, Hill, Glazer, & Sharma, 2003; Marchioni, 1988; Sano, 1996; Shneiderman, 1998; Snyder, 1996; Yankelovich, Meyrowitz & van Dam, 1994), thus unable to find the information they need. Historically, web site design has been driven by either a technological or aesthetic perspective rather than by the needs of the user (Barnum, 2002; Bruinsma, 1998; Cooper, 1999, 2002; Flores et al., 1988; Friedlein, 2001; Hackos & Redish, 1998; Hackos & Stevens, 1997; Isaacs & Walendowski, 2002; Landauer, 1997; Lansdale & Ormerod, 1994; Mullet & Sano, 1995; Nielsen, 1993; Norman, 1990, 1998; Rouet & Levonen, 1996; Shneiderman, 1998, 2002; Wood, 1998; Wurman, 1997, 2001). Awareness of this potential problem raises the question of whether the instructional effectiveness of web sites is affected by the extent to which they meet usability standards.

Simply stated, the creation of effective, satisfying courses is not rooted in the production of materials using either print or digital technologies. Instead, creation of effective, satisfying courses should be rooted in human perception, instructional principles and good design (Berge, Collins & Dougherty, 2000; Hartley, 1982; Sano, 1996). Good design includes the ability of the designer to understand the user's tasks and to create an interface that allows the user to grasp its meaning and create a mental map of the space (Chen & Rada, 1996; Cooper, 1999; Cooper & Reimann, 2002; Cress & Knabel, 2003; Dias & Sousa, 1997; Garrett, 2003; Hackos & Redish, 1998; Hackos & Stevens, 1997; Otter & Johnson, 2000; Raskin, 2000) and the creation of materials that address the instructional needs of the audience (Cress & Knabel, 2003; Oblinger & Hawkins, 2006; Seels & Glasgow, 1990; Smith & Ragan, 2004). Unless the design meets user needs, the site may be misinterpreted, ineffective, or unusable (Baggerman, 2000; Cress & Knabel, 2003; Nielsen, 1993; Otter & Johnson, 2000; Sano, 1996). Usability is especially critical to educational web sites where learning is the goal. Students must be able to access and retrieve relevant course materials, navigate through the web site to interact with course elements, complete assignments and, finally, construct meaning to achieve learning outcomes. Beyond individual web site navigation, student collaboration and group dynamics data may also be evaluated through analysis of the discussion area, group work, and peer review forms (Roblyer & Wiencke, 2003).

Some student evaluations of one online course offered by the online and distance learning program at the Midwestern university included in this study in the fall semester, 2004, indicated that students enrolled in the course had difficulty understanding the course site design and how to navigate it. By investigating the perceptions, satisfaction, and achievement of learners, usability research can elucidate the needs of students and provide evidence about the effectiveness of the current course design. The identification of design strengths and weaknesses as evidenced by user testing provides guidance for how the current course design can be improved to facilitate use and learning (Hackos & Redish, 1998; Hackos & Stevens, 1997). In their text on educational research, Gall, Borg, and Gall (1996) state "educators are continually searching for more effective and efficient versions of instructional programs or procedures" (p. 54) and pursuing research in this area extends previous research.

Web-based Instruction and Instructional Design

Web-based instruction is dominating contemporary open and distance learning. The popularity, intensity of use, and penetration of the Web and other emerging technologies has not only changed the media used to distribute course materials at a distance, but it has also changed both the types of learning activities available and how students engage with the instructor and collaborate with each other at a distance. In the past, distance education programs, “which overlap with online learning” (U. S. Department of Education, 2009, p. xi) were comprised of courses delivered via print-based correspondence courses, educational television broadcasts, or videoconferencing. Many distance education programs were based solely upon print-based correspondence courses. In print-based correspondence course distance learning programs, course materials and communication between the students and the instructor were transmitted by postal mail. This type of transmission increased the time gap between assignment submission and instructor response to the student as compared to the fast responses enabled by the technology used in web-based instructional web sites. In print-based correspondence courses, instructional interactions were solely between the instructor and the student. The student, separated by time and space from any other students enrolled in the same correspondence course, did not have the opportunity to interact or collaborate with any of the other students taking the course.

The use of web and other emerging technologies to transmit course materials and to communicate has significantly minimized this time and space gap, significantly increased the types of learning activities and types of interactions technically possible, and has changed how we think about distance education. The variety of learning activities and interactions possible between students and content, students and their peers, and students and their instructors has increased the importance of using instructional design principles to make the most effective use of these new educational tools and options.

According to Naidu (2003), contemporary open and distance learning has spearheaded and re-focused the attention of educators on various aspects of teaching and learning. These aspects include:

1. instructional design,
2. the role and function of electronic publication and distribution of course materials,
3. use of alternative and noncontiguous delivery technologies (i.e., alternative to face-to-face instruction), and
4. ownership of intellectual property and copyright.

Of these various aspects, he states that the "most pervasive is the recognition of the role and importance of instructional design" (p. 349).

Instructional Design

This section draws a closer relationship between instructional design, web-based instruction, and usability. First, instructional design is defined and discussed. Second, the need to evaluate the design and usability of online courses is discussed. This section includes a discussion of the results of three recent meta-analyses of online education research which identify this gap in the research and underscore the need to evaluate the design and usability of online courses. Third, the differences between designing instruction for a face-to-face class and an online course are discussed. This discussion includes the unique challenges facing instructors and students in web-based courses.

Defining Instructional Design

The field of instructional design began as a systematic approach to designing instruction; specifically training, for the military in World War II. It is based on the premise that the learning activities should not occur accidentally, but rather should be developed in accordance with an established, orderly process that includes measurable outcomes for the students (Seels & Glasgow, 1990). These measurable outcomes, objectives, or learning goals allow the instructor and student to gauge the success of the training and answer the question, “Have the students successfully learned and achieved course goals?” If students have achieved the objectives, then the course can be deemed successful, and, if not, the course design needs to be modified “to facilitate student attainment of specific, intended leaning goals” (Smith & Ragan, 2004, p. 2). Instructional design by its nature is an iterative process. There is a need for instructional designers to examine their design, evaluate whether or not significant learning is taking place, then evaluate and correct any design flaws, if necessary. This involves learning from instruction that fails as well as instruction that succeeds as planned. These basic tenets of instructional design apply to courses whether the instruction is delivered in the classroom or online.

Instructional design can be defined both as a process and a discipline which results in a product that defines the educational setting (Dijkstra, 1997; Zheng & Smaldino, 2009). Smith and Ragan (2004) define instructional design “as a systematic process of translating principles of learning and instruction into plans for instructional materials and activities" (p. 2). According to Carl Berger's (1996) *Definitions of Instructional Design* web site, instructional design is:

> The systematic development of instructional specifications which uses learning and instructional theory to ensure the quality of instruction. It is the entire process of analysis of learning needs and goals and the development of a delivery system to meet those needs. It includes development of instructional materials and activities; try-out and evaluation of all instruction and learner activities.

Smith and Ragan (2004) further note that "careful, systematic planning is particularly important when the medium of instruction is something other than a teacher" (p. 2). Sadik and Reisman (2009) note that many online courses do not have clear learning objectives which are stated either in the beginning of a course (i.e., course goals) or in individual lessons as the course progresses. The lack of specified goals or objectives results in learners who are unsure of the learning outcomes they are expected to achieve.

The rapid expansion and demand for online courses in recent years has resulted in the rapid development of online "courses" which do not follow instructional design principles. It must be noted here that merely delivering course materials online does not constitute web-based instruction. "Online instruction is more than a series of readings posted to a web site; it requires deliberate instructional design that links measurable learning objectives to specific learning activities and measurable outcomes" (Morrison & Anglin, 2009; Oblinger & Hawkins, 2006 p. 14).

Some of these poorly designed online courses consist of materials designed for courses delivered face-to-face in the classroom uploaded to the Web to create an “online course.” This type of online course is comprised of a vast array of information uploaded to a course site and is called “shovelware” (Khan, 1997; Morrison & Anglin, 2009). This practice is distinguished here as different from the practice of faculty uploading course materials to a class web site to augment the face-to-face classroom experience, a practice which results in a “blended” course (Garrison & Vaughan, 2008). An online course composed of shovelware is often lacking in instructional design suitable for the online environment and is woefully inadequate in terms of meeting the instructional needs of the student. These types of online courses are not “instructionally sound” (Morrison & Anglin, 2009, p. 359). The ability of the learner to navigate course materials uploaded to a course site via various site tools such as drop-down menus, breadcrumbs, buttons, and hyperlinked files does not automatically constitute an instructional web site (Rogers, 2000). Rather, in the online, hypertext, learning environment of the Web, where the student and instructor are separated by time and space, the importance and need for good instructional design and the try-out and evaluation of all instruction and all learner activities as noted above becomes more evident.

The Need to Evaluate Design and Quality

Given the increased student demand for anytime, anywhere learning, the expansion of distance education offerings worldwide (Allen & Seaman, 2008; U. S. Department of Education, 2009), and the challenge of providing courses based on pedagogical principles (Alley & Jansak, 2001; Orellana, Hudgins, & Simonson, 2009) in an ever-changing technological environment, there is a compelling need to evaluate and measure the quality of online courses. Traditionally, distance learning courses have been evaluated using such measures as achievement scores, grade-point averages, completion rates (Dupin-Bryant, 2004; Rovai, 2002), and attitude (Abrami, Bernard, & Lou, 2004). After investigating frameworks for research, design, benchmarks, training, and pedagogy in web-based distance education, Bonk and Dennen (2003) reported that "there is a dearth of knowledge about pedagogical tools and strategies for the Web" (p. 338). Further, in their research, Hannafin, Hill, Oliver, Glazer, and Sharma (2003) found that although there is a great deal of buzz about web-based learning, "only limited empirical research has emerged, many researchers report equivocal, non-significant, or even contradictory findings and as a result, researchers and practitioners are left more confused than enlightened" (p. 245).

Citing that the "use of hypertext involves a basic set of cognitive processes and strategies regardless of context" (p.11), Rouet and Levonen, et al. (1996) express the need for empirical studies of hypertext for teaching and learning. Their recommendations include empirical studies:

1. to identify these cognitive processes and how they are affected by particular design features,
2. to explain when and how nonlinear documents can fruitfully support learning activities, and
3. to allow hypertext developers to make design decisions based on the needs *of users* rather than on fuzzy principles or mere intuition (p. 11; italics added.)

Abrami, Bernard, and Lou (2004), Moos and Azevedo (2009), and the U. S. Department of Education (2009) recently published meta-analyses of empirical online learning research. Abrami, Bernard, and Lou (2004), reviewed 232 studies conducted between 1985 and 2002 to answer the question, "How does distance education compare with classroom instruction?" Results of their analyses were inconclusive. They found heterogeneous results on achievement, attitude, and retention outcomes. For example, achievement effects for synchronous instruction favored the classroom and asynchronous achievement effects favored distance education. The authors stated that although many distance education applications outperform classroom instruction, many perform more poorly than in the classroom.

Moos and Azevedo (2009) reviewed studies that examined factors related to self-efficacy, learning outcomes, and learning processes with computer-based learning environments (CBLEs). The outcomes found in their analysis suggested implications for changes in research methodology. The first outcome of their analysis suggested that the relationship between computer self-efficacy and learning may change as students acquire knowledge; the second outcome suggested that different dimensions of computer self-efficacy may be related to computer-based learning environments (a finding consistent with Bandura's research), and that self-efficacy beliefs associated with a specific activity may be generalized to similar activities. They concluded that measures that include more specific, distinct dimensions of self-efficacy such as the level, strength, and generality will account for the relationship between self-efficacy and CBLEs more accurately.

The U. S. Department of Education (2009) reviewed studies conducted between 1996 and 2006 that compared online learning with face-to-face instruction. Their analyses showed that participation by students in a course that was delivered all or partially online resulted in better performance than students who received classroom instruction alone. Their analyses found the addition of more media such as video did not appear to positively influence the learning outcomes: the use of course management system (CMS) (e.g., Blackboard, Moodle, WebVista) tools such as online quizzes did not appear to positively influence the learning outcomes; and overall, the medium of online learning was not better in and of itself. Rather, it was *how* online courses were implemented. According to research, understanding *how* to implement online learning practices effectively is important. The most salient point is that none of these three recent meta-analyses, which collectively looked at hundreds of studies, looked at either the usability or interface design of online courses. This underscores the need to evaluate the design and usability of web-based instruction.

Instructional Design Differences

Most educators are familiar with designing instructional materials for a face-to-face class. These materials may include a lecture, a demonstration, problem-solving examples, small or large group discussions, lecture notes or outline, PowerPoint slides or other visual aids. A professor may develop an afternoon lecture related to a current event read in the morning newspaper. Designing web-based courses is distinctly different. One primary difference is that the entire course is prepared, written, edited and any multi-media developed prior to uploading the course to the course management system. Web-based course development requires considerable technical and instructional expertise (Alley & Jansak, 2001; Berge, Collins & Dougherty, 2000; Oblinger & Hawkins, 2006). Secondly, the student experience is different. It is mediated by the computer (Berge, Collins & Dougherty, 2000; Coe, 1997; Kukulaska-Hulme, 1999; Maeroff, 2004; McCarthy & Wright, 2004; Swan, 2004). The interface may be the only classroom experience and class structure that the student encounters for the course. Instead of being able to interact directly with the content, professor and other students, the online user must negotiate through the medium (i.e., the computer, browser software, and Internet connection), navigate to the presentation and open it successfully to gain access to lesson information and content. Maeroff (2004) calls this instructional experience a "classroom of one," while Swan (2004) views the interface as a "window" through which the student views the class. This perspective calls into one's consciousness the experience of being unable to see clearly through a window that is smeared and dirty. In the case of a smeared and dirty windshield, the user's inability to see clearly is a roadblock to their ability to drive safely. The dirty windshield gets in the way of the user's task. In the same way, a poorly designed course interface prevents students from using the course site effectively and efficiently to complete course tasks—students are unable to see clearly through the interface to locate the content they need to learn and the tools they need to complete course-related tasks.

Some course interfaces are intuitive, usable and allow easy access, while others are complicated, difficult, or confusing and become a barrier—blocking students' access to the course content, thus causing a breakdown in workflow. Kukulaska-Hulme (1999) views all computer users as being language learners because commonly used terms from everyday language, critical to users' ability to use the technology effectively, have different meanings in the computer environment. Language refinement plays a critical role in enhancing a person's cognitive maps, and their ability to think critically is the knowledge base for efficient action (Costa & Kallick, 2000) in navigating the course site. Moreover, Flores et al. (1988) state "language is ontology: a set of distinctions that allows us to live and act together in a common world" (p. 156). Language refinement for simplicity and clarity, using a controlled vocabulary familiar to the user, and consistency in word use are important design factors (Nielsen, 1993) for efficient site use. Thus, the usability of an online course interface is critical to student access just as the ability to understand the language, accent, speech patterns, and social context of the lecture is critical to student access of content in a face-to-face class.

Usability is a complex construct of the online classroom. Through years of prior experience, students know how to sit at a desk, read a textbook, listen to a lecture, participate in a discussion, take notes, take tests, and submit assignments in a face-to-face class. How these familiar activities are presented and accomplished in the online class context is what makes usability an issue.

Usability is dependent upon the language used, the information architecture, human factors, and technological affordances and constraints. The design of a course web site may be simple or complex ranging from a few links to hundreds of links. The language used to label and describe links and actions shapes user's understanding of the interface, what they think they are able to do, and determines their capacity to make use of the course tools and functions (Crystal, 2002; Engelbart, 1962; Flores et al., 1988; Winograd, 1996). Users may not understand the options available to them on the screen, rendering them helpless to perform the desired action and wasting time as they fumble through multiple options to find the correct one (Kukulaska-Hulme, 1999), resulting in a frustrating experience in the online classroom which interferes with learning.

Usability and Aesthetics

Kurosu and Kashimura (1995) conducted a correlational analysis of the evaluation data of the determinants of apparent and inherent usability in screen layout and design. Apparent usability is related to the aesthetic appeal of a web site as opposed to the inherent usability which is related to its functionality. They concluded that “users are strongly affected by the aesthetics of a web site even as they evaluate its functionality” (p. 3).

This study was replicated and validated three times by Tractinsky (1997), who doubted the high correlation between aesthetics and apparent usability that Kurosu and Kashimura found in their study results. Tractinsky initially attributed Kurosu and Kashimura’s (1995) results as a cultural phenomenon of the Japanese population, a culture commonly known for its aesthetic tradition. Thus, he conducted his study in a different culture, his own country, Israel. He used Israeli subjects and characterized them (in contrast to the Japanese subjects) as “a culture that does not seem to value aesthetics as much as the Japanese” (p. 3). His results

> strongly suggest that the degree to which aesthetics relate to usability is

> culturally dependent, that our current knowledge limits our ability to accurately predict how culture influences human computer interface (HCI) issues, and that researchers should pay more attention to people's perceptions of the interface aesthetics than has been done thus far (p. 10).

In 2004, Tractinsky wrote, "Despite the paucity of scientific evidence regarding the role of aesthetics in interactive systems, there is enough theoretical, practical, and anecdotal evidence to support the proposition that such a role exists" (p. 12). This body of research supports Norman's (2002, 2004) concept of emotional design and the effect that good design has on the user's affect—their feelings and attitude toward how well an object works.

Historically, research on hypertext has centered around two main perspectives: a system-centered approach and a user-centered approach. System-centered research observes the goal-directed development of new hypertext systems and the technical aspects of the implementation of these new systems. User-centered research observes the interaction of the user and the hypertext, in particular, the skills required to use a hypertext document and the effect of its design on users' tasks (Röet et al. 1996).

According to Kirschner, Martens, and Strijbos (2004), usability matters should be resolved from the perspective of technological affordances and human factors. In contrast, educational and social functionality should be designed with the perspective of educational and social affordances.

Bransford, Vye, and Bateman (2003) state that the ability to design an effective learning environment is dependent upon the designers' understanding of the kinds of skills, attitudes, and knowledge structures that support competent user performance. In addition, the designer needs to understand ways to develop student competence and confidence.

Usability Guidelines for Interface Design

Based on user-centered research begun at Sun Microsystems in 1994, Jakob Nielsen developed usability guidelines that have been widely adopted, particularly for commercial web sites. A recognized usability expert (for example, see Kirschner, Martens, & Strijbos, 2004; Shneiderman, 1998, 2002), Nielsen (1993, 2004) separates the usefulness of a site into its utility and usability. Utility refers to the functionality that a system offers a user, similar to the inherent usability described by Kurosu and Kashimura (1995). For example, an online course may have educational (i.e., presentation of instructional materials as part of its instructional design) and social functionality (i.e., the course discussion area). Usability, in contrast, refers to the technological functionality, a concept similar to Kurosu and Kashimura's (1995) apparent usability. Nielsen (1993, 2004) identifies five attributes that define usability. These are

1. learnability,
2. efficiency,
3. memorability,
4. errors, and
5. satisfaction.

When an educational web site possesses usability, this means that students are able to interact with the interface in a manner that is natural or intuitive to them to complete tasks. Usability is a construct critical to educational web sites. Learners must be able to access and retrieve relevant course materials, navigate to locate and interact with course elements, participate in group activities, complete assignments and, finally, construct meaning to achieve learning outcomes.

Summary

Although distance education, which originated in the 1800s, is not a new concept, the popularity and penetration of the World Wide Web through all strata of society has led to an increased demand for and the exponential growth of the number of courses offered online in the past few years. Web-based instruction now dominates the field of distance education as traditional brick and mortar universities and colleges upload additional course offerings to the Web and develop fully online degree programs. The affordances of the Web which facilitate student interaction with the instructor, delivery of media-rich content and interaction with other students asynchronously offer benefits to students not previously available. The increased numbers of non-traditional, adult students who enroll in these courses combine working lives and families with their student role. The asynchronous quality of web-based instruction allows working adults to learn anytime, anywhere and engage with course content at their own pace.

Research has shown that usability, the way a user actually navigates, finds information, and interacts with a site, to be an important quality for educational Web sites. Usability is defined in terms of the learnability of the site, the efficiency with which users can accomplish tasks, the memorability of a site, the minimization of user errors, and the users' satisfaction with their experience using the site. In other words, if a site is usable, the technology does not cause a breakdown or get in the way of the user accomplishing learning tasks.

The construct of usability is particularly important for students as it applies to educational web sites. Students must be able to successfully navigate and use the course web site in addition to learning the course content. The use of established instructional design principles to design and develop a course is important whether the course is offered online or face-to-face, perhaps even more important in the online environment where instructor and students are separated by time and space.

Designing a course for web-based instruction is different from designing for a face-to face course. The most obvious reason for this difference is because the instructor and students are separated by time and space. The computer interface is the only window into the classroom. What appears “in the window” must be usable and clear for the students to accomplish the learning tasks and course requirements.

Recent meta-analyses of distance learning (2004, 2009) by several different groups of researchers have examined studies of online learning from 1985 to 2006. Although distance education was compared to face-to face instruction in terms of learner outcomes and achievement, self-efficacy, and the impact of the use of some media (specifically videos and quizzes) on learner outcomes, these studies did not look at either the usability or interface design of online courses, the focus of this study.

Chapter Three

Research Method

Introduction

The research problem for this study was to evaluate the usability of six online courses offered by one online and distance learning program at a large public university in the Midwest. Since as noted previously, “usability means that *people who use the product* can do so *quickly and easily* to accomplish *their own tasks*” (Dumas & Redish, 1994, p. 4; italics added), and usability is a construct best judged by the students who use the course site, it follows that to test the usability of these educational web sites, students who were enrolled in the selected courses were recruited as participants for usability testing in the lab.

The contents of this chapter answers questions concerning the methodology used in this research; the “what,” “why,” “where,” “who,” “when,” and “how” the research was conducted. The first section, Research Questions and Data Collection, concerns what was studied and what data were collected to answer each question. The second section, Rationale of the Methodology, answers why the quantitative and qualitative methods were chosen, lists each instrument, then discusses the rationale of each choice and the reliability and validity of each instrument. The third section, Institutional Context, answers where the research was conducted and who participated. The fourth section, Student Selection and Recruitment, answers who the study participants were and how they were recruited. The fifth section, Data Collection Procedures, provides an overview of how the quantitative and qualitative data were collected. The sixth section, Usability Testing describes where the usability testing sessions took place, what was tested, and what happened in the usability testing sessions. Finally, the seventh section, Time Log Video and Eye-tracking Data Collection describes how these data were collected. The chapter ends with a summary of the content. The results of the study are discussed in Chapter Four.

Research Questions and Data Collection

The research questions asked in this study and the data collection planned to answer each question are outlined below.

Question 1: *What does the construct of usability mean from a student's perspective?*

- Usability Analysis which answers the question, "What do the users do and say during the testing sessions?" and includes
    - Think-Aloud Verbal Report Analysis, which answers the questions what do users say during the testing sessions and summary interview
    - Error Rate, which answers the question, "How many errors does the user make per minute while completing the task?"

Question 2: *How do Nielsen's usability heuristics compare to students' judgments about instructional web sites?*

- *The Xerox Heuristic Evaluation: A System Checklist* developed by Xerox Corporation, (1995)
- Usability Analysis which answers the question, "What do the users do and say during the testing sessions?" and includes

    - Think-Aloud Verbal Report Analysis, which answers the questions what do users say during the testing sessions and summary interview
    - Error Rate, which answers the question, “How many errors does the user make per minute while completing the task?”

Question 3: *Is computer self-efficacy related to students’ perceptions of web site usability?*

- Survey One (Pre-course): *Computer User Self-efficacy Scale* (CUSE) developed by Eachus and Cassidy (2006).
- Usability Analysis which answers the question, “What do the users do and say during the testing sessions?” and includes
    - Think-Aloud Verbal Report Analysis, which answers the questions what do users say during the testing sessions and summary interview
    - Error Rate, which answers the question, “How many errors per minute does the user make while completing the task?”

Question 4: *Is web site usability related to student satisfaction with online courses?*

- Survey Two (Post-course): *Student Evaluation of the Quality of Web-Based Instruction* developed by Stewart, Hong and Strudler (2004).
- Usability Analysis which answers the question, “What do the users do and say during the testing sessions?” and includes
    - Think-Aloud Verbal Report Analysis, which answers the questions what do users say during the testing sessions and summary interview

    - Error Rate, which answers the question, "How many errors per minute does the user make while completing the task?"

Question 5: *Is computer self-efficacy related to student satisfaction with online courses?*

- Survey One (Pre-course): *Computer User Self-efficacy Scale (CUSE)* developed by Eachus and Cassidy, (2006)
- Survey Two (Post-course): *Student Evaluation of the Quality of Web-Based Instruction* developed by Stewart, Hong and Strudler (2004).

Question 6: *Is course development type related to task error rate, Nielsen's heuristic evaluation score and student satisfaction?*

- Usability Analysis which answers the question, "What do the users do and say during the testing sessions?" and includes
    - Think-Aloud Verbal Report Analysis, which answers the questions what do users say during the testing sessions and summary interview
    - Error Rate, which answers the question, "How many errors does the user make per minute while completing the task?"
- *The Xerox Heuristic Evaluation: A System Checklist* developed by Xerox Corporation, (1995)
- Survey Two (Post-course): *Student Evaluation of the Quality of Web-Based Instruction* developed by Stewart, Hong and Strudler (2004).

Rationale of the Methodology

This study uses both qualitative and quantitative methods to answer the research questions. Guided by the philosophy that knowledge is individually and socially constructed, this research is a mixed method study based on both the case study method and the collection of quantitative survey data. The qualitative research methods inherent in usability testing were used in this study because the goals of this study include:

1. Understanding the meaning of course web site usability from the perspective of the students taking the courses,
2. Understanding the particular context (i.e., the course web site) within which the students act and the influence that this context has on their actions,
3. Identifying unanticipated phenomena and influences, and
4. Understanding the process by which students accomplish tasks within a course web site.

By understanding online course usability through the perceptions and experiences of students enrolled in the six selected courses, the outcome of this study was to write guidelines for the design and development of web-based instruction. The guidelines written by the researcher are based on empirical research—what students actually said and did as they accomplished tasks in the selected online courses. The themes, identified from the contents of students' verbal reports and summary interviews data collected in the usability testing sessions, were first mapped to Nielsen's (1994, 2000, 2002) established usability heuristics to compare students' judgments about instructional web sites to Nielsen's (1994, 2000, 2002) heuristics. The results of this analysis are presented in Table 8. Then, the results of mapping the contents of the verbal reports, summary interviews, to Nielsen's (1994, 2000, 2002) heuristics were analyzed by the researcher. Subsequently, guidelines were written for the design and development of web-based instruction. These guidelines were also mapped back to Nielsen's (1994, 2000, 2002) heuristics and are presented in Table 28. The next sections of this paper discuss the rationale for the selection of each quantitative instrument used in the study and a discussion of the validity and reliability of each instrument.

Xerox Heuristics Evaluation: A System Checklist

This section discusses the rationale behind the selection of heuristics evaluation instrument, *The Xerox Heuristics Evaluation: A System Checklist* (1995). The first section describes the selection rationale, the second section discusses the validity, and the third section discusses the reliability of the instrument.

Rationale

The Xerox Heuristics Evaluation: A System Checklist (1995) was selected to measure the heuristics of the six course sites because it operationalizes Nielsen's (1993, 1994, 2000, 2002) widely accepted usability heuristics. The instrument was developed by the Usability Analysis and Design Group at Xerox Corporation and authored by its manager, Deniese Pierotti. Pierotti based the checklist on two credible sources, Weiss's *Making Computers People Literate* (1993) and Nielsen and Mack's *Usability Inspection Methods* (1994). Xerox Corporation has been an innovative leader in the fields of human computer interaction, interface design, and information technology since Xerox PARC, the Palo Alto Research Center, was founded in 1970 in Palo Alto, California. The strength of this long history in the field of human computer interaction and interface design and the corporation's positive global reputation was instrumental in the selection of the instrument for use in this study. Another factor that contributed to the selection of this particular instrument over other instruments, (i.e., Chin, Diel, & Norman's (1988) *Questionnaire for User Interface Satisfaction*, Davis's (1989) *Perceived Usefulness and Ease of Use*, Lin, Choong, & Salvendy's (1997) *Purdue Usability Testing Questionnaire,* and Perlman's (1997) *Practical Heuristics for Usability Evaluation*), is its continuing and current inclusion in the Usability Toolkit of the Society for Technical Communicators, a professional organization for practitioners in technical communication.

The usability of each course web site was analyzed using the *Xerox Heuristic Evaluation: A System Checklist* instrument to operationalize Nielsen's (1994, 2000, 2002) widely accepted usability heuristics. Heuristic evaluation is a method that involves having a small number of experts examine an interface independently and judge its compliance with established usability heuristics or standards. It is recommended that more than one expert evaluate the interface to ensure that some usability problems are not missed. A heuristic evaluation is a "discount" usability engineering method that is easy to learn. The evaluation is termed "discount" because it is less expensive and time consuming than other usability engineering methods (i.e., testing users either in a usability lab or conducting an on-site visit for usability testing). According to Nielsen (1994), the evaluation method can be taught in a half-day workshop, and the evaluation itself can be completed in a day. Heuristics are defined as prescribed “rules of thumb” used by designers and developers to create usable web sites.

Validity

Nielsen (1994) tested his heuristics on a factor analysis of 249 problems frequently found in the usability of software interfaces. Using seven different sets of usability heuristics, (i.e., Carroll & Rosson, 1992; Holcomb & Tharp, 1991; Macintosh Human Interface Guidelines, 1992; Molich & Nielsen, 1990; Polson & Lewis, 1990; Star User Interface, 1982; and Sunsoft, 1993), Nielsen (1994) compared the seven sets of heuristics with a database of 249 known usability problems found in eleven projects to determine which heuristics explain *actual* usability problems. A principal component analysis of the data showed that more than a few factors account for the variance in usability problems. The top heuristics to explain all the usability problems and the percentage of the errors they explain along with the cumulative proportion of errors explained by Nielsen’s Heuristics are presented in Table 1:

Table 1

Top Heuristics to Explain the 249 Usability Problems in the Database

Heuristic	Percentage Errors Explained	
	Proportion Errors	Cumulative Proportion
Consistency: same thing, same way	23	23
Speak the user's language	16	39
Feedback: show receipt of the user's input	13	52
See/pointing vs. remembering/typing	7	59
Aesthetic integrity: keep the design simple	7	65
Shortcuts and accelerators	6	71
Real world conventions	4	76
Help error recognition/recovery	4	80
Forgiveness: reversible computer actions	3	83

The findings of his analysis concluded that the heuristics listed above found 85% of the known usability problems in the database. Using the results of this factor analysis, he created the list of heuristics upon which the *Xerox Heuristic Evaluation: A System Checklist* (1995) is based.

The design of selected course sites in this study was evaluated according to the conceptual framework implicit in Nielsen's (1994, 2000, 2002) ten usability heuristics for web sites. These heuristics are defined in the following list.

1. Visibility of system status: Keep users informed of system status through appropriate feedback within reasonable time.
2. Match between system and the real world: Speak the users' language, with words, phrases and concepts familiar to the user, rather than jargon. Follow real-world conventions, making information appear in a natural and logical order.
3. User control and freedom: Allow users who make mistakes to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
4. Consistency and standards: Be consistent in terminology and actions. Follow platform conventions.
5. Error prevention: Design the site carefully to prevent problems from occurring.
6. Recognition rather than recall: Reduce the cognitive load on the user by making objects, actions, and options visible. Instructions/Help should be accessible from anywhere in the system.
7. Flexibility and efficiency of use: Make the system work for both novices and experts. Allow more experienced users to tailor frequent actions (e.g., by using shortcuts, customizing the toolbar). Don’t confuse the novice with these actions.
8. Aesthetic and minimalist design: Use simple language and a clean design. Minimize “noise.”

9. Help users recognize, diagnose, and recover from errors: Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
10. Help and documentation: Provide help and documentation which is easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

The Xerox Heuristic Evaluation: A System Checklist (1995) used as an instrument in this study adds three additional heuristics to Nielsen’s original list for evaluating sites. Although these three categories were not included in Nielsen’s original heuristics, the researcher believes that these categories are applicable to instructional web sites and chose to include them in the evaluation of the selected course sites. The last heuristic included in the Xerox instrument, privacy, is a characteristic that is particularly important in educational web sites to protect the integrity of the course, course materials (i.e., student papers, exams, and quizzes), and student data.

11. Skills: The system should support, extend, supplement, or enhance the user’s skills, background knowledge, and expertise—not replace them.
12. Pleasurable and respectful interaction with the user: The user’s interactions with the system should enhance the quality of her or his work-life. The user should be treated with respect. The design should be aesthetically pleasing—with artistic as well as functional value.
13. Privacy: The system should help the user to protect personal or private information—belonging to the user or his/her clients.

Reliability

According to Nielsen (1994), more than one heuristic evaluator is needed to ensure that most usability problems will be found in a web site. Some usability problems are obvious, thus will be found by almost all evaluators, while other problems are less obvious and will only be found by a few. Furthermore, Nielsen's (1994) research found that heuristic evaluations identified approximately 85% of usability problems. The heuristic evaluation is a categorical measurement. Each course was evaluated using the *Xerox Heuristic Evaluation: A System Checklist* (1995) as the instrument. This instrument has 296 usability characteristics organized into thirteen categories. For each course the evaluator categorized the usability characteristics as "present," "absent," or "not applicable." In the current research study the reliability of the heuristic evaluation conducted independently by two experts was established by calculating the percent of agreement between the two raters. Using the scores from both raters on the heuristic evaluations, the number of items that both raters agreed upon was counted and the percentage of agreement was calculated. The proportion of scores that both raters agreed upon was 78 %. To determine the internal validity of the heuristic evaluation instrument, a Cronbach's alpha was calculated using the evaluation scores from the six courses (N = 6). The Cronbach's alpha calculated using SPSS (alpha = .76).

Method

By using the *Xerox Heuristic Evaluation: A System Checklist* (1995) to evaluate each course studied, the researcher was able to compare the usability of the six courses studied using a standard measure. These heuristic evaluation questions and the selected course websites were also evaluated independently by another expert, a colleague who was a professional in web course design and development. Each evaluator independently examined the course sites and compared them to each item on the *Xerox Heuristic Evaluation: A System Checklist* (1995). For the evaluation, the items in the checklist were entered into a spreadsheet. Each evaluator coded each item with the following codes:

- "2" to indicate a positive response, the checklist item is present,
- "1" to indicate a negative response, the checklist item is absent, and
- "N/A" to indicate the checklist item was not applicable to the course site.

According to Nielsen (1994), it is up to each evaluator to decide how many review passes to make through each site. We found that we made a minimum of two complete passes through each course site, examining some site characteristics more closely than others. Nielsen (1994) recommends two passes through an interface, the first pass gives the evaluator an overall impression of the interface, and the second pass allows the evaluator to examine the interface in greater depth. Each independent evaluation lasted approximately two hours per course site. After independent evaluation of the six selected course sites, the two evaluators met and compared their judgments. When differences were found in the heuristic evaluation judgments of the researcher and the other evaluator concerning the presence or absence of a particular characteristic, a discussion ensued and continued until consensus between the two evaluators concerning the evaluation was reached. This discussion was conducted to confirm inter-rater reliability. The answers to the evaluation questions, organized according to the thirteen categories of heuristics, were organized in a spreadsheet for tabulation and for rank ordering.

Survey One Computer User Self-efficacy Scale (CUSE)

This section discusses the rationale behind the selection of the pre-course survey, the *Computer User Self-efficacy Scale* (CUSE). The first section describes the selection rationale, the second section discusses the validity, and the third section discusses the reliability of the instrument.

Rationale

Eachus and Cassidy (2002) describe the increased assumption of students' proficiency with a variety of software packages in contemporary educational settings. Contributing to this assumption is the increasing integration of technology into the K-12 curriculum and into normal daily activities in the 21st century. Due to the computer's central role in contemporary education, many higher education institutions require incoming students to demonstrate a prescribed level of computer proficiency. Although many higher education institutions offer classes in introductory computing skills, some institutions offer minimal formal computer training to students (Eachus & Cassidy, 2002), while other institutions are eliminating computer training courses, and testing student computer proficiency by examination (Wallace & Clariana, 2005). Eachus and Cassidy (2002) note that a student's computer abilities and computer self-efficacy may play an important role in a student's academic success and may be a "significant limiting factor" (p. 137) in a student's educational experience whether in the classroom or in online courses.

The Eachus and Cassidy's *Computer Use Self-efficacy Scale* (CUSE) was used to evaluate the computer self-efficacy of study participants because according to Bandura (1997), "people make causal contributions to their own psychosocial functioning through mechanisms of personal agency" (p. 2). And, of all the mechanisms of agency, self-efficacy is both "central and pervasive" (p. 2). In simpler terms, whether or not a person believes that they can successfully produce a desired effect (e.g., successfully use a computer and complete an online course) is a major influence over their actions and, thus, the outcome of their actions. In their continuing research of self-efficacy as related to computer use, Eachus and Cassidy (2002, 2006) also identified confidence, or self-efficacy as a factor associated with greater self-rated computer competency and experience. They note that "self-efficacy is an egocentric construct that demands to be measured directly rather than indirectly" (Eachus & Cassidy 2002, p. 136). Therefore, the survey method—self-reporting—was selected for this research to measure student participants' beliefs about their proficiency with computers and to determine their level of expertise with computers and the Web.

The *Computer Use Self-Efficacy Scale* (CUSE) was selected for use in this research because it was "designed to measure general computer self-efficacy in an *adult* student population" (Eachus & Cassidy 2002, p. 137, italics added), the population of interest in this study. Further, this instrument was selected because of its high validity and reliability scores.

Validity

The construct validity of the instrument was assessed by correlating the self-efficacy scores with a self-reported measure of computer experience and the respondents' familiarity with various software packages. Eachus and Cassidy (2002) report that both correlations were significant; experience correlated at $r = 0.79$, $p < 0.005$, $N = 212$ and familiarity correlated at $r = 0.75$, $p < 0.0005$, $N = 210$.

Reliability

During the development of the CUSE, the internal consistency of the 30-item scale was measured using Cronbach's Alpha. Eachus and Cassidy (2002) reported high results (*alpha* = 0.97, $N = 184$). The test-retest reliability as measured over a one-month period was high and statistically significant ($r = 0.86$, $N = 74$, $p < 0.0005$).

Survey Two Student Evaluation of the Quality of Web-Based Instruction

This section discusses the rationale behind the selection of the post-course survey, the *Student Evaluation of the Quality of Web-Based Instruction.* The first section describes the selection rationale, the second section discusses the validity of the instrument, and the third section discusses the reliability of the instrument.

Rationale

The Student Evaluation of the Quality of Web-Based Instruction (Stewart, Hong & Strudler, 2004) survey instrument was used as the quantitative measure of student satisfaction with the online courses they completed. This particular instrument was selected for use in this study due to its rigorous development process. The development process was a three-step process. First, an instrument was initially developed based on survey results from faculty and students. Second, this instrument was placed on the Web for additional data collection. Third, this additional data was used to conduct a validity study. An additional reason that this particular instrument was selected is the instrument measures student satisfaction across seven dimensions of interest.

1. Appearance and structure of Web pages,
2. Hyperlinks and navigation,
3. Technical issues,
4. Class procedures and expectations,
5. Content delivery,
6. Quality of communication (between participants in the course), and
7. Presence of instructors and peers.

These dimensions matched the interests of the researcher.

In this study, the *Student Evaluation of the Quality of Web-Based Instruction* (Stewart, Hong & Strudler, 2004) survey instrument was used as a post-course measure to determine students' perception of quality and satisfaction level with online courses offered by the online and distance learning program. Student satisfaction was also measured by data collected during the debriefing questions asked at the conclusion of usability testing sessions.

Validity

As described in Stewart, Hong, and Strudler (2004), four university professors participated in a review of the instrument to establish its content validity. The professors were given a copy of the original instrument and asked to place each item into either one of the established dimensions, or, to create a new dimension for the item. They were also asked to eliminate items which they deemed irrelevant to web-based instruction or, to add any items or dimensions relevant to web-based instruction which they felt were missing. This faculty evaluation resulted in a revision of the original instrument. This revised instrument was placed on the Web and eight students enrolled in college-level online courses at a Western college were asked to evaluate the instrument. The students evaluated both the instructions and each item on the instrument for clarity. Again, these student evaluators were also asked to add any items or dimensions relevant to web-based instruction which they felt were missing. The final instrument, used in this study, was developed based on the recommendations of both the faculty and student evaluators.

Reliability

Cronbach’s alpha was calculated for each of the instrument’s seven dimensions to estimate the internal consistency of the test scores. All alpha coefficients were greater than .70 (Stewart, Hong, & Strudler 2004, p. 137).

Institutional context

This section describes the specific institutional context of this research. First, the university setting is described. Second, the college that administered the online and distance learning program is described. Third, the online and distance learning program that administered the selected courses is described. Finally, the course management systems that housed and delivered the course files for the six courses selected for study are described.

Institution

This research was conducted at a large, public university in the Midwest region of the United States. The university has a student body of over 40,000 undergraduates and over 25,000 graduate, professional, and other students.

College

The online and distance education program that is the focus of this research is administered by a college within the university that offers a variety of continuing education and outreach programs that support the University's mission as a land-grant institution. These programs include face-to-face, online, and distance education courses. Courses offered are both credit and non-credit and enroll both traditional and non-traditional students. The student body of the college consists of both degree and non-degree seeking students.

Online Distance Education Program

The online and distance learning program offers both online and print-based courses through one college at the university. The goals of the online and distance learning program are:

- to provide access to university courses to both degree-seeking and non-degree seeking students,
- to allow students to enroll in a single course without being admitted to the university degree or certificate program, and
- to allow students to study at a time or location that is convenient for them.

This distance education program has a long history at the university. The program began serving distance education students by offering correspondence courses at the beginning of the 20th century and continues to offer correspondence and online courses. Approximately 200 online courses have been offered over the past five years, and they continue to be offered to a large audience of students.

Course Management Systems

Five of the six courses studied were housed in the WebVista course management system. The WebVista course management system is an integrated set of software tools that house the various content files of each online course within a dedicated course site. Students access the course site, residing on university servers via a web browser (i.e., Internet Explorer, Safari, or Firefox). The WebVista software tools fall into four major categories: (a) productivity tools such as an assignment calculator, a calendar, and address book; (b) communication and collaboration tools, including discussion areas that may be set up to facilitate different types of interaction; student-student interactions for the entire class and groups, student-instructor interactions which may be public, accessible to all students or private, accessible to individuals or groups, chat, e-mail, whiteboards, and Wimba Voice Tools, a set of tools that allow students to create audio files to send to the instructor and/or students; (c) assessment tools such as learning objects (a custom feature created for individual courses produced by the professional design and development group), the assignments tool, online tests and quizzes, and an online grade book; and (d) content management tools such as Breeze and learning objects that allow online instructors to present rich multimedia content.

The sixth course studied was created using Hypertext Markup Language (HTML). These web pages were housed on the academic department's web site. Different sets of files were delivered as separate groups of web pages from different sections of the department site.

Course Selection

Six courses, offered by different academic departments and developed using different methods (WebVista CMS and HTML) and presumed to differ in usability attributes, were selected to study based on the accessibility to the researcher of both the course sites and class lists. The six identified courses were paired according to subject matter, but the selected courses in each pair were developed using different methods.

The first group of three courses selected included an online technical writing course, an online science course, and an online alcohol and substance abuse course.

These three courses were each developed by the professional development group in the WebVista course management system (CMS). This group produces courses for an online and distance learning program. As part of their production process, this group uses a template and information architecture created in-house and based upon current usability and pedagogy research. The three courses in this first group comprise the professional development course type.

The second group of three courses selected included an online technical writing course, an online science course, and an online alcohol and substance abuse course. Each of these three courses was developed by staff in three different academic departments. Two of the three courses were developed in WebVista; however, the information architectures of these two courses were each different and unique. The third course, an online science course was developed using Hypertext Mark-up Language (HTML). This course was not housed in any CMS and delivered as web pages from the academic department server. All three courses in the second group are offered through the same online and distance learning program as the first group of courses. The three courses in this second group comprise the nonprofessional development course type.

The six courses selected to represent the two course development types were presumed to differ in usability attributes. An initial analysis of the two course types using the thirteen categories of Nielsen’s heuristics (1994, 2000, 2002) as operationalized by the *Xerox Heuristic Evaluation: A System Checklist* (1995) showed the courses differed in at least one usability attribute for each category. These differences are presented in Table 2.

Table 2

Nielsen's Heuristic Differences by Course Development Type

Nielsen's Heuristic	Professional	Nonprofessional
Visibility of System Status	Title of course page clearly states topic	Title of course page does not clearly state topic
Match between System and the Real World	Terminology and language familiar to user	Terminology and language unfamiliar
User Control and Freedom	Menus are shallow and broad; options are visible	Menus are deep and narrow; hiding options
Consistency and Standards	Content is consistently organized across site	Content not consistently organized across site
Help Users Recognize, Diagnose, and Recover from Errors	Clear instructions provided on use of unfamiliar site features	No/unclear instructions provided on use of unfamiliar site features
Error Prevention	Current dates in course	Past dates in course
Recognition Rather Than Recall	Site-wide conventions used for course elements	Different conventions used for course elements
Flexibility and Minimalist Design	Alternative formats provided for users	One format provided for users-all treated the same
Aesthetic and Minimalist Design	Uncluttered, clear design	Cluttered, unclear design
Help and Documentation	Provides help and documentation	Does not provide help and documentation
Skills	Provides multiple layers of detail to support both novices and experts	Provides one layer of support for novices or experts
Pleasurable and Respectful Interaction with the User	Clear, aesthetic design; a pleasure to use	Cluttered, unclear design; frustrating to use
Privacy	Course site is password protected	Not all sections of the course site are password protected

All six courses selected for this research were term-based courses. These courses followed the same sixteen week semester-based calendar as on-campus, face-to-face, classroom courses. All assignments in these online courses have specified due dates and all coursework is to be completed by the end of the semester.

In this online and distance learning program the alternative format to a term-based course is the extended-term course. Extended-term courses operate on a nine-month calendar that is both separate and different from semester-based courses. Students enroll in extended-term courses on a rolling basis; courses are open for enrollment and students may begin their course work on a monthly cycle. Students enrolled in extended-term courses work and turn in assignments at their own pace, however, to receive academic credit all course work must be completed within the nine-month enrollment period. The extended term format is a holdover from correspondence courses. It is currently being phased out in this online and distance learning program. As courses are converted from print-based to online media, they are also converted from an extended-term to term-based format.

Student Selection/Recruitment

The following section discusses the selection and recruitment of student participants for both the usability testing sessions and the pre- and post-course survey participation. First, the approval process to conduct the research by the Institutional Research Board is discussed. Second, the student recruitment procedures are described.

IRB Approval

The application and required documents for the protection of Human Subjects were submitted for expedited review in April, 2007 and approved by the Institutional Research Board (IRB) at the University. IRB approval for the research was granted in April, 2007 and recruitment of student volunteers began immediately. A copy of the IRB letter approving the research is located in Appendix A.

Recruitment Procedures

Permission was obtained from college and online and distance learning program administration and the academic departments involved to study the six selected courses. The researcher was given permission to access the class lists of enrolled students of the six selected courses to recruit study participants. The class lists contain the names and e-mail addresses of students enrolled for each course. This public, demographic data for the courses selected for study was used by the researcher to contact student volunteers via e-mail. The e-mail messages asked student volunteers to participate in the usability assessment of the course in which they were enrolled and to give their opinion of how they actually use and rate the course site as they use the online course. The purpose of the usability testing was to have student volunteers help the researcher identify aspects of the online course design that work well and which aspects needed improvement. Student volunteers were given an honorarium gift of $50.00, their parking was paid during the testing sessions, and free refreshments were provided. The e-mail message outlined specific dates and appointment times for the testing sessions. Students interested in participating in the usability testing sessions were instructed to reply to the message and to indicate the date and time they were available to come to the usability testing lab on campus along with contact information—a phone number to allow me to get in touch with them, if necessary. The researcher created a pen and paper grid for appointment scheduling. Students who volunteered for study participation were separated by course enrollment and assigned individual testing appointments in the usability lab. The class lists were used to contact all students enrolled in the six selected courses for survey participation in Surveys One and Two.

Data Collection Procedures

The data collection procedures section provides a summary of all the data collection procedures used in this research study. A summary table of students who participated in each aspect of the study, Table 3, is located in the first section, General Collection Procedures. The second section, Volunteers for Usability Testing, first describes the number of students identified by Nielsen's (1994) research required for usability testing to identify 80 percent of usability difficulties, then identifies the number of students who volunteered and ultimately participated in the usability testing sessions. The third section, Follow-up Attempts, describes the follow-up attempts with students by the researcher. The fourth section, Quantitative Data Collection, describes the collection of the quantitative data. The fifth section, Timing of Instrument Use, describes the timing of the administration of the different quantitative instruments. The sixth section, Qualitative Data Collection, describes the timing of the usability testing sessions. This section of the dissertation concludes with the section Qualitative Data from Usability Testing Sessions which lists the qualitative data collected during the testing sessions.

General Collection Procedures

The general collection procedures are summarized in Table 3, Summary of Participants. Table 3 provides a summary of the number of students who participated in each aspect of data collection for the research study. The six selected courses which comprise the study courses are listed across the top of the table. The courses are divided into two groups, the professionally developed courses and the nonprofessionally developed courses. The participant categories are listed down the left side of the table. These categories include the number of student testers who participated in the usability testing sessions, the number of students who participated in the pre-course Self-Efficacy survey, post-course Student Satisfaction survey, and both surveys respectively, the total number of students enrolled in each course categorized by summer session and fall semester enrollments, and the total enrollment in all cases.

Table 3

Summary of Participants

	Professionally Developed			Nonprofessionally Developed			
Course	1	2	3	4	5	6	Total
Student Testers	5	5	4	5	6	4	29
Pre-Course Survey	9	18	16	18	15	13	89
Post-Course Survey	12	12	12	14	14	15	79
Both Surveys	9	12	12	14	14	13	74
Enrolled Students							
Summer 2007	22	34	27	19	53	75	230
Fall 2007	28	37	26	21	50	48	210
Total Enrollment	50	71	53	40	103	123	440

Volunteers for Usability Testing

The number of subjects that Nielsen (1994) found to be a satisfactory number to identify eighty percent of all usability difficulties was 4-6 participants per usability test. In this study, six courses were tested, so at least 36 students (6 per course) were sought for participation in on-site interviews. Additional student volunteers were recruited as back-ups to accommodate potential participant dropout. A total of 32 students volunteered for usability analysis; two students failed to appear for their scheduled usability testing sessions. The final number of students participating in the usability lab testing was 30. Each participant was assigned a unique identification code created by the researcher to identify the course they were enrolled in and tested.

Follow-up Attempts

After the two appointment failures, the researcher used the class lists along with the public data (telephone numbers) available on the university web site to attempt to recruit additional students by telephone to fill in the empty usability testing time slots. These attempts were unsuccessful due to the short lead time between the recruiting request and the usability lab appointment times.

Quantitative Data Collection

The three instruments used in the collection of quantitative data included: *Xerox Heuristic Evaluation: A System Checklist* (1995), *Computer User Self-efficacy* (CUSE) (2006), and the *Student Evaluation of the Quality of Web-Based Instruction* (2004). The timing of the administration of each of these instruments is described in the following sections.

Timing of Instrument Use

The heuristic evaluation as measured by the *Xerox Heuristic Evaluation: A System Checklist* (1995) was conducted by two evaluators prior to the usability testing sessions.

Survey One *Computer User Self-efficacy* (CUSE) (Pre-course) was administered either in person at the Lab or via e-mail prior to the beginning of the semester to measure students' computer self-efficacy prior to beginning the online course. E-mail messages were sent to students who did not participate in the usability testing sessions requesting participation the completion of Survey One in May, 2007 for the Summer session and August, 2007 for Fall semester.

Survey Two *Student Evaluation of the Quality of Web-Based Instruction* (Post-course) was administered post course to measure student satisfaction after completion of the online course. Survey Two was administered first by e-mail to all students enrolled in the selected courses including the participants in the usability testing sessions, then on a study web site created by the researcher to recruit more participants from subsequent offerings of the courses. Student enrolled in the six courses who did not participate in the usability testing sessions Summer session 2007 and Fall semester 2007 were sent e-mail messages approximately three weeks prior to the end of either the summer session or fall semester respectively and asked to participate in the study by completing Survey Two.

Qualitative Data Collection

Timing of Usability Testing

The goal of usability testing was to observe how users actually interact with the interface being tested. In this study students were observed interacting with their online course site (the course in which they were currently enrolled) *prior* to the beginning of the semester in which the course began. In all reported courses, usability testing sessions took place during the May intersession period prior to the beginning of Summer Session, 2007. This timing allowed the researcher to capture students' impressions and ability to interact with the course *prior* to beginning the course rather than after gaining experience using the course site.

Qualitative Data from the Usability Testing Sessions

The usability testing methods used in this study resulted in several different sets of qualitative data. These data sets used in this study and sources are listed below.

- The think-aloud protocol data as captured by the video and audio media,
- The time/error log as captured by the time recording equipment
- Eye-tracking data as captured by the Tobii 750 monitor and video
- Summary interview data

Usability Testing

The following sections discuss the specifics of the usability testing part of the research study. First, the usability testing site is described in detail. This section includes a description of the physical setting, the protocol followed when the student arrived at the testing site, and a description of the equipment. Next, the pre-determined tasks students were asked to complete during each testing session are described. Finally, the think-aloud protocol portion of the usability testing sessions are described.

Usability Testing Site

The testing was conducted in the Usability Lab, located on the university campus. The Usability Lab is a high-tech testing facility comprised of several distinct areas fitted with equipment related to usability testing. Each student volunteer was scheduled for a private, ninety-minute usability testing session. Student participants arrived at the reception area where they were directed to come for a usability testing appointment. Here, the student was greeted by the receptionist, the researcher, and a member of the usability testing staff, offered refreshments, and completed initial study paper work (i.e., registration materials, release form, and Survey One). Then, the student was escorted by the researcher and the usability staff member to the second room, which is the testing lab. The testing lab is a separate room equipped with a computer, desk, office chair, telephone, and whiteboard. Digital equipment in the testing lab records video, audio, and creates a time log of participant navigation through the course site. To minimize participant discomfort, an unobtrusive ceiling-mounted bubble camera was used to record audio and video rather than an obvious freestanding camera mounted on a tripod. The third room in the Usability Lab is a conference room. The conference room, separated from the testing lab by a two-way mirror, is equipped with a large flat-screen monitor. Images of the student's computer screen, showing the position of the participants' eyes via the eye-tracking monitor, the keyboard, and the participant's face were viewed simultaneously or the camera was moved to project just one of these views for closer examination as the student proceeded through the tasks.

One of the cornerstones of this study was to elicit and capture students' thoughts about the course they were enrolled in and reactions to the course site as they navigated the site to complete predetermined tasks. The usability testing method that is used to capture students' thoughts is a think-aloud protocol.

Pre-determined Tasks

The specific tasks students were asked to complete during the usability testing sessions were created for each course to highlight and examine specific course components. Students were asked to accomplish critical tasks that students must successfully complete on their own to fulfill the requirements of the course. Examples of user tasks included: locating various syllabus components, determining assignments, due dates, scheduling proctored exams, taking and submitting online quizzes and exams, discussion area and group activity instructions and requirements, and how to submit assignments. The intent was to observe student interaction with all components of target courses. The seven tasks for each course can be found in the Course Materials (Appendix E).

Think-aloud Protocols

Usability testing is a method that observes users while they navigate a site to perform specific tasks. The observation of users as they attempt to complete pre-determined tasks provides the means to collect data on how users experience the visual and textual design of a site (Barnum, 2002; Dumas & Redish, 1994; Hackos & Redish, 1998; Hackos & Stevens, 1997; Johnson, 1998; Nielsen, 1993, 1994, 1995, 2002; Rubin, 1994; Shneiderman, 1998, 2002). By “thinking aloud,” or talking about what they are doing as they are doing it, each participant reveals their thoughts as they complete each task, giving the researcher insight into why each action is being performed (Ericsson & Simon, 1993). According to Nielsen (1993), “this additional insight into the user’s thought process can help to pinpoint concrete interface elements that cause misunderstanding so they can be redesigned" (p. 19). The resulting data is a verbal report (Ericsson & Simon, 1993).

Students, those participants currently enrolled in the course they tested, navigated through the target online and distance learning program course to complete pre-determined tasks. A think-aloud protocol was used to observe and record each participant's reaction to the design of the course site as they completed course-related tasks. Each individual student was asked to "think aloud" and talk about what they were thinking as they attempted to complete each task. The use of a think-aloud protocol specifically reveals users' difficulties in the comprehension or use of a web site since their spontaneous comments reveal both the location and nature of any difficulty. For example, one comment was, "I can't figure out how to open WebVista e-mail to send a message to my professor."

Users completed their tasks at the computer alone in a separate testing room equipped to capture audio and video. The researcher observed the testing sessions through a two-way mirror from the conference room in the Usability Testing suite. The researcher was able to visually observe and hear each session through the two-way mirror and the audio equipment which recorded each session.

One of the surprising results of this study was how easily and naturally the participants were able to verbalize what they were doing and thinking during the testing sessions. All of the participants verbalized their actions without any lapses and without being reminded that they needed to think-aloud. They appeared very comfortable reporting what they were doing.

If participants had a problem which they felt they needed assistance solving, they had access to a telephone and a helpline number to call. This helpline was a telephone line connected to a phone in the usability testing room which was anonymously answered by a usability lab staff member who pretended to be part of the central university help desk staff. Help desk services are provided to all students and staff of the university through a central telephone number to answer technical, hardware, software, and connectivity-related questions.

Each participant was scheduled for a ninety-minute testing session. Each student had seven pre-determined tasks to complete within their ninety-minute testing session. The tasks were all similar between the courses, yet customized to reflect the features of each individual course. Prior to the start of each ninety-minute testing session students were instructed to verbalize as they began and ended each task. For example, students verbalized as they began each task, “I’m beginning Task 1” and as they completed each task, “I’m finished with Task 1.” They were instructed to move along to the next task as they completed each one and to identify which task they were working to complete. If students felt they could not complete a specific task, they were instructed to verbalize their difficulty, they were unable to complete the task, and were moving on to the next task.

The testing time of each participant varied. Some participants easily completed all tasks within the allotted ninety minutes or less, while other participants were unable to complete all tasks in the allotted time. The students determined whether they had completed a task and when to move on to the next task. The think-aloud protocol data were collected via video and audio equipment operated by the usability lab staff and recorded to DVD for later review by the researcher. The researcher also took notes via the keyboard input device connected to the time recording equipment.

Time Log, Video, Audio, & Eye-tracking Data Collection

The specific details of the time log, video, audio, and eye-tracking data collection are described in the following section. First, the time log data capture is described, followed by a section on the collection of the video, audio, and eye-tracking data collection. Second, the Error Log data capture is explained. A third section describes the Summary interviews which took place at the conclusion of each testing session. The fourth section describes the administration of the post-course survey, the *Student Evaluation of the Quality of Web-based Instruction*.

Time Log Data

Data from each test session was captured through a written time log, video and audio recordings, and eye-tracking equipment. A time log that ran and recorded the time automatically was used to record the users' activities as they attempted to complete each task. The successes and difficulties users had as they accomplished tasks was observed and recorded by usability lab staff outside the testing room through a two-way mirror. The running time log was started as each user began their usability testing session. The time log ran continuously throughout each testing session and recorded the time each user spent completing each task and the time between tasks. A keyboard input device connected to the time log recording equipment in the conference room allowed the researcher and usability lab staff to make observation notes while testing was conducted. The researcher entered notes about each participant's activities as they worked through each task. Additional details about the participant's activities (i.e., whether or not each task was successfully completed, if the participant became frustrated with one task, stopped, and moved on to the next task, or was stopped by the researcher due to time constraints) were also recorded in the time log. A printed time log was produced for each test session. At the conclusion of the usability testing sessions, data from the time log was entered into a spreadsheet for analysis.

Data collected in the spreadsheet included the course name, student study ID number, task number, the success or failure of the student to complete each task, the time taken to complete each task and comments concerning the testing session by the researcher and usability staff. Descriptive statistical analysis of the time logs included the time for each task, the mean time for each task, and standard deviation for each task. The elapsed time was measured in minutes and seconds. These values were converted to a decimal number then error rates per minute were calculated.

Video, Audio, and Eye-tracking Data

Each testing session in the usability lab was recorded on DVD by video and audio equipment for post-session review. Usability lab staff in the conference room had the ability to change the angle of the testing room camera, zoom in closer, and change what image was projected on the flat screen monitor (e.g., images of the user's computer screen, the keyboard, the student's face). This allowed a better view of what each student was doing during a particular task and provided additional clarity of the students' actions and affect during the testing session. Digital recording equipment attached to the bubble camera in the testing room recorded the video and audio of each session on a DVD for later analysis. The two-way mirror in the conference room provided a means for usability lab staff and the researcher to observe students in the testing room without sitting directly beside the participant.

Eye-tracking equipment was used to identify the specific areas of the web site students looked at and showed the amount of time students spent looking at each area. Course web sites were accessed through a Tobii 1750 monitor, a computer screen that reflected, recorded, and tracked student eye movements. The Tobii monitor was calibrated for each student's eyes by a usability lab staff member. Each student was asked by the usability staff member to locate a series of particular objects in a "Where's Waldo" type image on the screen. As they located each object in the series, the software calibrated the monitor for the student's eyes. A small window at the bottom of the computer screen indicated whether or not the eye-tracking equipment was capturing the student's gaze. Once the monitor was calibrated, the researcher demonstrated the think-aloud protocol by thinking aloud through the process of searching for a book on the Amazon.com website. Next, the researcher logged into the site of the course that the student was enrolled in for the semester, asked the student if they had any questions concerning the think-aloud protocol, and asked them to begin after the researcher left the room. The student read the introductory paragraph and then turned the page in their packet to begin Task 1. Each task was read aloud by the student and their activities during the testing session were recorded via video, audio, and eye-tracking. The eye-tracking data was used to confirm the data collected by video, audio, and the time and error logs during the think-aloud protocol. The confirmation of data collected by other sources is a common use of eye-tracking equipment in usability testing (Karn, Ellis & Juliano, 2000). Trained, professional staff employed at the Usability Lab assisted in data collection.

These recordings (i.e., time log, video, audio, and eye-tracking data) were used for triangulation with the data collected by the usability lab staff during the observed think-aloud protocol. The data collected consists of a list of usability problems, quantitative data from logs, and qualitative data from participant's verbal reports during each session.

Error Log

First, the list of usability problems was compiled. A usability problem was defined as a task that a student had difficulty completing. The distinction between tasks which were easy for students to complete and those which resulted in usability problems was not difficult to discern in the testing sessions. Tasks which were easy for students to complete, which did not involve usability problems, were completed very quickly and easily by the participants—sometimes amazingly quickly—literally, in seconds. Students would verbalize their success, "Here you go," "I found it," "Here's what I was looking for," or "That was easy." The tasks which involved usability problems were obvious, too, but in a different way. Usability problems caused students to struggle to complete the assigned task. This struggle often involved students searching for the information they needed to complete the assigned task. Struggling students navigated to multiple sections of the course site, opened many links before successfully (or not successfully) completing the task. Students verbalized their frustration with the course site, too. “I can’t find X,” I think it should be here, but it’s not here,” “It would be easier to find if the link was labeled XYZ and their reasoning, “I thought it would be here because…” These verbal reports were noted in the sessions then confirmed when the video and audio media was reviewed.

This list compiled during the sessions was used by the researcher in consultation with usability staff present during the testing sessions to organize the problems. Before this list was organized, the quantitative data were entered into a spreadsheet, tabulated and summarized. The elapsed time for each task, the number of errors, and any requests for help are examples of this quantitative data that was tabulated and summarized. A time log sheet of the usability testing session with observer (researcher/usability staff) comments keyed in during the testing session by the researcher was automatically generated by the equipment in the lab during each test. Next, the data was examined for any trends. A trend is defined for this study as tasks that are difficult for multiple users to complete. Data were also examined for unexpected results. Descriptive statistics were tabulated including: frequency of scores (i.e., number of errors for a given task); the mean and the median, variability of scores (i.e., the range of times and errors for a given task). To address the reliability and validity of the data, all usability lab staff participated in the discussion of each problem and came to a consensus as to what occurred during the usability testing sessions.

After data collection, the success of the user in completion of each task within that particular context was analyzed and the usability of the site was evaluated. For the purpose of this paper, the term “evaluation” includes both the process of systematically collecting data that informs the researcher of the users’ experience as they completed these specified tasks while navigating a particular course web site and the analysis of the data collected by the other measures.

Summary Interview

At the end of each testing sessions participants were asked a short series of open-ended questions to ensure that participants had a chance to fully describe their experience with the course site. A copy of these questions can be found in Appendix B. The results of these interviews were included in the qualitative evaluation of each course site.

Post-course Student Evaluation of the Quality of Web-Based Instruction

All students enrolled in each selected course were contacted via e-mail approximately three weeks prior to the end of the semester and asked to fill out Survey Two. These initial messages were followed up with subsequent messages weekly up through a month after the end of Summer Session, 2007 and Fall, 2007.

Limitations of the Study

The limitations of this research include the following:

Selection of courses: The results will not be generalizable to a different selection of courses since the six online and distance learning program courses may not represent the structure of other web-based courses.

Case study method: Research results have a limited generalizability of results due to the individuality of the selected cases and the context of the research location.

Course Management System (CMS): The inherent structure of the individual course management system limits the designers' choices in how an online course may be structured. Designers and developers using these systems are forced to follow the constraints of the software when locating instructional materials within the system.

Usability lab setting: Subjects may perform differently under the duress of testing in the artificial environment of a research lab situation. Further, the act of "thinking-aloud" as they perform tasks may affect test results (i.e., time to complete each task) and may produce an incomplete record of subjects' thinking during task completion.

Finally, although every effort is made to assure the validity and reliability of the survey instruments prior to the research, the validity and reliability of the instruments may be limitations.

Summary

The research problem of this study was to investigate the construct of usability in six online courses offered through one online and distance learning program at a large, public university in the Midwest. Students enrolled in the six courses were recruited for study participation using the official university class lists. Students were contacted via e-mail, asked to participate in usability testing sessions, and to complete both a pre-course and post-course survey. A total of 30 students participated in the usability testing sessions and a total of 74 students completed both surveys.

Six courses which were designed and developed by different groups and presumed to differ in usability attributes were selected for study. The six courses were divided into two groups of three courses which were matched on subject matter. The first group of three courses, professional, was developed by a group of professional online course designers and developers. The second group of courses, nonprofessional, was developed by staff in various academic departments.

The study used mixed methods to collect both quantitative and qualitative data on the usability of six courses as perceived by students enrolled in each course. In the following section the quantitative and qualitative data collection methods are described.

The quantitative data was collected using three different instruments. First, the six selected courses were evaluated for their compliance to established usability guidelines, Nielsen's (1994, 2000, 2002) thirteen usability heuristics for web sites using a heuristic evaluation instrument, *The Xerox Heuristic Evaluation: A System Checklist* developed by Xerox Corporation, (1995). This heuristic evaluation was completed independently by two experts, the researcher and a professional colleague experienced in the design and development of online courses. Second, the *Computer User Self-efficacy Scale* (CUSE) developed by Eachus and Cassidy (2006), a pre-course survey, was administered to enrolled students in the six selected courses so participants could self-report their computer self-efficacy prior to taking the online course. Third, the *Student Evaluation of the Quality of Web-Based Instruction* developed by Stewart, Hong, and Strudler (2004), a post-course survey, was administered to enrolled students after completion of the online course to measure their satisfaction with their online course experience.

The qualitative data were collected in usability testing sessions in a high-tech usability lab located on the university campus. Usability testing sessions were conducted during the May intersession prior to the opening of the online courses (defined as the period of time before the course sites are "live" and registered students can access the online course materials) and the start of the summer session before student participants actually started their online courses. The qualitative measures, gathered as student participants completed course tasks, included think-aloud protocol data, verbal reports of what students actually said they thought about the course site as they completed predetermined tasks, time/error data as measured by a time stamp log and recorded by the researcher as students completed tasks. Video, audio, and eye-tracking recordings of usability testing sessions captured all the events that occurred during the usability testing sessions. The summary interview data, answers to the open-ended questions asked at the conclusion of each testing session gave participants a chance to tell the researcher what was most important to them about each course site. The data collection results and its analysis are presented in Chapter Four.

Chapter Four

Research Findings

This study was designed to research what the construct of usability means to students enrolled in online courses. A total of 30 students enrolled in six different online courses categorized by two different group types, the professional development and nonprofessional development groups, were observed in the usability lab. Students participated in a think-aloud protocol resulting in verbal reports of what they were doing and what they were thinking as they completed seven course-related tasks. A total of 74 students (30 usability lab testing participants plus 44 additional students enrolled in the six selected online courses) completed two surveys, a pre-course survey, the *Computer User Self-efficacy Scale* (CUSE) developed by Eachus and Cassidy (2006), to measure their computer self-efficacy, and a post-course survey, the *Student Evaluation of the Quality of Web-Based Instruction,* developed by Stewart, Hong, and Strudler (2004), to measure students' satisfaction with their online courses.

The quantitative data collected was analyzed using descriptive statistics for the treatment means and standard deviations of the dependent and independent variables. Non-parametric statistical methods were used to assess the degree of correspondence between rank-ordered data. An analysis of covariance (ANCOVA) was used to determine whether students' computer self-efficacy before beginning their online course had any effect on students' satisfaction with their online course at its completion using course development type as the independent variable. In these analyses an alpha level of .05 was used to determine the level of significance between treatment means.

Usability was quantitatively measured in two ways; using the students' calculated error rates gathered during the usability testing sessions and by the Nielsen's heuristic evaluation scores—data collected during the independent heuristic evaluations of the six course sites by two experts. Using descriptive statistical methods the means and standard deviations of these two usability measures were compared and rank-ordered. These ranked variables were examined using the non-parametric technique of Kendall's tau correlation. This statistical method was selected because the number of courses (six courses) examined in this study is less than ten.

The qualitative usability data, students' verbal report data collected during the usability testing sessions and the summary interviews conducted immediately after the usability testing sessions were analyzed by compiling the data related to each student within a spreadsheet. This verbal report data was examined for and organized by themes. A coding scheme was created to categorize these themes. The themes were examined and confirmed by another course design and development professional familiar with the study. The themes and student comments were compared to Nielsen's (1994, 2000, 2002) heuristics and positive and negative comments mapped to each heuristic. Recommended design guidelines based on the outcomes of the usability testing sessions were written.

The research questions asked in this study, the data collection, and the results of the statistical analyses of the data collected to answer each research question are presented in the following sections of this chapter. The six research questions asked in this study are presented below.

1. What does the construct of usability mean from a student's perspective?

2. How do Nielsen's usability heuristics compare to students' judgments about instructional web sites?
3. Is computer self-efficacy related to students' perceptions of web site usability?
4. Is web site usability related to student satisfaction with online courses?
5. Is computer self-efficacy related to student satisfaction with online courses?
6. Is course development type related to task error rate, Nielsen's heuristic evaluation score, and student satisfaction?

Research Questions

Question 1: *What does the construct of usability mean from a student's perspective?*

This question is answered by the data collected during the usability testing sessions as students attempted to complete seven pre-determined tasks. The usability testing sessions provided both verbal report data from the testing sessions and quantitative data about the usability of each course site in the form of a calculated task usability error rate. This task usability error rate was calculated by counting the total number of student errors and dividing the total number of errors by the total time (as measured in minutes and seconds) students spent on completing tasks per course.

The data were collected using the Time/Error log running during the usability testing sessions. This computerized log, which was started at the beginning of each session, automatically records the testing session time. Using a keyboard as an input device, the researcher recorded notes based on the observation of the student's activities and verbal reports during the session. The beginning and the end of each task were verbally reported by each student as they started and completed each task. Students were able to successfully report the beginning and end of each task they completed in their testing sessions. The time for each task was recorded in minutes and seconds and entered into a spreadsheet. Seconds were converted to fractions of minutes by dividing them by 60. These values are expressed as decimals. During one of the usability testing sessions the time recorder of the computer capturing the Time/Error log malfunctioned. Thus, the N for all the task usability error rate data was 29 instead of 30.

A longer length of time spent on a task was not always the result of a larger number of errors on a task. In the usability testing sessions, students were not instructed to complete the tasks as “quickly as possible.” Rather, they were instructed to complete the tasks. Some students took longer on some tasks as they explored the site to see what different links contained. This gave them the freedom to work without time pressure and take the time to explore the site as they worked through the tasks, which many students did. Since these students were thinking-aloud, they verbalized they were exploring the site rather than having difficulties with task completion (e.g., “I think this looks interesting, I’m going to open this link and see what’s there”).

The number of errors was counted for each task. Several types of errors were counted. An error was counted when students failed to complete a task, (i.e., quit before they completed the task, or ran out of time to complete the task) or failed to complete a task successfully (i.e., were unable to complete the task because they could not find what they needed or did not complete all of the elements of a task). The number of errors for each task was counted and the value was entered into the spreadsheet. A task usability error rate was calculated for each task by dividing the converted number of minutes into the number of counted errors. The calculated error rates represent the number of errors per minute per course. Two of the data sets contain missing data. During the Course 1 testing sessions, the timer on the machine generating the time measurement of the Time/Error log malfunctioned for the entire testing session for student tester number four. Consequently, there were no time measurements for student tester number four. The calculated error rate for Course 1 is based on the results of five student testing sessions. The failure of the computer to capture the time for student 4 resulted in a reduction of the N for the task usability rates from 30 to 29. During the Course 5 testing sessions some task data is missing for student tester number two. This student ran out of time during the testing session and did not complete all tasks. The summary of this data is presented in Appendix C. Task usability error rates, mean error rates, mean task completion times, and standard deviations were calculated for each course. The courses were rank-ordered by the mean error rate and accompanied by mean errors and mean task completion times.

Table 4

Courses Rank-Ordered by Error Rate with Mean Errors and Mean Task Completion Time

Course	N	Mean Error Rate	SD	Mean Errors	SD	Mean Time	SD
3	4	0.03	0.07	0.50	1.0	15.71	4.26
2	5	0.07	0.22	1.20	1.79	16.61	5.92
5	6	0.20	0.07	4.80	2.50	23.42	8.54
1	5	0.24	0.20	6.33	2.39	38.97	4.36
4	5	0.30	0.05	4.20	0.84	14.41	3.35
6	4	0.32	0.27	5.17	4.96	16.38	5.35

The results of rank-ordering the courses by mean task usability error rates show that two of the professionally-developed courses were ranked in the top three most usable courses and Course 1 was ranked fourth out of the six courses. One of the nonprofessionally-developed courses, Course 5, was in the top three by usability as measured by error rates. The remaining two nonprofessionally-developed courses were ranked in the bottom third. These data are presented in Table 4.

The second set of data collected and analyzed to answer research question one was the analysis of the think-aloud protocol. The students' verbal reports data recorded during the usability testing sessions as they completed pre-determined tasks were captured on DVD for later review by the researcher. Subsequent review, transcription, and analysis of this audio, eye-tracking, and video data revealed students in the usability testing sessions expressed similar thoughts and ideas. These thoughts and ideas were transcribed from the Time/Error logs and the audio, eye-tracking, and video recordings, entered into in a spreadsheet then, organized by themes. Analysis of the students' verbal reports during the think-aloud protocol and the summary interviews resulted in the identification of themes and the development of a coding scale. A professional colleague familiar with the issues of online course design and development who observed some of the usability testing sessions reviewed the themes and the coding scale and confirmed the themes and topics presented in Table 5.

Table 5

Usability Analysis Themes and Coding Scale

Categories	Topics
Assignments (A)	Finding assignment guidelines
	Submitting assignments
	Creating assignment content
	No directions in Assignments Tool
	Confusing assignment due dates
	Lack of clarity how to submit assignments
	Need tutorial how to submit assignments
	Out of date due dates
Messaging (M)	Locating contact information
	No problems with e-mail
	Locating professor’s contact information
Content (C)	Too much text
	Organizing content
	Accessing course materials
	Locating content
	Printing content
	Need more images
	Add internal links within content
	Using multimedia content

Table 5, continued

Usability Analysis Themes and Coding Scale

Categories	Topics
Language (L)	Clear link labels
	Unclear link labels
	Did not like the term “modules”
	Language doesn’t match syllabus language
Exams (E)	Locating exams in assessment tool
	Submitting exams in assessment tool
	Locating proctored exam location
	Scheduling exam appointment
	Understanding concept “proctored” exams
Grades (G)	Checking grades, ability to
	No problems checking grades
	Monitor throughout course
Navigation (N)	Via left navigation bar
	Via Scrolling
	Need site map for overview
	Ease of Navigation
	Thrown by navigation bar
	Needs tutorial in site use

Table 5, continued

Usability Analysis Themes and Coding Scale

Categories	Topics
Tools (T)	Organizing toolbar
	Providing “Calendar” tool
	Using “More Tools”
Prior Experience (PE)	Ease of use due to
Syllabus (S)	Lesson topics not listed in
	Too bulky
	Content needs to be on home page
Easiest task (ET)	Posting in discussion area
	Browsing
	Finding number of assignments
	Nothing was hard
	Finding grades; using e-mail
	Assignment submission

Table 5, continued

Usability Analysis Themes and Coding Scale

Categories	Topics
Most Difficult Task (MDT)	
	Finding assignment guidelines
	Navigation-lack of internal links
	Nothing was difficult
	Syllabus no match to users' mental model
	Locating exams
	Late submission policy
	Finding instructor contact info
	Locating content
	Knowing I was on correct site

Question 2: *How do Nielsen's usability heuristics compare to students' judgments about instructional web sites?*

This question is answered by comparing the scores from the heuristic evaluations of the course sites as measured by *The Xerox Heuristic Evaluation: A System Checklist* (1995) and students' judgments about instructional web sites as measured by the task usability error rate.

Each course site was evaluated for its compliance to Nielsen's (1994, 2000, 2002) heuristics by two experts. Each evaluator independently examined the course sites and compared each course design to each item on the *Xerox Heuristic Evaluation: A System Checklist* (1995). For the evaluation, the items in the checklist were entered into a spreadsheet. Each evaluator coded each item with the following codes:

- “2” to indicate a positive response, the checklist item is present,
- “1” to indicate a negative response, the checklist item is absent, and
- “N/A” to indicate the checklist item was not applicable to the course site.

Following these independent evaluations, the scores resulting from the evaluators’ heuristic evaluation were compared for inter-rater reliability. The spreadsheet columns of heuristic evaluation scores for each evaluator were compared and the reliability of the heuristic evaluation was established by calculating the percent of agreement between the two raters. The proportion of scores that both raters agreed upon was 78 %.

A Nielsen’s Heuristic Score was calculated for each course by calculating the mean heuristic score for each course. Since a score of 2 indicates that the heuristic checklist item is a feature present in the course design, if the evaluated course complied perfectly with all of Nielsen’s (1994, 2000, 2002) heuristics, its mean score would be 2. Conversely, if the evaluated course did not have any of the features of Nielsen’s (1994, 2000, 2002) heuristics in its course design (i.e., did not follow any of the checklist heuristics) its mean score would be 1. The content of the *Xerox Heuristic Evaluation: A System Checklist* (1995) was placed into a spreadsheet. Three columns to the right of the checklist items were labeled present, not present, and not applicable respectively. Each evaluator rated each characteristic as a “2”, “1” or “N/A” and placed these values in the appropriate column. Column values were summed for each of the 13 heuristics and the mean was calculated for each course. The courses evaluated in this study had a mean range of 1.79 - 1.89. The standard deviation was 0.03. A higher mean score indicates that the course design features more characteristics that comply with Nielsen's (1994, 2000, 2002) widely-accepted heuristics, a lower score indicates that the course design features fewer characteristics that comply with Nielsen's (1994, 2000, 2002) widely-accepted heuristics. Therefore, a course with a higher score is ranked higher in usability according to the Nielsen's Heuristic Evaluation score.

The Time/Error log data collected during the usability testing sessions as students attempted to complete seven pre-determined tasks were used to calculate an error rate. This task usability error rate was used as a measure of students' judgments concerning the usability of each educational web site. The task usability error rate was calculated by counting the total number of student errors and dividing the total number of errors by the total time (as measured by the decimal equivalent of minutes and seconds) students spent on completing tasks per course.

The courses are ranked according to the calculated task usability error rate per course and compared to the Nielsen's Heuristic Evaluation Scores in Table 6.

Table 6

Courses Rank Ordered by Task Usability Error Rate and Nielsen's Heuristic Score

Course	N	Error Rate	Rank Order	Nielsen's Score	Rank Order
1	5	0.24	4	1.89	1
2	5	0.07	2	1.88	2
3	4	0.04	1	1.85	3
4	5	0.30	5	1.84	4
5	6	0.22	3	1.79	6
6	4	0.32	6	1.83	5
Total	29	0.20		1.85	

The rank order of courses was different between the two measures. (See Table 7 for the results of a Kendall's tau correlation analysis).

The correlation between these rankings was analyzed using the non-parametric statistical technique of Kendall's tau correlation. Kendall's tau was used to correlate these two rank-ordered statistics rather than Spearman's rank order correlation due to the small number of courses (six). Kendall's tau correlation is preferable to Spearman's rank order correlation when the number of cases is less than ten (Leedy, 1989). The results of the statistical calculations to correlate the results of all courses rank-ordered by error rates (i.e., usability as measured by the students' performance in the usability testing sessions) and Nielsen's heuristic evaluations (i.e., usability as measured by the heuristic evaluations) are presented in Table 7.

Table 7

Kendall's Tau Correlation of Task Usability Error Score and Nielsen's Heuristic Evaluation

Course	N	Error Score	Nielsen's Score	Kendall's tau	2 sided p-value
1	5	0.24	1.89	-0.06	1
2	5	0.07	1.88		
3	4	0.04	1.85		
4	5	0.30	1.84		
5	6	0.22	1.79		
6	4	0.32	1.83		

The results of the Kendall's tau correlation show that for the six courses evaluated in this research study the degree of correspondence between Nielsen's heuristic evaluation rankings (usability as measured by heuristic evaluation) and error rate (usability as measured by student's performance during the usability testing sessions) was negative and very low (Kendall's tau = -0.06). There was no relationship between the usability rankings of courses by Nielsen's heuristics and usability as judged by students (as measured by error rate).

Usability Analysis Themes

Usability testing sessions were captured on audio, eye-tracking, video recordings. The analysis of students' verbal reports as they completed tasks in the course sites, the summary interview data, and the review, transcription, and analysis of this audio, eye-tracking, and video data revealed students in the usability testing sessions expressing similar thoughts and ideas. These thoughts and ideas were transcribed from the time/error logs and the audio, eye-tracking, and video recordings, entered into in a spreadsheet then, organized by themes. Analysis of the students' verbal reports during the think-aloud protocol and the summary interviews resulted in the identification of themes and the development of a coding scale. Following this initial analysis, each comment was coded as either positive or negative and compared to Nielsen's heuristics (1994, 2000, 2002). Each comment was matched to each specific, corresponding heuristic characteristic as operationalized in *The Xerox Heuristic Evaluation: A System Checklist* developed by Xerox Corporation, (1995). Finally, the identified comments were mapped to the corresponding Nielsen (1994, 2000, 2002) heuristic in a table, positive and negative comments were summed, and the percentage of each type of comment was calculated. The total number and percentage of positive and negative comments for each course, each type of course, and comments for all courses were calculated. A total count of positive and negative comments were calculated for each theme and mapped to the corresponding heuristic. The results of these analyses are presented in Table 8. Guidelines for the design and development of educational web sites (i.e., online course sites) were derived and written from this data and presented in Table 22.

Table 8

Students' Verbal Reports Compared to Nielsen's Heuristics

Heuristic / **Course**	1 Visibility System Status	2 Match system with real world	3 User control and freedom	4 Consistency and Standards	5 Recognize, Diagnose and Recover from Errors	6 Error Prevention	7 Recognition Rather Than Recall	8 Flexibility Minimalist Design	9 Aesthetic Minimalist	10 Help	11 Skills	12 Pleasurable , respectful inter-action	13 Privacy	Row Total	Column %
Professional															
Course 1 (N = 6)															
Heuristic Score = 1.89															
Positive Comments	1	0	4	5	0	3	5	0	4	0	7	2	0	31	41.3%
Negative Comments	1	18	2	7	0	5	6	0	6	0	0	0	0	44	58.7%
Course Total	2	18	6	12	0	8	11	0	10	0	7	2	0	75	100.0%
Row %	2.7%	24.0%	8.0%	16.0%	0.0%	10.7%	14.7%	0.0%	13.3%	0.0%	9.3%	2.7%	0.0%	100.0%	
Course 2 (N = 5)															
Heuristic Score = 1.88															
Positive Comments	4	17	4	7	0	2	9	0	5	0	6	1	0	56	51.4%
Negative Comments	6	16	1	11	0	2	3	3	6	0	4	1	0	53	48.6%
Course Total	10	33	5	18	0	4	12	3	11	0	10	2	0	109	100.0%
Row %	9.2%	30.3%	4.6%	16.5%	0.0%	3.7%	11.0%	2.8%	10.1%	0.0%	9.2%	1.8%	0.0%	100.0%	

Table 8 (Continued)

Students' Verbal Reports Compared to Nielsen's Heuristics

Heuristic / Course	1 Visibility System Status	2 Match system with real world	3 User control and freedom	4 Consistency and Standards	5 Recognize, Diagnose and Recover from Errors	6 Error Prevention	7 Recognition Rather Than Recall	8 Flexibility Minimalist Design	9 Aesthetic Minimalist	10 Help	11 Skills	12 Pleasurable , respectful inter-action	13 Privacy	Row Total	Column %
Course 3 (N=4)															
Heuristic Score = 1.85															
Positive Comments	11	13	3	13	0	0	7	2	9	0	7	8	0	73	73.0%
Negative Comments	5	3	0	4	0	0	5	1	4	0	1	4	0	27	27.0%
Course Total	16	16	3	17	0	0	12	3	13	0	8	12	0	100	100.0%
Row %	16.0%	16.0%	3.0%	17.0%	0.0%	0%	12.0%	3.0%	13.0%	0.0%	8.0%	12.0%	0.0%	100.0%	
Professional															
Column Totals															
Positive Total	16	30	11	25	0	5	21	2	18	0	20	11	0	160	56.3%
Negative Total	12	37	3	22	0	7	14	4	16	0	5	5	0	124	43.7%
Professional Total	28	67	14	47	0	12	35	6	34	0	25	16	0	284	100.0%
Row %	9.9%	23.6%	4.9%	16.5%	0.0%	4.2%	12.3%	2.1%	12.0%	0.0%	8.8%	5.6%	0.0%	100.0%	
Nonprofessional															
Course 4 (N=5)															
Heuristic Score = 1.84															
Positive Comments	3	3	0	3	0	0	2	1	3	0	1	3	0	19	21.6%
Negative Comments	12	11	0	10	0	3	9	0	11	0	2	11	0	69	78.4%
Course Total	15	14	0	13	0	3	11	1	14	0	3	14	0	88	100.0%
Row %	17.0%	15.9%	0.0%	14.8%	0.0%	3.4%	12.5%	1.1%	15.9%	0.0%	3.4%	15.9%	0.0%	100.0%	

Table 8 (Continued)

Students' Verbal Reports Compared to Nielsen's Heuristics

Heuristic	1 Visibility System Status	2 Match system with real world	3 User control and freedom	4 Consistency and Standards	5 Recognize, Diagnose and Recover from Errors	6 Error Prevention	7 Recognition Rather Than Recall	8 Flexibility Minimalist Design	9 Aesthetic Minimalist	10 Help	11 Skills	12 Pleasurable , respectful inter-action	13 Privacy	Row Total	Column %
Course 5 (N=6)															
Heuristic Score = 1.79															
Positive Comments	2	3	0	3	0	0	3	1	3	0	0	3	0	18	18.4%
Negative Comments	7	13	2	13	0	0	13	5	13	0	1	13	0	80	81.6%
Course Total	9	16	2	16	0	0	16	6	16	0	1	16	0	98	100.0%
Row %	9.2%	16.3%	2.0%	16.3%	0.0%	0.0%	16.3%	6.1%	16.3%	0.0%	1.0%	16.3%	0.0%	100.0%	
Course 6 (N=4)															
Heuristic Score = 1.83															
Positive Comments	2	2	0	2	0	0	2	0	2	0	0	2	0	12	11.8%
Negative Comments	13	14	0	14	0	0	13	0	13	0	9	14	0	90	88.2%
Course Total	15	16	0	16	0	0	15	0	15	0	9	16	0	102	100.0%
Row %	14.7%	15.7%	0.0%	15.7%	0.0%	0.0%	14.7%	0.0%	14.7%	0.0%	8.8%	15.7%	0.0%	100.0%	
Nonprofessional															
Column Totals															
Positive Total	7	8	0	8	0	0	7	2	8	0	1	8	0	49	17.0%
Negative Total	32	38	2	37	0	3	35	5	37	0	12	38	0	239	83.0%
Nonprofessional Total	39	46	2	45	0	3	42	7	45	0	13	46	0	288	100.0%
Row %	13.5%	16.0%	0.7%	15.6%	0.0%	1.0%	14.6%	2.4%	15.6%	0.0%	4.5%	16.0%	0.0%	100.0%	

Table 8 (Continued)

Students' Verbal Reports Compared to Nielsen's Heuristics

Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13		
All Course Totals	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than Recall	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , respectful inter-action	Privacy	Row Total	Column %
Positive Totals	23	38	11	33	0	5	28	4	26	0	21	19	0	209	36.5%
Negative Totals	44	75	5	59	0	10	49	9	53	0	17	43	0	363	63.5%
Total	67	113	16	92	0	15	77	13	79	0	38	62	0	572	100.0%
Row %	11.7%	19.8%	2.8%	16.1%	0.0%	2.6%	13.5%	2.3%	13.8%	0.0%	6.6%	10.8%	0.0%	100.0%	

An analysis found that the number of positive and negative comments differed between the two course development types. For the professionally-developed courses with the highest heuristic evaluation scores student comments were more evenly distributed between positive and negative comments. There were 56.3% positive comments and 43.7% negative comments for the professionally-developed courses. For the non-professionally developed courses with the lower heuristic evaluation scores the comments were 17% positive and 83% negative. Four times as many negative comments as positive ones. These results are reported in Table 8.

The results of a Chi square analysis between the two types of comments, positive or negative for the two course development types, were significant ($X^2 = 95.36$) beyond the $p < .01$ level. See Table 9.

Table 9

Chi Square of Positive and Negative Verbal Reports by Course Development Type

		Verbal Reports		
Course Development Type	Frequency	Positive	Negative	Total
Professional	Actual	160	124	284
	Expected	103.77	180.23	284
Nonprofessional	Actual	49	239	288
	Expected	105.23	182.77	288
Total		209	363	572

Question 3: *Is computer self-efficacy related to students' perceptions of web site usability?*

The data collected and analyzed to answer this question include the scores from the 20-item, Likert-based, pre-course survey, the *Computer User Self-efficacy Scale* (CUSE) developed by Eachus and Cassidy (2006) and the scores of students' judgments of web site usability as measured by the calculated task usability error rate. The total score for each student survey was calculated as described in Eachus and Cassidy's article, *Development of the web users self-efficacy scale* (2006). The survey is designed to measure students' self-efficacy in using the Web. The task usability error rate, the number of errors students made per minute, was calculated as previously described in this chapter. The mean and standard deviation were calculated for the students in each course resulting in the comparison of the means and standard deviations of the Computer Self-Efficacy Scores and the course means for student task usability error rates reported in Table 10.

Table 10

Task Usability Error Rate and Computer Self Efficacy Descriptive Statistics

Course	N	Mean Error Rate	SD	N	Mean Self-Efficacy	SD
1	5	0.24	0.20	9	59.75	3.83
2	5	0.07	0.22	18	55.60	5.12
3	4	0.04	0.09	16	62.25	4.30
4	5	0.30	0.06	18	61.92	4.25
5	6	0.22	0.07	15	58.12	6.27
6	4	0.32	0.27	13	60.63	2.10
Total	29	0.20	0.15	89	59.71	4.31

A correlation between the ranking orderings of the task usability error rate and computer self-efficacy was calculated using Kendall’s tau. The results of this correlation are presented in Table 11. The correlation was negative and small in magnitude. (Kendall’s tau = -0.19).

Table 11

Kendall's Tau Correlation of the Rank Ordering of Task Usability Error Rate and Computer Self-Efficacy

Course	Error Rate	Self-Efficacy	Kendall's tau	2 sided p-value
1	0.24	59.75	-0.19	0.71
2	0.07	55.60		
3	0.04	62.25		
4	0.30	61.92		
5	0.22	58.12		
6	0.32	60.63		

Using students as the unit of analysis (N=29), a Pearson product-moment correlation was run between the computer self-efficacy mean scores and the task usability error rate mean scores (r = -.097) (r^2 = 0.94%) (p = 0.62). These results are summarized in Table 17.

Question 4: *Is web site usability related to student satisfaction with online courses?*

The data collected and analyzed to answer this question included the scores from the 60-item, Likert-based, post-course survey, the *Student Evaluation of the Quality of Web-Based Instruction*, developed by Stewart, Hong, and Strudler (2004), the scores of students' judgments of web site usability as measured by the task usability error rate, and usability as measured by the Nielsen's heuristic evaluation score. The total score for each student survey was calculated as described in Stewart, Hong, and Strudler's (2004) article, *Development and validation of an instrument for student evaluation of the quality of web-based instruction*. The survey is designed to measure students' satisfaction in their web-based courses. The calculation of the task usability error rate, the number of errors students made per minute, was previously described in this chapter. The mean and standard deviation were calculated for the students in each course resulting in the comparison of the course means and standard deviations of the Student Satisfaction Scores and the student task usability Error Rates reported in Table 12.

Table 12

Courses Rank Ordered by Task Usability Error Rate Score and Student Satisfaction Score Descriptive Statistics

	Error Rate				Satisfaction			
Course	N	Rank	Mean	SD	N	Rank	Mean	SD
1	5	4	0.24	0.20	12	3	209.16	25.52
2	5	2	0.07	1.20	12	1	219.25	21.26
3	4	1	0.04	0.09	12	4	204.75	14.11
4	5	5	0.30	0.06	14	2	220.85	32.18
5	6	3	0.22	0.07	14	6	186.86	20.16
6	4	6	0.32	0.27	15	5	158.00	47.65
Total	29		0.20	0.32	79		199.81	26.81

Using Kendall's tau, the degree of correspondence between task usability error rate and student satisfaction was calculated. The correspondence of student satisfaction to task usability error rate found a small, non-significant negative correlation between student satisfaction and error rate (Kendall's tau = -0.06). See Table 13.

Table 13

Kendall's Tau Correlation of the Rank Ordering of Task Usability Error Rate and Student Satisfaction Scores

Course	Error Rate	Satisfaction	Kendall's tau	2 sided p-value
1	0.24	209.16	-0.06	1.0
2	0.07	219.25		
3	0.04	204.75		
4	0.30	220.85		
5	0.22	186.86		
6	0.32	158.00		

Using students as the unit of analysis (N=29), a Pearson product-moment correlation was run between the task usability error rate mean scores and student satisfaction (r = 0.013) (r^2 = 0.02%) (p = 0.95). These results are summarized in Table 17.

The courses were rank-ordered by the Nielsen's Heuristic Evaluation Scores and compared to the Student Satisfaction scores per course in Table 14.

Table 14

Courses Rank Order by Nielsen's Heuristic Evaluation Score and Student Satisfaction Score Descriptive Statistics

	Nielsen's Heuristic				Satisfaction			
Course	N	Rank	Mean	SD	N	Rank	Mean	SD
1	5	1	1.89	0.20	12	3	209.16	25.52
2	5	2	1.88	1.20	12	2	219.25	21.26
3	4	3	1.85	0.09	12	4	204.75	14.11
4	5	4	1.84	0.06	14	1	220.85	32.18
5	6	6	1.79	0.07	14	5	186.86	20.16
6	4	5	1.83	0.27	15	6	158.00	47.65
Total	29		1.85	0.32	79		199.81	26.81

A Kendall's tau correlation was calculated to measure the degree of correspondence between the two rankings and to assess the significance of the correspondence. The results are presented in Table 15.

Table 15

Kendall's Tau Correlation of Rank Ordering of Nielsen's Heuristic Evaluation and Student Satisfaction Score

Course	Satisfaction	Nielsen's Score	Kendall's tau	2 sided p-value
1	209.16	1.89	0.33	0.45
2	219.25	1.88		
3	204.75	1.85		
4	220.85	1.84		
5	186.86	1.79		
6	158.00	1.83		

The results of the Kendall's tau correlation show that for the six courses evaluated in this research study the degree of correspondence between student satisfaction (as measured by the post-course survey) and Nielsen's heuristic evaluation rankings (usability as measured by heuristic evaluation) was 0.33. There was a slight positive, but non-significant, relationship.

Question 5: *Is computer self-efficacy related to student satisfaction with online courses?*

The data collected and analyzed to answer this question include the results of 20-item Eachus and Cassidy's (2006) Computer Use Self-Efficacy Survey and 60-item Stewart, Hong and Strudler's (2004) Student Satisfaction Survey. Both surveys were completed by 74 common students. This data, collected in the usability testing sessions, through e-mail, and in a WebVista site set up for the study by the researcher, are reported in Table 16.

Table 16

Computer Self-Efficacy and Student Satisfaction Scores Descriptive Statistics

Course	N	Self-Efficacy	SD	N	Student Satisfaction	SD
1	9	59.75	3.83	12	209.16	25.52
2	18	55.60	5.12	12	219.25	21.26
3	16	62.25	4.30	12	204.75	14.11
4	18	61.92	4.25	14	220.85	32.18
5	15	58.12	6.27	14	186.86	20.16
6	13	60.63	2.10	15	158.00	47.65
Total	89	59.71	4.31	79	199.81	26.81
Common	74	59.54	3.86	74	196.00	21.92

Using students as the unit of analysis, a Pearson product-moment correlation was run between the 74 pairs of surveys that were completed by both students prior to and after they completed their online courses. The results showed a slight positive correlation (r = 0.15) (r^2 = 2.25%) (p = 0.073) between computer self-efficacy and student satisfaction. The level was non-significant (p = 0.073). The correlation matrix is presented in Table 17.

Table 17

Correlation Matrix of Self-Efficacy, Satisfaction, and Error Rate

	Self-Efficacy	Satisfaction	Error Rate
Self-Efficacy	1		
Satisfaction	0.15	1	
Error Rate	-0.097	0.013	1

r^2 Self-efficacy and Error Rate = 0.94%

r^2 Error Rate and Satisfaction = 0.02%

r^2 Self-efficacy and Satisfaction = 2.25%

The results showed that all correlations are small in magnitude, close to zero.

Question 6: *Is course development type related to task error rate, Nielsen's heuristic evaluation score, and student satisfaction?*

The task usability error rate results were related to course development type using students as the unit of analysis. After comparing the task usability rates of student testers in the usability lab (N=29) by professional or nonprofessional course development type using a t-test, the results, reported in Table 18, were significant (p = 0.04).

Table 18

T-Test Comparing Task Usability Error Rate by Course Development Type

	Professional	Nonprofessional
Mean	0.15	0.27
Variance	0.04	0.03
Observations	14	15
Pooled Variance	0.03	
Hypothesized Mean	0	
df	27	
t Stat	-1.79	
P(T<=t) one tail	0.04	
T Critical one-tail	1.70	
P(T<=t) two tail	0.08	
T Critical two-tail	2.05	

The results of this test showed that the difference in the means of error rates between course development types was significant for the one-tailed test (p = 0.04). Results of the two-tailed test (p = 0.08) were also notable, given the small sample size. The effect size was calculated. The results (*d* = 3.39) indicated a large effect size.

The Nielsen's heuristic evaluation score results were also related to course development type. Using the courses as the unit of analysis (N = 6), the heuristic evaluation mean scores analyzed using a t-test. The difference in the means of Nielsen's heuristic evaluation scores was significant for both the one-tailed (p = 0.02) and two-tailed (p = 0.05) tests. The results are reported in Table 19.

Table 19

T-Test of Nielsen's Heuristic Evaluation Score by Course Development Type

	Professional	Nonprofessional
Mean	1.87	1.82
Variance	0.00043	0.0007
Observations	3	3
Pooled Variance	0.0005	
Hypothesized Mean	0	
df	4	
t Stat	2.74	
P(T<=t) one tail	0.026	
T Critical one-tail	2.13	
P(T<=t) two tail	0.05	
T Critical two-tail	2.77	

An ANCOVA analysis was run in Statistical Package for Social Sciences (SPSS) to examine the effect of course development type, professional or nonprofessional, on student satisfaction while controlling for the covariate self-efficacy. The results of this analysis are reported in Table 20.

Table 20

ANCOVA with Course Development Type as Independent Variable, Student Satisfaction as Dependent Variable, and Self-Efficacy as Covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	16193.34	2	8096.67	6.76.	.002
Intercept	3478.46	1	3478.46	2.90	.093
Self-efficacy	3956.87	1	3956.87	3.03	.073
Course Dev Type	14045.17	1	14045.17	11.72	.001
Total	2944038	74			
Corrected Total	4263.36	73			

The results of the ANCOVA with student satisfaction as the dependent variable presented in Table 20 shows that the relationship between self-efficacy and student satisfaction was non-significant (p = 0.073). However, after accounting for the mean self-efficacy scores, there was a significant difference between the mean satisfaction scores for the two course development types, professionally and nonprofessionally developed courses (p = 0.001). Course development type was a factor in post-course student satisfaction, though there was not a strong correlation between self-efficacy and student end-of-course satisfaction.

Table 21

T-Test of Student Satisfaction Scores by Course Development Type

	Professional	Nonprofessional
Mean	210.30	184.50
Variance	513.22	1814.85
Observations	33	41
Pooled Variance	1236.35	
Hypothesized Mean	0	
df	72	
t Stat	3.14	
P(T<=t) one tail	0.001	
T Critical one-tail	1.66	
P(T<=t) two tail	0.002	
T Critical two-tail	1.99	

The t-test comparing the student satisfaction means by course development type resulted in a significant (p = 0.001) difference between the professional and nonprofessional development groups in satisfaction and confirmed the results of the ANCOVA. For comparison with the ANCOVA data, which used the data of “common” students who completed both the pre-and post-course surveys, this t-test uses N=74.

Summary

The study used mixed methods to collect both quantitative and qualitative data on the usability of six courses as perceived by students enrolled in each of the courses. The six courses were grouped into two course development types, professionally- and nonprofessionally-developed. The results of the data analysis were presented in Chapter 4. Next, a summary of the results, organized by research question is presented.

Question 1: *What does the construct of usability mean from a student's perspective?*

Students' judgments of the construct of usability of the six courses were measured quantitatively by the calculated task usability error rate and mean task completion times and qualitatively by the analysis of students' verbal reports. The six courses were ranked by the task usability error rate. The ranking of the courses was mixed between course types with one of the professionally-designed courses ranked in the bottom half and one of the nonprofessionally-designed courses ranked in the top half. The ranking of courses by the mean task completion times did not match the rankings by task usability error rate. Course 3, 4, and 6 ranked in the first, second, and third by time, while Courses 2, 5, and 1 ranked in the lower half by mean time.

An analysis of the verbal reports identified 52 common themes regarding usability woven through the students' comments as they completed seven pre-determined tasks in the six different courses. Students identified locating content as one of the most difficult tasks. Checking grades and communicating via e-mail were the easiest.

Question 2: *How do Nielsen's usability heuristics compare to students' judgments about instructional web sites?*

The mean scores from the heuristic evaluations of the course sites as measured by *The Xerox Heuristic Evaluation: A System Checklist* (1995) and students' usability as measured by the mean task usability error rate were ranked. The correlation of the rank order of the six courses was analyzed using a Kendall's tau correlation. These results show the degree of correspondence between these two usability rankings was negative and very low (Kendall's tau = -0.06). There was no relationship between the usability ranking of courses by Nielsen's heuristics and usability as judged by students.

As another measure of students' judgments of usability, the verbal reports were analyzed for themes, and the number of positive and negative comments students made during the usability testing sessions were counted. Comments were compared to Nielsen's heuristic categories and the positive and negative comments were mapped to each heuristic category. It was found that the number of positive and negative comments differed between the two groups of courses. The results of a Chi-square analysis between the two types of comments, positive or negative, were highly significant ($X^2 = 95.36$). For the professionally-developed courses with the highest heuristic evaluation scores there were 56.3% positive comments and 43.7% negative comments. For the nonprofessionally-developed courses with the lower heuristic evaluation scores, the comments were 17% positive and 83% negative.

Question 3: *Is computer self-efficacy related to students' perceptions of web site usability?*

Scores from the 20-item, Likert-based, pre-course survey, the *Computer User Self-efficacy Scale* (CUSE) developed by Eachus and Cassidy (2006) and the scores of students' judgments of web site usability as measured by the calculated task usability error rate were compared to analyze the relationship of student's computer self-efficacy and students' judgments of usability. Kendall's tau correlation was calculated to measure the degree of correspondence between the rank orderings of student self-efficacy and students' judgments of usability. The results of this analysis between self-efficacy and error rate was negative and very small (Kendall's tau = -0.19). Using students as the unit of analysis, a Pearson product-moment correlation was run between the computer self-efficacy mean scores and the task usability error rate mean scores (r = -0.097) (r^2. = 0.94%) (p = 0.62).The correlation between self-efficacy and error rate was very small, negative, and close to zero. Student self-efficacy was not related to students' judgments of usability as measured by task usability error rates.

Question 4: *Is web site usability related to student satisfaction with online courses?*

Using courses as the unit of analysis, the courses were rank-ordered by task usability error rate and compared to the student satisfaction scores. A Kendall's tau correlation of student satisfaction survey scores to usability as measured by task usability error rate found a small, negative, non-significant correlation between student satisfaction and error rate (Kendall's tau = -0.06). Using students as the unit of analysis (N=79), a

Pearson product-moment correlation was run between the task usability error rate mean scores and student satisfaction scores (*r* = -0.013) (r^2. = 0.02%) (p = 0.95).

The courses were rank-ordered by Nielsen's heuristic evaluation score and student satisfaction scores. There was a slightly positive, but non-significant relationship between web site usability as measured by Nielsen's heuristic evaluation and student satisfaction scores.A Kendall's tau correlation was calculated to measure the degree of correspondence between the Nielsen's heuristic evaluation and student satisfaction scores rankings (Kendall's tau = 0.33). There was a slightly positive, but non-significant, relationship between web site usability as measured by Nielsen's heuristic evaluation and student satisfaction scores.

Question 5: *Is computer self-efficacy related to student satisfaction with online courses?*

The results of the computer self-efficacy and student satisfaction surveys were compared. Both surveys were completed by 74 common students. A Pearson product-moment correlation was run between the computer self-efficacy survey scores and student satisfaction using students as the unit of analysis. The results showed a slightly positive correlation between computer self-efficacy and student satisfaction (*r* =0.15., r^2 = 2.25%) (p = 0.073).

Question 6: *Is course development type related to task error rate, Nielsen's heuristic evaluation score and student satisfaction?*

The task usability error rate results were related to course development type. After comparing the task usability rates of student testers in the usability lab (N = 29) by professional or nonprofessional course development type using a t-test, the results showed a significant ($p = 0.04$) relationship for the one-tailed test. Results of the two-tailed test ($p = 0.08$) were also notable.

The Nielsen's heuristic evaluation score results were also related to course development type. Using the courses as the unit of analysis (N = 6), the heuristic evaluation mean scores were analyzed using a t-test. The results were significant ($p = 0.026$).

Student satisfaction was also related to course development type. After comparing the mean scores of the students who completed both the pre-course and post-course surveys (N = 74) by professional or nonprofessional course development type using a t-test, the results were highly significant ($p = 0.001$). Students were more satisfied with the professionally-developed courses.

An ANCOVA was run in SPSS to determine the relationship of self-efficacy to student satisfaction. The results of the ANCOVA with student satisfaction as the dependent variable, self-efficacy as the covariate, and course development type as the independent variable showed that the relationship between self-efficacy and student satisfaction were not significant ($p = 0.73$). However, after accounting for the self-efficacy scores, there was a significant difference between the mean satisfaction scores for professionally- and nonprofessionally-developed courses.

The findings and conclusions of the research study will be discussed in Chapter 5. Guidelines for the design of educational course sites will be presented and a table of the observed characteristics that impede usability in educational web sites and their educational impact on students concludes the study findings and conclusions. Recommendations for future research will also be discussed.

Chapter Five

Summary, Conclusions, Discussion, and Recommendations

Background and Rationale

This research sought to explore what the construct of usability, or ease of use, means for students taking online courses. Site usability is defined as the way the user, in this case student, *actually* navigates, finds information, and interacts with the site (Goto & Cotler, 2002; Wood, 1998). The terms usability and ease of use in this context mean that students using the course site can do so quickly and easily to accomplish their own tasks. Course site usability rests on four assumptions which include a focus on the student, students use a course site to be productive, students are busy people who are trying to accomplish tasks, and students decide when a course site is easy to use (Dumas & Redish, 1994).

Although the construct of usability is not well understood, it is apparent that usability is a construct that results from the interaction of software design, user experience, and user expectations. This study sought to understand what usability means to students enrolled in six online courses, judged to differ in usability attributes, within the context of one online and distance learning program at one university. The question raised in this study was whether Nielsen's usability heuristics, a respected evaluation tool used primarily to measure the usability of commercial web sites, can be used to evaluate instructional web sites and used to differentiate between levels of usability in the same way usability is judged by students.

There is a need to study student perceptions of the usability of online instructional web sites because there continues to be few research-based guidelines concerning how to enhance the usability of online course sites and how to effectively use the online tools available in contemporary course management systems for teaching and learning. The issue of usability is important not only because the demand for online education continues to increase rapidly, but also due to the global penetration and use of course management systems to house online courses and to present instructional content to students.

Recent reports (see, for example, Abrami, Bernard, & Lou, 2004; Moos & Azevedo, 2009; U. S. Department of Education, 2009; and Woolsey, 2008) identify an increased demand for online courses, particularly in higher education, and note that few research studies conducted in the areas of teaching and learning have focused on online course design and development. Thus, few research-based guidelines have been published to help educators take full advantage of the online environment. The tools available in higher education and training courseware today were described as “crude” by Bonk and Wisher (2000, p. 52). The lack of guidelines and strategies has left many educators unsure of how to proceed as they design online course offerings (Alley & Jansak, 2001; Bonk & Zhang, 2008; Katz, 2008) and has resulted in a wide continuum of course interfaces, structures, and content (Oblinger & Hawkins, 2006). The lack of research-based guidelines has also resulted in poorly designed courses that students find difficult to use (Barbules & Callister, 1996; Duffy & Kirkley, 2004; Hall, Watkins & Eller, 2003; Hara & Kling, 2000; Shotsberger, 1996). Tallent-Runnells, et al. (2006) reported that further research is needed in the area of “appropriate and excellent course design and development” (p. 117). They attribute this need to the role course design and development plays in student success in the online environment.

One of the outcomes of this research is the development of recommended guidelines for the design and development of online courses. The research-based guidelines presented are the results of observations in the usability lab as students attempted to complete predetermined course-related tasks. The course-related tasks selected for inclusion in this study were tasks critical to successful participation in each course, that is, tasks critical to the successful completion of required course activities and assignments. The guidelines written were mapped to Nielsen’s (1994, 2000, 2002) usability heuristics.

The research questions addressed in this study are presented below.

Research Questions

This study is concerned with determining:

1. What does the construct of usability mean from a student’s perspective?
2. How do Nielsen’s usability heuristics compare to students’ judgments about instructional web sites?
3. Is computer self-efficacy related to students’ perceptions of web site usability?
4. Is web site usability related to student satisfaction with online courses?
5. Is computer self-efficacy related to student satisfaction with online courses?
6. Is course development type related to task error rate, Nielsen’s heuristic evaluation score, and student satisfaction?

Review of the Literature

Although distance education, which originated in the 1800s, is not a new concept, the popularity and penetration of the World Wide Web through all strata of society has led to an increased demand for, and the exponential growth of, the number of courses offered online in the past few years. Web-based instruction now dominates the field of distance education as traditional brick and mortar universities and colleges upload additional course offerings to the Web and develop fully online degree programs. The affordances of the Web which facilitate student interaction with the instructor, delivery of media-rich content, and interaction with other students asynchronously offer benefits to students not previously available in distance education. The increased numbers of non-traditional, adult students who enroll in these courses combine working lives and families with their student role. The asynchronous quality of web-based instruction allows working adults to learn anytime, anywhere and engage with course content at their own pace (Allen & Seaman, 2007, 2008; Bonk & Zhang, 2008; Eachus & Cassidy, 2006; Katz, 2008; Laurillard, 2002; Peters, 2003; Twigg, 2002; U.S. Department of Education, 2009).

Research (Dillon & McKnight, 1995; Dumas & Redish, 1994; Hackos & Redish, 1998; Nielsen, 1993, 2002) has shown that usability, the way a user *actually* navigates, finds information, and interacts with a site to be an important quality for web sites. Usability is defined in terms of the learnability of the site, the efficiency with which users can accomplish tasks, the memorability of a site, the minimization of user errors, and the users' satisfaction with their experience using the site (Nielsen, 1993, 2000, 2002).

Students need to be able to create a mental model of the course site and plan their work (Amadieu, van Gog, Paas, Tricot, & Mariné, 2009; Berge, Collins, & Dougherty, 2000; Brown, 1986; Dillon & Greene, 2003; Garrett, 2003; Hackos & Redish, 1998; Johnson-Laird & Byrne, 2000; Laurel, 1993; Norman, 1988, 2002; Otter & Johnson, 2000). If a site is usable, the technology does not cause a work "breakdown" or get in the way of the user accomplishing the task at hand—learning (Flores et al., 1988; Laurillard, 2002; Winograd & Flores, 1987). It is the users rather than the designers who create and communicate meaning in a course site (Cockton, 2009, p. 2223; Dourish, 2001; Flores et al., 1988; Winograd & Flores, 1987).

The construct of usability is particularly important for students as it applies to educational web sites. Students must be able to successfully navigate and use the course web site in addition to learning the course content. The use of established instructional design principles to design and develop a course is important whether the course is offered online or face-to-face (Smith & Ragan, 2004). The use of instructional design principles is a key factor in the creation of course materials that address the instructional needs of the audience in this case, students enrolled in an online course. If the design of the course materials does not address the needs of the student, then the site may be misinterpreted, ineffective, or unusable (Baggerman, 2000; Cress & Knabel, 2003; Nielsen, 1993; Otter & Johnson, 2000; Sano, 1996). Course material design is even more important in the online environment where instructor and students are separated by time and space. Due to this separation, students are on their own, viewing the course content and interacting with the instructor and other students through the "window" of the course interface. They are alone—without the physical presence of the instructor or classmates thus cannot easily get help in a timely manner. For example, students in an online course are unable to raise their hand or ask the person sitting beside them to get help. Although most online courses are completely designed and developed prior to being uploaded and going "live," there are some CMS tools that instructors may use to clarify misunderstandings. For example, instructors may use one of the CMS tools to broadcast a message to resolve students' difficulties. Many CMSs have an announcements tool to send messages that automatically appear the next time each student accesses the course to ensure that all students view the message without opening a specific link. Alternatively, instructors and students can resolve misunderstandings through the use of the discussions tool.

Designing a course for web-based instruction is different from designing for a face-to-face course. The most obvious reason for this difference is because the instructor and students are separated by time and space. The computer interface is the only window into the classroom. What appears "in the window" must be usable and clear for the students to accomplish the learning tasks, course requirements, and learning outcomes. Designers need to strive to create course sites that are ready-at-hand. Winograd and Flores (1987) distinguish between tools that are ready-at-hand and present-at-hand. A tool (in this case, the web-based instructional course site) is ready-at-hand when the operation of the course site does not intrude on the tasks students are trying to achieve. The course site operates unobtrusively in the background freeing the student to think about the content domain while completing an assignment without thinking about the computer-based tools. A tool is present-in-hand when it comes to the foreground (the user's awareness). This awareness of the tool happens when a breakdown occurs. Instead of being able to focus on the content domain, students must contend with how to operate course tools and navigate the course site.

As students navigate a course site that is ready-at-hand, the course site is transparent in a way that allows students to think about, concentrate their attention upon, and accomplish their learning tasks rather than how to operate the computer-based tools within the confines of the course site. Part of designing course sites for this kind of transparency requires that designers acquire an awareness of and anticipate the potential breakdowns that may occur and how they may be avoided. Although Winograd and Flores (1987) state that all breakdowns cannot be avoided by design, aids such as orientation videos and contextual online help can be designed to help students cope with usability issues.

Recent meta-analyses of distance learning (Abrami, Bernard, & Lou, 2004, Moos & Azevedo, 2009; U. S. Department of Education, 2009) by several different groups of researchers have examined studies of online learning from 1985 to 2006. Although distance education was compared to face-to-face instruction in terms of learner outcomes and achievement, self-efficacy, and the impact of the use of some media (specifically videos and quizzes) on learner outcomes, these studies did not look at either the usability or interface design of online courses, the focus of this study.

In this study the construct of usability was measured quantitatively in several ways. The first measure was a heuristic evaluation. These metrics were developed according to the conceptual framework of usability based on the work of Jakob Nielsen (1994, 2000, 2001, 2002, 2004). Nielsen (1994, 2000, 2002) developed a heuristic evaluation to be used by experts to evaluate the design of software or a web site in terms of design heuristics or “rules of thumb.” In this study two experts reviewed the six course sites using *The Xerox Heuristics Evaluation Checklist* (1995) to operationalize Nielsen’s (1994, 2000, 2002) heuristics. The second measure was a calculated task error rate. Students’ judgments of educational web site usability were measured quantitatively by the time it took for students to complete a task and the number of errors they made while attempting to complete tasks. These time and error measurements were used to calculate an error rate. This task usability error rate is a measure of the number of errors students made per minute while completing each task. The results of the two different usability measures were compared and courses were rank-ordered by their scores.

Student judgments about the usability of their course were also measured quantitatively by the scores of the post-course survey, *Student Evaluation of the Quality of Web-Based Instruction* developed by Stewart, Hong, and Strudler (2004). This survey was administered after the students completed their online course. Finally, the usability of course sites was measured qualitatively through students’ verbal reports during usability testing.

Research Methodology

The research problem of this study was to investigate the construct of usability in six online courses offered through one online and distance learning program at a large, public university in the Midwest. Students enrolled in the six courses were recruited for study participation using the official university class lists of registered students. Students enrolled in the six selected courses were contacted via e-mail, asked to participate in usability testing sessions, and to complete both a pre-course and post-course survey. A total of 30 students participated in the usability testing sessions and a total of 74 students completed both surveys.

Six courses which were designed and developed by different groups and presumed to differ in usability attributes were selected for study. The six courses were divided into two groups of three courses which were matched on subject matter but differed in development type. The first group of three courses, the professional development type, was developed by a group of professional online course designers and developers. The second group of courses, the nonprofessional development type, was developed by staff in various academic departments.

The study used mixed methods to collect both quantitative and qualitative data on the usability of six courses as perceived by students enrolled in each course. In the following section the quantitative and qualitative data collection methods are described.

The quantitative data was collected using four different instruments. First, the six selected courses were evaluated for their compliance to established usability guidelines, Nielsen's (1994, 2000, 2002) ten usability heuristics for web sites using a heuristic evaluation instrument, *The Xerox Heuristic Evaluation: A System Checklist* developed by Xerox Corporation (1995). *The Xerox Heuristic Evaluation: A System Checklist* developed by Xerox Corporation (1995) adds three additional heuristics, skills, pleasurable and respectful interaction with the user, and privacy to Nielsen's original ten. This heuristic evaluation was completed independently by two experts, the researcher and a professional colleague experienced in the design and development of online courses. Second, the *Computer User Self-efficacy Scale* (CUSE) developed by Eachus and Cassidy (2006), a pre-course survey, was administered to enrolled students in the six selected courses so participants could self-report their computer self-efficacy prior to taking the online course. Third, time/error data as measured by a time stamp log (time to complete tasks and errors made as students completed tasks, and the success or failure of the student to complete the task) were collected during the usability testing sessions in the usability lab. Fourth, the *Student Evaluation of the Quality of Web-Based Instruction* developed by Stewart, Hong and Strudler (2004), a post-course survey, was administered to enrolled students after completion of the online course to measure their satisfaction with their online course experience.

The qualitative data was collected in usability testing sessions in a high-tech usability lab located on the university campus. Usability testing sessions were conducted during the May intersession prior to the opening of the online courses (defined as the period of time before the course sites are "live" and registered students can access the online course materials) and the start of the summer session before student participants actually started their online courses. The qualitative measures, gathered as student participants completed course tasks, included think-aloud protocol data. The think-aloud protocol data were the verbal reports of what students actually said and reported they thought about each course site as they completed predetermined tasks. These data were recorded by the researcher as students completed tasks. Video, audio, and eye-tracking recordings of usability testing sessions captured all the events that occurred during each session. The summary interview data, the answers to open-ended questions asked at the conclusion of each testing session to give participants a chance to tell the researcher what was most important to them about each course site, were also collected at this time.

Findings

The findings of the research are organized by research question and summarized below.

Question 1: *What does the construct of usability mean from a student's perspective?*

Task usability error rates, mean error rates, mean task completion times, and standard deviations were calculated for each course. The courses were rank-ordered by the error rate and by mean task completion times. The results of rank-ordering the courses by mean task usability error rates showed that two of the professionally-developed courses were ranked in the top three most usable courses and Course 1 was ranked fourth out of the six courses. One of the nonprofessionally-developed courses, Course 5, was in the top three by usability as measured by error rates. The remaining two nonprofessionally-developed courses were ranked in the bottom third. The ranking of courses by the mean task completion times did not match the rankings by task usability error rate. Courses 3, 4, and 6 ranked in the first, second, and third by time, while Courses 2, 5, and 1 ranked in the lower half by mean time.

Analysis of the verbal report results from the usability testing sessions in the lab identified the following themes related to the construct of usability: assignments, messaging, content, language, exams, grades/grading, navigation, tools, the effect of prior experience, and the syllabus. Students were also asked to identify the easiest task, and the most difficult task. Guidelines for the design and development of educational web sites (i.e., online course sites) were derived and written from this data. The findings and conclusions of the verbal reports are summarized in the Recommended Educational Web

Site Guidelines presented later in this chapter. Detailed descriptions of the identified themes and conclusions are provided in Appendix G, Verbal Report Findings and Conclusions.

Question 2: *How do Nielsen's usability heuristics compare to students' judgments about instructional web sites?*

Students' judgments about usability as measured by the task usability error rate did not coincide with the results of the Nielsen's heuristic evaluation. The mean scores from the heuristic evaluations of the course sites as measured by *The Xerox Heuristic Evaluation: A System Checklist* (1995) and students' usability as measured by the mean task usability error rate were ranked. The correlation of courses rank-ordered according to the task usability error rate and the Nielsen's heuristic evaluation was analyzed using Kendall's tau (Kendall's tau = -0.06). These results show the degree of correspondence between these two usability rankings was negative and very low (Kendall's tau = -0.06). There was no relationship between the usability ranking of courses by Nielsen's heuristics and usability as judged by students.

As another measure of students' judgments of usability, the verbal reports were analyzed for themes, and the number of positive and negative comments students made during the usability testing sessions were counted. Comments were compared to Nielsen's heuristic categories and the positive and negative comments were mapped to each heuristic category. It was found that the number of positive and negative comments differed between the two groups of courses. The results of a Chi-square analysis between the two types of comments, positive or negative, were highly significant (X^2 = 95.36). For the professionally-developed courses with the highest heuristic evaluation scores there were 56.3% positive comments and 43.7% negative comments. For the nonprofessionally-developed courses with the lower heuristic evaluation scores, the comments were 17% positive and 83% negative.

Question 3: *Is computer self-efficacy related to students' perceptions of web site usability?*

Scores from the 20-item, Likert-based, pre-course survey, the *Computer User Self-efficacy Scale* (CUSE) developed by Eachus and Cassidy (2006) and the scores of students' judgments of web site usability as measured by the calculated task usability error rate were compared to analyze the relationship of student's computer self-efficacy and students' judgments of usability. Kendall's tau correlation was calculated to measure the degree of correspondence between the rank orderings of student self-efficacy and students' judgments of usability. The results of this analysis between self-efficacy and error rate was negative and very small (Kendall's tau = -0.19). Using students as the unit of analysis, a Pearson product-moment correlation was run between the computer self-efficacy mean scores and the task usability error rate mean scores (r = -0.097) (r^2. = 0.94%) (p = 0.62). The correlation between self-efficacy and error rate was very small, negative, and close to zero. Student self-efficacy was not related to students' judgments of usability as measured by task usability error rates.

Question 4: *Is web site usability related to student satisfaction with online courses?*

Using courses as the unit of analysis, the courses were rank-ordered by task usability error rate and compared to the student satisfaction scores. A Kendall's tau correlation of student satisfaction survey scores to usability as measured by task usability error rate found a small, negative, non-significant correlation between student satisfaction and error rate (Kendall's tau = -0.06). Using students as the unit of analysis (N=79), a Pearson product-moment correlation was run between the task usability error rate mean scores and student satisfaction scores (r = -0.013) (r^2. = 0.02%) (p = 0.95).

The courses were rank-ordered by Nielsen's heuristic evaluation score and student satisfaction scores. There was a slightly positive, but non-significant relationship between web site usability as measured by Nielsen's heuristic evaluation and student satisfaction scores. A Kendall's tau correlation was calculated to measure the degree of correspondence between the Nielsen's heuristic evaluation and student satisfaction scores rankings (Kendall's tau = 0.33). There was a slightly positive, but non-significant, relationship between web site usability as measured by Nielsen's heuristic evaluation and student satisfaction scores.

Question 5: *Is computer self-efficacy related to student satisfaction with online courses?*

The results of the computer self-efficacy and student satisfaction surveys were compared. Both surveys were completed by 74 common students. A Pearson product-moment correlation was run between the computer self-efficacy survey scores and student satisfaction using students as the unit of analysis. The results showed a slight positive correlation between computer self-efficacy and student satisfaction (*r* =0.15., r^2 = 2.25%) (p = 0.073).

Question 6: *Is course development type related to task error rate, Nielsen's heuristic evaluation score, and student satisfaction?*

The development type of the courses, professional or nonprofessional, was related to task error rate, Nielsen's heuristic evaluation scores, and student satisfaction. The task usability error rate results were related to course development type. After comparing the task usability rates of student testers in the usability lab (N=29) by professional or nonprofessional course development type using a t-test, the results were significant for both the one-tailed (p = 0.04). and two-tailed (p = 0.08) tests.

The Nielsen's heuristic evaluation score results were also related to course development type. Using the courses as the unit of analysis (N = 6), the heuristic evaluation mean scores were analyzed using a t-test. Both the one-tail (p = 0.026) and two-tail (p = 0.05) tests were significant.

Finally, student satisfaction was also related to course development type. After comparing the mean scores of the students who completed both the pre-course and post-course surveys (N = 74) by professional or nonprofessional course development type using a both ANCOVA and a t-test, the results were highly significant (p = 0.001). Students were significantly more satisfied with the professionally-developed courses.

Conclusions and Discussion

The following section provides the conclusions of the study based on student pre- and post-survey scores and student observation as they navigated the six course sites to complete course-related tasks.

The usability characteristics Nielsen found to be important for commercial web sites also apply to educational web sites. If usability is defined in terms of the learnability of the site, the efficiency with which users can accomplish tasks, the memorability of a site, the minimization of user errors, and the users' satisfaction with their experience using the site (Nielsen, 1993, 2000, 2002), these characteristics also apply to education where students main task is to learn course *content* rather than how to operate the technology. The application of Nielsen's heuristics to educational course site development helps produce a tool that is ready-at-hand and ready for learning.

As Winograd and Flores (1987) stated, students need a tool (course site) that is ready-at-hand. This type of course site operates unobtrusively in the background freeing the student to think about the content domain while completing their assignments without thinking about how to operate and navigate the course site. In contrast, a present-at-hand tool forces students' attention from the content being learned to course site operation.

The pre-course self-efficacy survey was not related to students' perceptions of web site usability. Students with higher self-efficacy were slightly, though not significantly, more satisfied with their online course experience. This could be the result of prior experience with online courses or greater experience with technology and the Internet in general. This conclusion can be explained by the possibility that a student who possesses high computer self-efficacy can enroll in a poorly designed online course and still have trouble with the usability of a poorly designed course. Even if a person has high computer self-efficacy, this personal belief does not change the usability characteristics of the course itself. The population of students in this study was mainly undergraduates. Their mean self-efficacy scores were lower than the mean scores reported in another study of students using the same survey instrument who had more experience; students who either received either computer training for the application being studied or were graduate students at the time of the survey administration (Eachus & Cassidy, 2002).

As Goto and Cotler (2002) and Wood (1998) state, site usability is defined as the way the user, in this case the student, *actually* navigates, finds information, and interacts with the site. In addition, a person can possess high computer self-efficacy and be expert in the use of different types of computer software, but they become novices again when confronting a new interface until they become familiar with the structure and navigation. This also applies to online course sites. Nielsen (2000b) stated users rarely spent enough time in a particular web site to become true experts of a site. However, the online course sites examined in this study became an exception to this statement as students continued to access and use the site over time. These online courses had assignments due each week which required students to log on frequently, at a minimum, once a week. The use of instructional materials housed in the course sites allowed students the opportunity to become more familiar with the information architecture of the course, the content, terminology used, and how the course tools worked. The concept of usability in this instance referred back to one of Nielsen's (1993) original five characteristics of usability, the learnability of the site. Learnability of an educational course site was important because it allowed the student to use the site more efficiently and effectively as it became more familiar through repeated use.

The post-course student satisfaction survey was not related to students' perceptions of web site usability as measured by task usability error rates. The lack of relationship in the findings between usability and student satisfaction may be temporally-based. The usability testing sessions were conducted prior to the opening of the courses. The error rate was measured prior to students gaining any experience with each course site, while the student satisfaction survey was administered at the end of the course. This time difference allowed students who were novices in the course site at the time of the usability testing sessions to become expert in the use of their course sites over the span of the semester. The post-course survey also measured multiple dimensions of students' experiences in their online course other than just error rates. Survey questions covered these dimensions: appearance and structure of web pages, hyperlinks and navigation, technical issues, class procedures and expectations, content delivery, quality of communication, and the presence of instructor and peers (Stewart, Hong, & Strudler, 2004). The survey questions organized in these dimensions covered not only the usability and technical aspects of the students' experiences with the course site, but also covered various social aspects of the course including the interactions between students and their classmates, instructor, the instructors' responsiveness to students, and instructor presence and communication with students. If these social aspects of the course were satisfying to the student and resulted in a higher satisfaction score, that could explain the difference in results.

As previously stated, the verbal reports gathered during the usability testing sessions revealed the importance of the organization and location of course content in students' perceptions of usability. Course site usability in this context rests on four assumptions that include: a focus on the student, students use a course site to be productive, students are busy people who are trying to accomplish tasks, and students decide when a course site is easy to use (Dumas & Redish, 1994).

Educational course sites need to be tools that are ready-at-hand (Winograd & Flores, 1987). Ready-at-hand course sites are usable in an unconscious, effortless way that allow students to stay focused on their tasks, support their ability to accomplish their tasks, and allow students to be productive. In contrast, course sites with poor usability are present-at-hand tools (Winograd & Flores, 1987). Present-at-hand course sites are difficult to use for a variety of reasons. Instead of enabling students to focus on their tasks, these sites cause students to focus on how to operate the course site, locate content, or use course tools rather than their learning tasks. Present-at-hand sites impede students' productivity and accomplishment of tasks in a timely manner. This violates one of Nielsen's (1993) characteristics of usability, learnability, and affects a second characteristic, efficiency. Students are busy people who often enroll in online courses due to the perceived time savings and comfort, (as compared to attending class on campus) two factors that have never played any role in traditional pedagogy (Peters, 2003).

To provide consistent organization and structure for all course web sites, the professionally-developed course group uses an information architecture based upon Nielsen's heuristics and other best practices in the field of information design (e.g., Tufte, 1990, 1997, 2001; Wurman, 1989, 1997, 2001). A description of the information architecture used for these courses is provided in Appendix F, Professionally-Developed Courses Information Architecture.

Using this information architecture as a blueprint for course development, the professionally-developed courses had a lower task error rate, higher Nielsen's heuristic evaluation score, higher student satisfaction scores, and a significantly higher number of positive comments than the nonprofessionally-developed courses. These study results mean that Nielsen's usability heuristics, a respected evaluation tool used primarily to measure the usability of commercial web sites can be used to evaluate instructional web sites and used to differentiate between levels of usability in the same way usability is judged by students.

Recommendations

Recommendations for Practice

This section discusses both the recommendations for practice and recommendations for research based on the outcomes of this study. The recommendations for practice to improve the usability of educational web sites include the Recommended Educational Web Site Guidelines and the Characteristics That Impede Usability in Educational Web Sites. These two sets of recommendations are based upon the observations made in the usability testing sessions. Following these recommendations to improve practice, the recommendations for research reflect the need to learn how to improve web site design to enhance students' ability to locate course content and to learn how instructors think about, develop, and use educational web sites.

This study contributes to the field of education by providing recommended guidelines for the design and development of educational course sites based upon the results of an empirical study of the usability of educational web sites and relating these guidelines to Nielsen's (1992, 200, 2002) widely accepted heuristics.

One of the key questions raised in this study was what does usability mean from the student perspective? What is effective, efficient design for student learning in online courses? One outcome of the study are the recommended guidelines written based on Nielsen's (1994, 2000, 2002) heuristics and students' verbal reports as they completed tasks within course sites.

Since this research study used Nielsen's heuristics as a framework for evaluating and talking about the usability of educational web sites, these thirteen heuristics served as a means of organizing the guidelines. The guidelines presented as an outcome of this study are a result of a comparison of Nielsen's heuristics as operationalized by *The Xerox Heuristic Evaluation: A System Checklist* (1995), the observations of students completing tasks in the usability testing sessions, and students' verbal reports as they completed tasks.

Nielsen (2003) defines usability as a "quality attribute" that indicates a web site's ease of use. The five characteristics that Nielsen (2003) uses to define usability are learnability, efficiency, memorability, errors, and satisfaction. In terms of quality, they answer the following questions concerning a site's usability:

- Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?

- Efficiency: Once users have learned the design, how quickly can they perform tasks?
- Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?
- Errors: How many errors do users make, how severe are those errors, and how easily can they recover from errors?
- Satisfaction: How pleasant is it to use the design?

These quality indicators also served as a rationale for the guidelines. These five characteristics represent the quality components which are intertwined with, and woven throughout, the Nielsen's heuristics used to organize the guidelines. The recommended guidelines are the specific characteristics which are present in an educational web site that is usable as defined by Nielsen's characteristics. For example, the first category of guidelines is based upon the heuristic "Visibility of System Status." The first guideline, "Begin each page with a title that specifically describes its contents. Use topic-specific, descriptive titles rather than Lesson 1, Lesson 1.1, Lesson 1.2…" is related to all five usability characteristics. First, this guideline is related to learnability. Clear titles for content make it easier for users to accomplish basic tasks the first time they encounter a design. Second, it is also related to efficiency. Clear titles allow the user to perform tasks more quickly. They can see the titles of the content they want to access. Third, clear titles are related to memorability. Users are more proficient in accomplishing tasks when they return to a site if the content they want to access has a clear title. Fourth, clear titles prevent users from accessing incorrect content, thus preventing errors. Fifth, a web site that labels content with clear titles is more pleasant to use because it avoids wasting the users' time as they open the wrong links. This contributes to user satisfaction. This example is representative of the way Nielsen's (2003) five characteristics were used to write the guidelines. The recommended guidelines written from the empirical results of the usability testing sessions are presented in Table 22.

Finally, the researcher compiled a list of the consequences of poorly designed course sites based on her observations in usability testing sessions. These consequences describe the difficulties students experience as they attempt to accomplish course-related tasks and the educational impact of the consequences of poor educational web site design. The information in Table 23, Characteristics That Impede Usability in Educational Web Sites, is based upon the observations made in the usability testing sessions. The table is organized by the same themes identified by students' verbal reports that have been used throughout this thesis. The difference in the information presented in this table is the negative viewpoint. The table identifies the elements which are missing in a course site that students find difficult to use. The table pairs these absent elements with the educational impact on students that occurs when they are not included in a course site and cause usability problems.

Table 22

Recommended Educational Web Site Guidelines

Nielsen Heuristic	Educational Web Site Guidelines
Visibility of System Status	• Begin each course page with a title that specifically describes its contents. Use topic-specific, descriptive titles rather than lesson 1, Lesson 1.1, Lesson 1.2… • Use consistent page organization, headers, titles, and icons between pages. If the course site has a table of contents left navigation bar, arrange the pages in the same order across the course. • Make frequently used tools such as the grade book or Assignments Tool visible to the user. Don't hide them under "More Tools." • Use consistent language and a controlled vocabulary to refer to the same type of page or document. For example, use the terms exams, quizzes, assignments or assessments consistently to describe each type of activity. • Use terminology that matches the users' task domain. • Provide an indication when the system is working. For example, a status bar that tells students when a document is uploading and the remaining percentage. Or a visible change that indicates when an icon has been depressed or a link visited. • Avoid long pages which hide the majority of the information beyond the bottom of the page and require students to scroll through long passages. This breaks two usability heuristics. Students should be able to see the information available on each page and what choices for action are available. Break the text up into brief chunks on separate pages so students can locate information. • Avoid long, unbroken passages of text. Students skim web pages rather than read them.
Match between System and the Real World	• Use consistent page organization, headers, titles, and icons between pages. If the course site has a table of contents left navigation bar, arrange the pages in the same order across the course site. • Combine all interdependent pages, documents, and forms to complete a task in one location. • Use terminology is familiar to the user. Page, heading, titles, and categories need to use terms with meanings which are easily understood by users. For example, students in this study were unfamiliar with the concept of a "proctored" exam and unsure of the steps they needed to take to ensure they could complete the exams. • Ensure that dates on course pages are current and not from previous semesters. • Ensure that the instructor name on the site matches the current course instructor. • Organize content to match user expectations. • Provide instructions for an assignment in the Assignments Tool. • Provide a course calendar with assignment due dates. • Place all course materials on a single course site rather than breaking content up over several sites.

Table 22, continued

Recommended Educational Web Site Guidelines

Nielsen Heuristic	Educational Web Site Guidelines
User Control and Freedom	• Make course content menus shallow and broad so that menu options are visible. • Support movement between fields and dialogue box options. • Allow students to move ahead or back when answering questions.
Consistency and Standards	• Use consistent formatting within course site. • Organize content consistently between pages. • Use consistent menu titles within menus, between menus and pages, menus and downloadable documents,
Help Users Recognize, Diagnose, and Recover from Errors	• Provide clear, unambiguous instructions on how to use unfamiliar site features. • Provide clear, unambiguous instructions on how to download, install, and run all software required for course assignments.
Error Prevention	• Provide clear due dates for assignments. • Provide clear instructions for assignment submission. • Simplify assignments. Break them into smaller segments that can be completed in stages over the semester. • Advise students to download assignment forms and work locally. • Advise students to save their work frequently and back it up.
Recognition Rather Than Recall	• Use system-wide conventions for styles. • Use stylistic conventions for orienting formatting options. • Use cultural conventions for providing horizontal or vertical content (i.e., reading left to right, top to bottom or vice versa). • Use system-wide conventions for active button locations. • Provide content in an uncluttered layout—use white space. • Use white space to break up content logically. • Provide good contrast between background and text colors and intensity. • Provide mapping between actions and controls. • Group content used together in the same location. • Provide instructions for assignments in the Assignments Tool.
Flexibility and Minimalist Design	• Provide alternate means of access for novice and advanced users. • Allow students to go forward and back within multimedia presentations, forms, or database fields. • Provide downloadable (.pdf) copies of slides in a Breeze presentation. • Provide internal links between course pages. • Provide downloadable audio files.

Table 22, continued

Recommended Educational Web Site Guidelines

Nielsen Heuristic	Educational Web Site Guidelines
Aesthetic and Minimalist Design	• Provide all necessary information to complete a task on the same screens. • Keep content titles brief, yet clear. • Avoid clutter. • Provide images that clarify content.
Help and Documentation	• Provide help and documentation. • Provide context sensitive help. • Provide directions for obtaining and setting up software programs necessary to run the course site and complete course tasks. • Provide access to institution-wide technical support. • Provide access to course management system specific technical support to instructors and students using educational web sites. • Format downloadable forms identically to related online content. • Provide additional information for ambiguous labels (i.e., rollover explanations or definitions). • Provide instructions that follow the users' task sequence. • Provide complete information so users may complete tasks. • Provide way-finding cues (i.e., breadcrumbs). • Provide easy access to and return from help. • Provide an orientation tutorial. • Provide instructor training.
Skills	• Provide links to support materials (e.g., a tutorial for software used in course assignments) • Provide multiple levels of detail to support both novice and expert users.
Pleasurable and Respectful Interaction with the User	• Use pleasing, clear icon designs. • Use color with discretion. • Use color to draw attention, communicate organization, establish relationships, and indicate status changes.
Privacy	• Use passwords to protect course sites and abide by FERPA regulations. • Inform students if the course assignments use publicly accessible online spaces (i.e., an institution-wide wiki, chat, or blog space.) • Remind students that comments posted in the discussion areas are meant for class participants only.

Table 23

Characteristics That Impede Usability in Educational Web Sites

Characteristic	Educational Impact
Assignments	
• Inconsistent terminology/labeling links and content between pages in the site	• Student must search through multiple links to find content to complete lesson
• Multiple assignment deadlines located on various course pages	• Student must look at different course pages to find assignment deadlines, may miss one
• Lack of a master calendar/schedule that shows all deadlines and deliverables	• Student must look at different course pages to find assignment deadlines, may miss one
• Difficulty locating assignment guidelines/requirements	• Student unable to complete assignment according to guidelines
• Inability to download assignment forms	• Student unable to use correct form to complete assignment
• Incomplete or unclear instructions for assignment submission	• Student unable to submit assignment, may miss deadline
• Directions for assignments located on multiple pages	• Student must search through multiple pages to find all assignment directions
• Lack of assignment descriptions in assignments tool	• Student must exit assignments tool to complete assignment; must look at different course pages to find assignment
Content	
• Inconsistent terminology/labeling of links and content between pages in the site	• Student must search to find needed content
• Incorrect dates (i.e., previous semesters and years) on content pages	• Student unsure if content is correct for their class
• Unconventional labeling of content (i.e., Module 0)	• Student may skip opening link due to unclear content
• Not labeling content links by subject matter topic	• Student must search through multiple links to find content to complete lesson
• Inconsistent location of content on pages	• Student must search to find needed content
• Long pages of text without headings to label section content	• Student must scroll and read more text to find needed content
• Difficulty locating FAQs and Help	• Student may be stuck and not get the help they need to problem-solve
• Difficulty in downloading all files of a specific type to print (i.e., lessons, audio, slides)	• Student may be forced to use content online; unable to take away from computer
• Mentioning content in the syllabus but not linking to it directly	• Student must search to find needed content

Table 23, continued

Characteristics That Impede Usability in Educational Web Sites

Characteristic	Educational Impact
Exams	
• Difficulty locating the content covered on the exam	• Student must search to find needed content
• Difficulty locating the exam	• Student must search to find needed content
• Not locating all exam information together in one place	• Student must search to find needed content
• Not making the exam deadline prominent	• Student may miss exam deadline
• Proctored exam: location of unclear	• Student may miss exam by not knowing location
• Proctored exam: meaning of term unclear	• Student may misunderstand exam requirements
• Proctored exam: scheduling procedure unclear	• Student may miss exam due to not scheduling exam
• Proctored exam: off-campus procedure unclear	• Student may miss exams by not knowing how to schedule off-campus
Messaging	
• Not placing instructor's contact information in plain view	• Student may be unable to contact instructor in timely manner
• Not clarifying e-mail protocol, which program to use	• Student may use incorrect program; message may be lost
Multimedia	
• Not providing a separate link to multimedia content	• Student may have to search through lesson links to find multimedia content
• Not placing all multimedia content in a separate folder for downloads	• Student may have to search through lesson links to find multimedia content
Navigation	
• Lack of internal page links to facilitate navigation between content pages	• Student would have to return to main page to navigate through links
• Unclear terminology/labeling of links	• Student must search through multiple links to find content
Tools	
• Not making all tools used in the course visible in the toolbar	• Student must search to find correct tool

Recommendations for Research

The most difficult task for students in this study was locating content within the course site. Students' comments indicated that the language used to label links made it difficult for them to know before clicking on a link the information they might access. Consistency in language use and organization of course materials is of key importance. What terms do students expect to see used in course sites to describe educational materials so they can locate online materials easily? Students know what to expect in the classroom through years of experience. Designers need to have a controlled vocabulary for online learning so students may become familiar with these concepts. Researchers need to find out what expectations students have in terms of the language used to label links. What cues would help students intuit which materials are hidden behind links? However, any time students are entering a new field of study, they must necessarily first learn the language of a new domain. Designers may need to work with instructors and subject-matter experts to develop a progressively controlled vocabulary that builds on students' gradually developing expertise in a domain.

Given the increased number of online courses being developed as the demand for distance education continues to grow, further research needs to be conducted to learn how instructors think about, develop, and use educational web sites. Few instructors have the training to develop sites or the support of a professional development group for their online courses and are unsure of how to proceed as they design online course offerings (Alley & Jansak, 2001; Bonk & Zhang, 2008; Katz, 2008). This recommendation for further research also reflects the findings of Tallent-Runnells, et al (2006) concerning the need for research in the area of “appropriate and excellent course design and development” (p.117).

As stated in the beginning of this paper, ultimately, it is the user, student, or instructor, rather than the designer, who is the best judge of the usability of an educational web site. Therefore, it is important to understand how students perceive and use educational web sites so they can be designed and developed to best support students’ learning tasks.

Glossary

Aesthetic and Minimalist Design: Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Apparent usability: Apparent usability is related to the aesthetic appeal of a web site as opposed to the inherent usability which is related to its functionality.

Breakdown: Any interruption in the smooth, unexamined flow of action.

Consistency and Standards: Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Controlled vocabulary: A style guide used to prescribe the terminology used in the design and development of a product. A controlled vocabulary limits the number of natural and spoken language terms used. Its purpose is to ensure consistency in both the vocabulary and its usage in specific content. It is related to Nielsen’s Consistency and Standards heuristic.

Course Management System: A software program for organizing online course content that is composed of an array of tools for the creation and housing of an online course. The course tools included lesson or module folders, discussion areas that may be set up for the whole class, student groups, or private areas between instructor and students. The assignment tool or assignment drop box provides a place for students to submit their work and keeps a record of the submissions. The assessments tool may be configured in various ways for different types of quizzes or exams. Assessments may be automatically graded and recorded in the course grade book. Students may access the grade book online to monitor their progress. Finally, the course site is password protected so it may only be accessed by students registered in the course.

Course Site: The password-protected web site containing the contents of the course including (i.e., syllabus, course materials, course content, exams, PowerPoint slide presentations, UMConnect presentations, assessments, quizzes, surveys, laboratory exercises, discussion area, whiteboard, chat, private group areas). A course site may be constructed in HTML or using HTML be housed in a course management system (CMS).

Error Prevention: Even better than good error messages is a careful design which prevents a problem from occurring in the first place.

Eye tracker: The Tobii 1750 monitor is eye tracking equipment that periodically illuminates the users' eyes from a distance of 60 cm. (approximately 24 inches). It appears in the lab as a large computer monitor. The light that illuminates the users' eyes is not noticeable to the user as they complete tasks because it is outside the human visible spectrum. A camera in the Tobii 1750 monitor “sees” reflections from the users’ eyes while they look at the screen. These reflections appear as golden yellow highlights on the screen, illuminating exactly where the student is looking at any point in time.

Before an eye-tracking recording is made, the monitor is calibrated to each users’ eyes. The user is asked to look at a series of dots at various locations on the screen of the Tobii 1750 monitor as part of the calibration process for the eye tracker. This calibration “teaches” the eye tracker how the eyes of a particular person look and behave. This calibration usually takes less than a minute.

Eye tracking: A usability research method using eye tracker equipment to track where the student moves their eyes on the computer screen as they look at a particular portion of the screen. Eye tracking highlights (in this case study with a golden yellow color) the area of the students’ central direction of gaze. Simply speaking, eye tracking shows exactly where the student is looking on the screen as they respond to a specific task via the special eye tracker monitor. Therefore, tracking students’ eye movements, allows the researcher to follow along the students’ path of attention. This gives the researcher insight into where the student looks on the course site to find the information that enables them to complete each task. Eye tracking also reveals what words or areas drew their attention, what conventions students expect to aid them in navigating the site (i.e., a left navigation bar) and provides clues as to how that person perceives the course site (i.e., does the student keep looking in the same area of the screen for a particular link?)

Flexibility and Minimalist Design: Accelerators-unseen by the novice user-may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions. Provide alternative means of access and operation for users who differ from the “average” user (e.g., physical or cognitive ability, culture, language, etc.).

Help and Documentation: Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. This information should be easy to search, focused on the user’s task, list concrete steps to be carried out, and not be so large that it is difficult for the user to find the help that they need. Help may also be contextual; related specifically to the screen location or task the user is trying to complete.

Help Users Recognize, Diagnose, and Recover From Errors: Error messages should be expressed in plain language (i.e., no codes).

Heuristic: A rule of thumb that often helps in solving a certain class of problems, but makes no guarantees. (Perkins,1981). A recognized set of usability principles, in this study specifically defined as Nielsen’s (1993, 1994, 2000, 2002) heuristics.

Heuristic Evaluation: A usability engineering method which utilizes a small number of evaluators to find usability problems in a particular interface. The usability of the interface is measured against its compliance and adherence to heuristics, a recognized set of usability principles. The advantage of a heuristic evaluation is that it finds a high percentage of the usability problems using this small of users and therefore, it can easily be used during the iterative development phase of a course site. In this study, the heuristics being used for the evaluation were authored by Jakob Nielsen (1994), an internationally recognized usability expert.

Horizontal Information Seeking: A form of skimming activity where people view just one or two pages. (*Information behaviour of the researcher of the future*. January 11, 2008)

Information architecture: A series of course components standardized within a group of courses developed by a specific production group. These components may include specific organizational, labeling, structural, visual, and navigational elements designed to support course usability and a distinctive, recognizable “look and feel” for a group of course sites.

Information design: How information is presented and structured for a particular application. In this study, specifically how the information in a course web site is presented and structured.

Inherent Usability: The functional usability of a web site as opposed to the site’s apparent usability which is related to its aesthetic appeal.

Match Between System and the Real World: The system should speak the user’s language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

Pleasurable and Respectful Interaction with the User: The user’s interactions with the system should enhance the quality of her or his work life. The user should be treated with respect. The design should be aesthetically pleasing- with artistic as well as functional value.

Privacy: The system should help the user to protect personal or private information belonging to the user or their clients.

Recognition Rather Than Recall: Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Skills: The system should support, extend, supplement, or enhance the user's skills, background knowledge, and expertise—not replace them.

System-centered research: Research which observes the goal-directed development of new hypertext systems and the technical aspects of the implementation of these new systems.

Usability: Usability is a quality attribute that assesses how easy user interfaces are to use. The word "usability" also refers to methods for improving ease-of-use during the design process. According to Nielsen, usability is defined by five quality components:

Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?

Efficiency: Once users have learned the design, how quickly can they perform tasks?

Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?

Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?

Satisfaction: How pleasant is it to use the design?

Usability Engineering: A field of research and design with the goal of improving interactive systems and their corresponding user interfaces.

User: The person who uses the web site; in this study, the student registered in the course.

User Control and Freedom: Users should be free to select and sequence tasks (when appropriate), rather than the system selecting and sequencing tasks for them. Users often choose system functions by mistake and make errors; they need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Users should make their own decisions (with clear information) regarding the costs of exiting current work. The system should support undo and redo.

Visibility of System Status: The system should always keep user informed about what is going on, through appropriate feedback within reasonable time.

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Appendixes

Appendix A Study Forms

IRB Approval Letter

Date:04/17/2007
To:Kim, Ballard (balla007@umn.edu)
From:irb@umn.edu Subject:approval letter
Message: 04/16/2007 Joyce K Ballard CCE-Learning Technologies 540 Rarig Center Minneapolis Campus RE: "Web Site Usability: A Case Study of User Perceptions of Educational Web Sites"
IRB Code Number: 0704P05801
Dear Ms. Ballard:

The referenced study was reviewed by expedited review procedures and approved on April 16, 2007. If you have applied for a grant, this date is required for certification purposes as well as the Assurance of Compliance number which is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA 00004003). Approval for the study will expire one year from that date. A report form will be sent out two months before the expiration date. IRB approval of this study includes the consent form and recruitment materials received April 11, 2007. Please note that due to evolving guidelines, the following items are required on each page of the consent form: human subjects code, correct pagination and consent form version date. This will be required at the time of continuing review. The IRB would like to stress that subjects who go through the consent process are considered enrolled participants and are counted toward the total number of subjects, even if they have no further participation in the study. Please keep this in mind when calculating the number of subjects you request. This study is currently approved for 360 subjects. If you desire an increase in the number of approved subjects, you will need to make a formal request to the IRB. The code number above is assigned to your research. That number and the title of your study must be used in all communication with the IRB office. As the Principal Investigator of this project, you are required by federal regulations to inform the IRB of any proposed changes in your research that will affect human subjects. Changes should not be initiated until written IRB approval is received. Unanticipated problems and adverse events should be reported to the IRB as they occur. Research projects are subject to continuing review and renewal. If you have any questions, call the IRB office at 612-626-5654. On behalf of the IRB, I wish you success with your research.

Sincerely,

Cynthia McGill,

CIP Research Compliance Supervisor

CM/egk

CC: Judith Lambrecht

Recruiting E-mail for Usability Testing in the Lab

Dear [Name of online and distance learning program student]:

Thank you for your participation in the survey portion of this study. I am now looking for a subset of the students who completed the survey to participate in the usability assessment of the course. On [**month and date**], I will be conducting a research study which includes a usability assessment to obtain information on how students judge the usability of online courses offered by the Bachelor of Applied Science (BAS) program.

I am looking for several **students currently enrolled in your online class,** to give me their opinion of how they use and rate the course site while actually using the course online. Your perspective is extremely valuable, and your assistance will help me to identify aspects of the online course design that work well and what needs improvement. This is a valuable contribution to the course design process. To express my appreciation for your participation, I will be giving you an honorarium gift of $50.00, pay for your parking during your testing session, and provide free refreshments.

If you are interested in sharing your reactions to the course design, please include the code **Class Designator-XXXX** in the subject line of your reply to this e-mail, and answer the questions at the end of this e-mail.

Additional Information

On [**DATE and DATE**] I will be evaluating the online course site for **Class Designator-XXXX** in the Usability Lab. These evaluations provide data for a user-centered approach to the design of online courses. As a participant for this study, you will be asked to complete tasks similar to what you do as a student in the online course. These activities are related to the content and organization of the course web site design. Usability team members will observe your process and interview you about your opinions on how the web site should be organized as you use it. You will be asked if you are willing to participate in the eye-tracking portion of the study. Eye-tracking is a way of monitoring and recording where you look at the screen as you complete course tasks. We usually make audio and video recordings of the usability testing sessions so we can remember the details of each session. Usability testing sessions in the lab lasts approximately ninety-minutes.

Your participation and information about you will be kept strictly confidential within the usability team, and you will not be identified in any reports about the organization of the course web site design. Any audio/video recordings will only be viewed by the usability team and will be destroyed when they are no longer needed.

When?

We are currently seeking student evaluators for **DAY, DATE** and **DAY, DATE.** We anticipate that an appointment will take approximately 90 minutes of your time. Here are the available times:

Day, Date

8:30 a.m. – 10:00 a.m.

10:15 a.m. – 11:45 a.m.

1:00 p.m. – 2:30 p.m.

2:45 p.m. – 4:15 p.m.

Day, Date

8:30 a.m. – 10:00 a.m.

10:15 a.m. – 11:45 a.m.

1:00 p.m. – 2:30 p.m.

2:45 p.m. – 4:15 p.m.

Where?

The evaluation sessions will take place at the University's usability lab, B18 Walter on the East Bank of the Minneapolis campus. At the time I confirm that your appointment is scheduled, I will provide you a specific appointment time and directions to the lab. If you drive to your appointment and park in one of the hourly parking ramps, I will validate your ramp ticket so your parking will be free.

Honorarium Gift for Evaluators

I greatly appreciate that you are willing to provide feedback about the usability of course web sites. Your help provides a significant benefit to the University community, and I would like to express our gratitude with an honorarium of $50.00. There will also be free refreshments in the reception room that you may bring into your session.

Please let me know if you can help us with this project by replying to my e-mail. Please reply as soon as possible. When we are able to schedule you for an appointment, we will send you specific details and directions.

To sign up:

Just reply to this message with answers to all of the following questions:

1. The Code: **Class Designator-XXXX.** Make sure this is in the Subject line of your e-mail
2. Your name (first and last).
3. The appointment times that you are available for (please type your initials after your preferred times in the list above.)
4. Your e-mail address.
5. Your phone number(s)—used for appointment follow-up only.
6. Is English your native language? Yes/No

I look forward to hearing from you and hope that you can participate.

Sincerely,

Kim Ballard

Doctoral Candidate

Curriculum and Instruction

kballard@cce.umn.edu

612-625-3710

Consent Form

You are invited to participate in a study that will examine how students enrolled in online courses at the University judge the usability of course sites in the online and distance learning program at the University.

This study is being conducted by Kim Ballard, Doctoral Candidate in Learning Technologies, Department of Curriculum and Instruction at the University of Minnesota.

Background Information:

As distance education has moved from traditional, correspondence courses to online educational web sites, it becomes important to look at the usability or "ease of use" of these instructional web sites from a student's perspective. The course site design that seems "easy to use" and understand by the person who designed it may in fact, be difficult for students to navigate, find, and access required course materials, and to know how to complete and submit assignments. This case study is designed to explore what the construct of usability means for students taking online courses. Usability, or ease of use, is a construct resulting from the interaction of software design and the expectations of users. The purpose of the study is to use the resulting understanding of usability to provide guidelines for designing online courses.

Procedures:

This study is divided into two phases. The first phase is the completion of two online surveys. All students currently enrolled in the selected online and distance learning program courses are being asked to participate in the survey completion phase of the study. The second phase involves student testing of the course site in the Usability Lab. A subset of the first group of students will be asked to participate in usability testing phase.

If you agree to be in the first phase this study, participation would entail the completion of two online surveys. The first survey asks questions concerning your level of comfort in using computers and your feelings about your ability to successfully complete an online course. The second survey asks questions concerning the quality of, and your satisfaction with, the online course in which you are currently enrolled. These surveys will take approximately 20-30 minutes each to complete.

If you agree to participate in the usability testing portion of this study, you will be asked to come to the Usability Lab for a testing session that will last approximately 90 minutes. During this session you will be asked to read a scenario and complete course-related tasks. You will also be asked to “think-aloud” or say aloud what you are thinking as you complete each task. You may be asked to participate in “eye-tracking.” The eye-tracking equipment records where you look on the screen as you complete the tasks. An eye-tracking specialist will explain to you how the equipment works and calibrate the eye-tracking equipment to your eyes. This involves you looking at a series of dots on the computer screen for one to two minutes. No equipment comes in contact with your eyes during either the calibration or the eye-tracking test. In fact, you will not be aware of the eye-tracking portion of the test since a light outside of the visible spectrum is used to record where you are looking on the computer screen as you work.

Risks and Benefits of Participation in the Study

The study has minimal risks associated with participation. The risks of responding to two survey instruments are a common part of being in an instructional setting. Your survey scores will be kept confidential using an ID code so no one will be able to match specific scores to individual students. If you are participating in the usability testing part of the study, the recording of your computer session will be similar to other observations of student work. However, you may feel some embarrassment or awkwardness while using the course site in the Usability Lab while being observed, thinking aloud (saying aloud what you are doing) as you complete tasks, or answering the Summary Interview questions at the end of the session.

Students, faculty, staff, and administrators at higher education institutions that offer online courses are potential beneficiaries of this study, since its goal is to understand how students actually use and perceive elements within online courses. This research promises to provide important insights into student judgments concerning the usability of online courses. Participants in this study may not benefit directly.

Compensation:

There is no compensation for participating in the online survey other than the satisfaction of voicing your opinion and knowing that your responses to the surveys will help improve the online courses offered through the online and distance learning program.

There is a $50.00 honorarium for participating in the usability testing portion of the study and your parking will be paid for the time you spend in the Usability Lab. Free refreshments will also be available to you during your usability testing session.

Confidentiality:

The records of this study will be kept private. You will not be identified in any reports published about the study. Research records and recordings of usability testing sessions will be password protected and stored securely. Only Kim Ballard and her dissertation advisor Professor Judith J. Lambrecht will have access to the records.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University or the researcher. If you decide to participate, you are free to withdraw at any time or decline to answer any question. Your withdrawal or decision to not answer any question will not affect your relationships with the University.

Contacts and Questions:

The researcher conducting this study is Kim Ballard. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact the researcher at: Kim Ballard, 540 Rarig Center, 330 21st Ave. S., Minneapolis, MN 55455, 612-625-3710, kballard@cce.umn.edu or her advisor, Professor Judith J. Lambrecht, 612-626-1256, jlambrec@umn.edu

If you have any questions or concerns regarding this study and would like to talk to someone other than the researchers, **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St., SE, Minneapolis, MN 55455; 612-625-1650.

You will be given a copy of this information for your records.

Statement of Consent:

I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature____Date_______

Signature of Investigator___________________________ Date____________

Participant Information Usability Lab Equipment

Computer Use

You will use a computer, monitor, keyboard, and mouse to access the course web site and complete the research tasks.

Video Recording

The testing room has two cameras. One is used to record your facial expressions and the other is used to record your actions on the keyboard and with the mouse. You will be informed if a video recording is being made of a usability session.

Voice Recording

The testing room has two ceiling microphones and one desk microphone used to record your comments during a usability session. You will be informed if a voice recording is being made of a usability session.

Screen Recording

The monitor screen, which shows what you do as you complete tasks, may be recorded during your usability session. You will be informed if a recording is being made of your computer screen.

Eye-Tracking Recording

When eye-tracking is included in usability testing, it is used to record where the participant is looking on the computer screen.

You will be informed if an eye-tracking recording is being made during your usability session. Before an eye-tracking recording can be made, the usability consultant will ask you to look at a series of dots on the screen of the Tobii 1750 monitor as part of the calibration process for the eye-tracker. This calibration "teaches" the eye-tracker how the eyes of a particular person look and behave. This calibration usually takes less than a minute.

When eye-tracking is activated, the Tobii 1750 monitor periodically illuminates your eyes from a distance of 60 cm. (approximately 24 inches). The light will not be noticeable to you because it is outside the visible spectrum. A camera in the Tobii monitor "sees" reflections from your eyes while you look at the screen.

The manufacturer of the eye-tracker has provided the University of Minnesota with technical documentation that assures us that the Tobii 1750 monitor is very safe for long-term usage and does not present any hazard to the person whose eyes are being tracked. The Usability Laboratory Manager will provide copies of this documentation to participants upon request.

Please initial this document to indicate that you have read how the equipment in the Usability Lab works and that you agree to its use in the research being performed.

Participant's Initials ______________________

Evaluator Briefing Script

1. **Agreement Form**: You just completed our agreement form for usability evaluators. Did you have any questions about anything on the form?

2. **Informed Consent Form**: Please read the informed consent form carefully and be sure to ask any questions you have about the study.

3. **Purpose of Test**: Usability Services helps design teams make their web sites and applications as intuitive and easy-to-use as possible from the user's perspective. So we bring users in to try out the design early on and tell us what they think–what's easy to use, what's difficult, so that web sites may be improved through your feedback.

4. **Software Introduction**: We've invited you here today to help us evaluate the design of the online course (Course name). As part of the evaluation, please fill out this survey to help me understand your experience with computers and the Web. I will ask you to fill out another survey later after you finish your course to tell me your thoughts about your experience taking this online course.

5. **Typical tasks / Think Aloud Protocol**: So you have some context for evaluating the course design, I'll give you some typical tasks that students would normally do as part of taking this online course. As you complete these tasks, I want you to think out

loud while you're doing each one and give us your impressions as you go along.

Example: For example, if you wanted to buy a specific DVD on the amazon.com web site, to think aloud as you complete this task you might say:

> "I'm on the Amazon.com web site.
>
> I want to purchase the DVD for the movie Star Wars.
>
> The first thing I need to do is find the movie.
>
> I go up to the Search box and type in "Star Wars" and hit "Enter" on my keyboard.
>
> Now I'm on the Star Wars page that includes both DVDs and books.
>
> I just want to look for DVDs so I will hit the DVD link.
>
> There are a bunch of different Star Wars DVDs, so I am going to look through them to find the one to purchase."

6. **User Bill of Rights**: You read your Bill of Rights? Did you have any questions about it?

    - The most important thing to remember is that you are evaluating the course design—you are not being evaluated.

    - We don't expect people to know how to use the course design. That's why we're asking you to test the course before it begins. Although there may be problems with the design, but you can't do anything wrong.

- If you have any trouble using the course, that actually helps us to identify usability issues so our team can improve the design for students. Your feedback helps us make better design decisions.

7. Other things you need to know:

- You're here voluntarily, and you can leave whenever you need to—just let me know. If you need to take a short break for a few minutes, that's fine too. Just let me know and I'll make sure the outside door is kept open for you.
- The usability team will be observing your session and we'll be making audio and video recordings. But your participation is confidential with the usability team, audio and video recordings which could identify you will be kept confidential, and notes and reports about the evaluation will not reveal your identity. Instead of your name, the data resulting from your session will be given a unique code that does not have any personal identifying information.
- We're also going to use our eye-tracker so the usability team can see where you're looking on the computer screen. The eye-tracker will show the usability team where you are looking on the computer screen with a blue dot.
- The other thing you need to know is that it's possible you could get into a part of the course. If that happens, or if you feel you're stuck and you've already tried to figure out what to do on your own, you can call a Help Desk at 5-4364 to ask questions. (not a real Help Desk)

- Is everything set up okay for you at the computer—chair a comfortable height, the mouse on the right side for you?
- The first thing we need to do is to set up our eye-tracker so it can "see" your eyes and where you're looking on the screen. It takes just a couple minutes to calibrate the eye-tracker and then it will recognize your eyes when you're looking at the screen.
- Bring up the eye-tracker status screen and adjust the position of the monitor
- Start the calibration process
- "A number of blue dots will appear on your screen. Just focus on each blue dot when it appears."
- If recalibration is necessary:
- "I'm going to show you a couple more dots. Just focus on each blue dot when it appears."
- Verify the calibration process:

  "I'm going to show you a "Where's Waldo" type of picture"

  "Look at the lion in the upper right hand corner"

  "Look at the seal with the ball on his nose on the right"

  "Look at the big tan dog in the lower right"

  "Look at the small white dog on the lower left"

  "Look at the man throwing a ball at the milk bottles in the center"

  "Look at the big sign for cotton candy in the upper left"
- If the calibration is not good:

- Tell the evaluator that we're ready to start
- We'll ignore the live gaze-tracking in the observer room

Start the process: (** when there is a written task and a "think out loud" method)

"Okay, we're ready to start"

"Here's your next task… in this task, we want you to remember to think out loud. You can start by reading the task out loud, and just keep giving us your thoughts about what you're looking for and what you think of the design as you go along.   I'll be going in the other room, so just say out loud when you've finished the task and I'll come back at that time to ask you some questions and to set up the next task."

If the evaluator has concerns about the eye-tracker in the evaluation room:

- Show the evaluator the "Information for Evaluators about the Usability Lab Equipment"
- and assure the evaluator that the eye-tracker is considered very safe
- If the evaluator wants a copy of the Tobii technical documentation, provide them with a
- packet of that documentation, but tell the evaluator that if he/she isn't comfortable with the idea of eye-tracking, then we won't use it on his/her evaluation session.

Appendix B

Summary Interview Questions

1. What is your overall impression of the course site?

2. What do you like about the course site?

3. What do you dislike about the course site?

4. What was easy for you to do?

5. What was the most difficult for you to do?

6. To improve the course site, what changes would you make?

7. What is the single most important change you would make?

Appendix C

Usability Analysis Data

Table 24

Usability Analysis Data: Course 1

	Task 1				Task 2				Task 3				Task 4			
Student	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate
1	1	1:56	1.93	0.52	1	3:32	3.53	0.28	2	2:34	2.57	0.78	0	0:05	0.08	0
2	0	1:36	1.6	0	1	3:00	3.00	0.33	4	6:11	6.18	0.65	0	1:18	1.3	0
3	0	0:17	0.28	0	1	1:19	1.32	0.76	2	3:00	3	0.67	0	0:10	0.17	0
4*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	0	3:36	3.60	0	1	5:07	5.12	0.20	0	4:32	4.53	0	0	0:18	0.3	0
6	0	1:25	1.42	0	0	5:16	5.27	0	0	3:03	3.05	0	0	0:04	0.07	0
Sum	1		8.83	0.11	4		18.24	0.22	8		16.28	0.49	0		1.92	0

* Student 4 The time/error log malfunctioned and did not record any times

Table 24

Usability Analysis Data: Course 1, continued

Student	Task 5				Task 6				Task 7				Course Totals		
	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Total Errors	Total Time	Error Rate
1	2	2:36	2.6	0.77	0	1:12	1.20	0	0	3:06	3.10	0	6	15.01	0.40
2	0	0:04	0.07	0	0	4:35	4.58	0	0	1:03	1.05	0	5	17.78	0.28
3	0	0:26	0.43	0	2	4:25	4.42	0.45	0	0:15	0.25	0	5	9.87	0.51
4*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	0	0:17	0.28	0	2	5:52	5.87	0.34	0	2:08	2.13	0	3	21.83	0.14
6	0	0:28	0.47	0	0	3:31	3.52	0	0	1:30	1.50	0	0	15.30	0
Sum	2		3.85	0.52	4	9:23	19.59	0.50	0		8.03	0	19.0	79.79	
Mean													6.33	38.97	0.26
SD													2.39	4.36	0.20
Calculated Error Rate															0.24

* Student 4 The time/error log malfunctioned and did not record any times

Table 25

Usability Analysis Data: Course 2

	Task 1				Task 2				Task 3				Task 4			
Student	Error	Time	Convert Time	Error Rate	Error	Time	Convert Time	Error Rate	Error	Time	Convert Time	Error Rate	Error	Time	Convert Time	Error Rate
1	1	1:22	1.37	0.73	0	0.15	0.25	0	0	1:22	1.37	0	0	0:06	0.1	0
2	0	3:12	3.20	0	0	2:32	2.53	0	0	3:30	3.20	0	0	1:22	1.37	0
3	0	3:30	3.50	0	0	1:05	1.08	0	0	2:09	2.15	0	0	0:14	0.23	0
4	1	2:14	2.23	0.45	1	3:26	3.43	0.29	0	2:08	2.13	0	0	0:06	0.1	0
5	0	1:13	1.22	0	0	12:14	12.23	0	0	2:21	2.35	0	0	0:18	0.3	0
Sum	2		11.52	0.17	1		19.52	0.05	0		11.20	0	0		2.1	0

Table 25

Usability Analysis Data: Course 2, continued

	Task 5				Task 6				Task 7				Course Totals		
Student	Error	Time	Convert Time	Error Rate	Error	Time	Convert Time	Error Rate	Error	Time	Convert Time	Error Rate	Total Errors	Total Time	Error Rate
1	1	1:13	1.22	0.82	1	2:08	2.13	0.47	0	1:27	1.45	0	4	7.89	0.51
2	0	2:13	2.22	0	0	5:05	5.08	0	0	3:13	3.22	0	0	20.82	0
3	0	2:14	2.23	0	0	3:08	3.70	0	0	0:25	0.42	0	0	13.31	0
4	0	3:29	3.48	0	0	3:04	3.07	0	0	4:33	4.55	0	2	18.99	0.11
5	0	2:22	2.37	0	0	2:07	2.12	0	0	1:28	1.47	0	**0**	22.06	0
Sum	1		11.5	0.09	1		16.10	0.06	0		11.11	0	6	83.07	
Mean													1.2	16.61	0.12
SD													1.79	5.92	0.22
Calculated Error Rate															0.07

Table 26

Usability Analysis Data: Course 3

Student	Task 1				Task 2				Task 3				Task 4			
	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate
1	0	1:05	1.70	0	0	2:23	2.38	0	1	4:15	4.25	0.24	0	0:22	0.37	0
2	0	1:20	1.33	0	0	2:05	2.08	0	0	3:12	3.20	0	0	0:29	0.48	0
3	0	4:31	4.52	0	0	4:02	4.03	0	0	3:14	3.23	0	0	0:18	0.3	0
4	0	1:10	1.17	0	0	3:14	3.23	0	0	3:17	3.28	0	0	0:08	0.13	0
Sum	0		8.72	0	0		11.72	0	1		13.96	0.07	0		1.28	0

Table 26

Usability Analysis Data: Course 3, continued

Student	Task 5 Errors	Task 5 Time	Task 5 Convert Time	Task 5 Error Rate	Task 6 Errors	Task 6 Time	Task 6 Convert Time	Task 6 Error Rate	Task 7 Errors	Task 7 Time	Task 7 Convert Time	Task 7 Error Rate	Course Totals Total Errors	Course Totals Total Time	Course Totals Error Rate
1	0	2:10	2.2	0	1	2:34	2.57	0.39	0	1:03	1.05	0	2	14.49	0.14
2	0	2:17	2.3	0	0	1:05	1.08	0	0	1:57	1.95	0	0	13.45	0
3	0	4:08	4.1	0	0	2:35	2.58	0	0	2:13	2.22	0	0	22.03	0
4	0	0:57	1	0	0	2:30	2.50	0	0	1:37	1.62	0	0	12.88	0
Sum	0		9.5	0	1		8.73	0.11	0		6.84	0	2	62.85	
Mean													0.5	15.71	0.03
SD													1	4.26	0.07
Calculated Error Rate															0.03

Table 27

Usability Analysis Data: Course 4

Student	Task 1				Task 2				Task 3				Task 4			
	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate
1	0	0:34	0.57	0	2	3:10	3.17	0.63	0	1:03	1.05	0	0	0:05	0.08	0
2	0	2:27	2.45	0	3	6:00	6.00	0.5	1	3:02	3.03	0.33	0	0:09	0.15	0
3	0	1:10	1.17	0	3	5:20	5.33	0.56	2	4:04	4.07	0.49	0	0:08	0.13	0
4	0	1:41	1.68	0	0	2:58	2.97	0	3	6:04	6.07	0.49	0	0:13	0.22	0
5	0	0:33	0.55	0	0	2:21	2.35	0	1	2:08	2.13	0.47	0	0:11	0.18	0
Sum	0		6.42	0	8		19.82	0.40	7		16.35	0.43	0		0.76	0

Table 27

Usability Analysis Data: Course 4, continued

	Task 5				Task 6				Task 7				Course Totals		
Student	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Total Errors	Total Time	Error Rate
1	0	0:22	0.4	0	1	3:27	3.45	0.29	0	1:12	1.20	0	3	9.89	0.30
2	1	1:15	1.3	0.8	0	1:46	1.77	0	0	1:27	1.45	0	5	16.10	0.31
3	0	0:23	0.4	0	0	1:56	1.93	0	0	1:02	1.03	0	5	14.04	0.36
4	0	2:27	2.5	0	0	1:36	1.60	0	1	3:53	3.88	0.3	4	18.87	0.21
5	1	2:09	2.2	0.47	2	4:04	4.07	0.49	0	1:44	1.73	0	4	13.16	0.30
Sum	2		6.6	0.30	3		12.82	0.23	1		9.29	0.11	21	72.06	
Mean													4.2	14.41	0.30
SD													0.84	3.35	0.05
Calculated Error Rate															0.29

Table 28

Usability Analysis Data: Course 5

Student	Task 1				Task 2				Task 3				Task 4			
	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate
1	1	3:07	3.12	0.32	1	3:29	3.48	0.29	0	10:05	10.08	0	0	0:18	0.3	0
2	1	2:37	2.62	0.38	2	7:14	7.23	0.28	2	12:11	12.18	0.16	0	0:08	0.13	0
3	0	2:16	2.27	0	1	2:41	2.68	0.37	3	6:00	6.00	0.5	0	0:34	0.57	0
4	0	1:45	1.75	0	0	1:59	1.98	0	2	2:06	2.10	0.95	0	0:05	0.08	0
Sum	2		9.76	0.20	4		15.37	0.26	7		30.36	0.23	0		1.08	0

Table 28

Usability Analysis Data: Course 5, continued

	Task 5				Task 6				Task 7				Course Totals		
Student	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Total Errors	Total Time	Error Rate
1	0	5:57	6	0	0	1:41	1.68	0	2	4:56	4.93	0.41	4	29.54	0.14
2*	3	4:26	4.4	0.68	.	.	.	.	.	.	.	.	8	26.59	0.30
3	1	3:58	4	0.25	0	0:47	0.78	0	0	10:30	10.50	0	5	26.77	0.19
4	0	3:02	3	0	0	0:27	0.45	0	0	1:22	1.37	0	**2**	10.76	0.19
Sum	4		17	0.23	0		1.23	0	0		11.87	0	19	93.66	
Mean													4.8	23.42	0.20
SD													2.5	8.54	0.07
Calculated Error Rate															0.20

* Student 2 ran out of time and did not finish the tasks.

Table 29

Usability Analysis Data: Course 6

Student	Task 1				Task 2				Task 3				Task 4			
	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate	Errors	Time	Convert Time	Error Rate
1	0	8:18	8.30	0	0	0:28	0.47	0	0	3:27	3.45	0	0	0:21	0.35	0
2	6	7:30	7.50	0.8	0	1:00	1.00	0	3	4:36	4.60	0.65	0	0:25	0.42	0
3	0	6:55	6.92	0	1	1:52	1.87	0.53	3	6:28	6.47	0.46	0	0:14	0.23	0
4	0	1:48	1.80	0	0	2:26	2.43	0	3	5:16	5.27	0.57	0	0:28	0.47	0
5	0	3:48	3.80	0	0	1:25	1.42	0	0	3:18	3.30	0	0	0:17	0.28	0
6	4	7:36	7.60	0.53	0	0:25	0.42	0	3	6:23	6.38	0.47	0	0:32	0.53	0
Sum	10		35.92	0.28	1		7.61	0.13	12		29.47	0.41	0		2.28	0

Table 29

Usability Analysis Data: Course 6, continued

Student	Task 5 Errors	Task 5 Time	Task 5 Convert Time	Task 5 Error Rate	Task 6 Errors	Task 6 Time	Task 6 Convert Time	Task 6 Error Rate	Task 7 Errors	Task 7 Time	Task 7 Convert Time	Task 7 Error Rate	Course Totals Total Errors	Course Totals Total Time	Course Totals Error Rate
1*	0	0:13	0.22	0	0	1:36	1.60	0	.	.	.	.	0	14.39	0
2	0	0:10	0.17	0	4	2:24	2.40	1.67	0	1:59	1.98	0	13	18.07	0.72
3	0	0:41	0.68	0	3	6:22	6.37	0.47	0	2:06	2.10	0	7	24.64	0.28
4	0	1:00	1	0	1	0:57	0.95	1.05	0	0:48	0.80	0	4	12.72	0.31
5	0	0:10	0.17	0	0	0:10	0.17	0	0	0:20	0.33	0	0	9.47	0
6	0	1:11	1.18	0	0	0:26	0.43	0	0	2:26	2.43	0	7	18.97	0.37
Sum	0		3.42	0	8		11.92	0.67	0		7.64	0	31	98.26	
Mean													5.17	16.38	0.28
SD													4.96	5.35	0.27
Calculated Error Rate															0.32

* Student 1 ran out of time and did not finish the tasks.

Appendix D

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics

Course 1 N = 6		Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
A	Finding assignment guidelines		-5 +1		-5 +1		-5 +1	-5 +1		-5 +1					-5 +5
A	Complexity of		-2		-2		-2			-2					-4
A	No directions in Assign. Tool		-1		-1		-1	-1							-4
A	Confusing due dates		-1		-1		-1	-1		-1					-5

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 1 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
A	How to submit		-1							-1					-2
A	Need tutorial on submit		-1												-1
A	Out of date different due dates		-1		-1		-1	-1		-1					-5
M	Locating contact info classmates														
M	Locating contact info professor														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 1 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
M	WebVista e-mail easy to use		+6		+6					+6		+6			+4
C	Too much text		-2					-2		-2					-3
C	Organization														
C	Accessing course materials			-4 +2											-4 +2
C	Locating content		+2	+2											+2

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 1 N = 6		Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
C	Add internal links		-1	-1	-1			-1							-4
C	Using multimedia content														
L	Clear link labels		+1		+1		+1	+1		+1		+1	+1		+7
L	Unclear link labels		-1												-1
L	Does not like term modules		-2		-2										-2

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 1 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
L	Language doesn't match syllabus		-1												
E	Locating exams in Assessment Tool	N	N	N	N	N	N	N	N	N	N	N	N	N	N
E	Locating proctored exam location	N	N	N	N	N	N	N	N	N	N	N	N	N	N
E	Scheduling exam appointment	N	N	N	N	N	N	N	N	N	N	N	N	N	N
E	Understanding concept of proctored exams	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 1 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
G	Checking grades, ability to		+6									+6			+2
G	No problems checking grades		+6									+6			+2
G	Monitor throughout course		+1									+1			+2
N	Via Left nav bar		+5	+5	+5			+5							+4
N	Via scrolling														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 1 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
N	Needs site map for overview		-1												-1
N	"Thrown" by left nav bar		-1												-1
N	Needs tutorial in site use														
T	Organizing toolbar		+6	+6	+6		+6	+6				+6	+6		+7
T	Providing calendar tool														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 1 N = 6		Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
T	Using "More Tools"														
PE	Ease of use due to	+2	+2		+2			+2		+2		+2			+6
S	Lesson topics not listed in														
S	Too bulky	-1	-1												-2
S	Content needs to be on Home page														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 1 N = 6		Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
ET	Posting in discussion area		+1												+1
ET	Browsing		+2												+1
ET	Nothing was hard		+1												+1
ET	Finding grades, using e-mail		+1												+1
ET	Finding number assignments		+1												+1

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 1 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
MDT	Finding assignment guidelines		-3												-1
MDT	Navigation-Lack of internal links		-1												-1
MDT	Nothing was difficult		+1												+1
MDT	Syllabus does not match users' mental model														
MDT	Locating exams														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 1 N = 6		Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.89													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	2.0	2.0	1.95	2.0	1.94	1.18	1.91	1.87	1.82	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row total
MDT	Late submission policy														
MDT	Finding instructor contact info														
MDT	Locating content/Too much info on pages		-2												-1
MDT	Knowing I was on correct site														
Column Total		-1 +1	-18	-2 +4	-7 +5	0 0	-5 +3	-6 +5	0 0	-6 +4	0 0	0 +7	0 +2	0 0	-44 +31

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Code	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													Row Total
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	Finding assignment guidelines		-4 +1		-4 +1		-4 +1	-4 +1		-4 +1					-5 +1
A	Complexity of														
A	No directions in Assign. Tool														
A	Confusing due dates		-1		-1		-1	-1		-1					-5

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2	Nielsen's Heuristics													
	N = 5	Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	How to submit		-2		-2					-2					-3
A	Need tutorial on submit														
A	Out of date different due dates														
M	Locating contact info classmates	-1	-1		-1					-1		-1			-5

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2	Nielsen's Heuristics													
	N = 5	Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
M	Locating contact info professor	-3	-3		-3					-3		-3			-5
M	WebVista e-mail easy to use	+3 -1	+3 -1		+3 -1					+3 -1		+3 -1			+5 -1
C	Too much text Not too much text	+1	+1					+1		+1					+4
C	Organization	+2	+2		+2			+2		+2		+2			+6
C	Accessing course materials														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 2		Nielsen's Heuristics													
N = 5		Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
C	Locating content	+4	+4	+4	+4			+4		+4		+4			+7
C	Add internal links		-3	-3	-3			-3	-3	-3					-6
C	Using multimedia content		+1												+1
L	Clear link labels														
L	Unclear link labels		-1		-1								-1		-3

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
L	Does not like term modules														
L	Language doesn't match syllabus														
E	Locating exams in Assessment Tool	-1	-1		-1				-1						-4
E	Locating proctored exam location														
E	Scheduling exam appointment	-1	-1		-1				-1						-4

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
E	Understanding concept of proctored exams	-1	-1		-1							-1			-4
G	Checking grades, ability to		+5					+5				+5			+3
G	No problems checking grades		+5					+5				+5			+3
G	Monitor throughout course														
N	Via Left nav bar		+2	+2	+2			+2							+4

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
N	Via scrolling		+2	+2	+2			+2							+4
N	Needs site map for overview														
N	"Thrown" by left nav bar		-1												-1
N	Needs tutorial in site use														
T	Organizing toolbar		+5	+5	+5		+5	+5				+5	+5		+7

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
T	Providing calendar tool		-1												-1
T	Using "More Tools"														
PE	Ease of use due to														
S	Lesson topics not listed in														
S	Too bulky		-1												-1

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
S	Content needs to be on Home page														
ET	Posting in discussion area		+1												+1
ET	Browsing		+2												+2
ET	Nothing was hard		+2												+2
ET	Finding grades, using e-mail		+1												+1

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
ET	Finding number assignments		+1												+1
MDT	Finding assignment guidelines		-1												-1
MDT	Navigation-Lack of internal links														
MDT	Nothing was difficult		+1												+1
MDT	Syllabus does not match users' mental model														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 2 N = 5	Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Locating exams														
MDT	Late submission policy														
MDT	Finding instructor contact info														
MDT	Locating content/Too much info on pages		-1												-1
MDT	Knowing I was on correct site														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 2 N = 5		Nielsen's Heuristics Course Heuristic Evaluation Mean Score = 1.88													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.96	2.0	2.0	2.0	1.93	1.75	1.97	1.33	2.0	1.95	1.62	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
Column Total		-6 +4	-16 +17	-1 +4	-11 +7	0 0	-2 +2	-3 +9	-3 0	-6 +5	0 0	-4 +6	-1 +1	0 0	-53 +56

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	Finding assignment guidelines	+2	+2		+2			+2		+2					+5
A	Complexity of														
A	No directions in Assign. Tool	-1	-1					-1		-1					-4
A	Confusing due dates														
A	How to submit														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Code	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	Need tutorial on submit														
A	Out of date different due dates														
M	Locating contact info classmates	+4	+4		+4					+4		+4			+5
M	Locating contact info professor	+4	+4		+4					+4		+4			+5
M	WebVista e-mail easy to use														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
C	Too much text														
C	Organization	+4	+4		+4			+4		+4					+5
C	Accessing course materials														
C	Locating content														
C	Add internal links														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 3		Nielsen's Heuristics													
N = 4		Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
C	Using multimedia content	+3	+3		+3										+3
L	Clear link labels														
L	Unclear link labels														
L	Does not like term modules														
L	Language doesn't match syllabus														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
E	Locating exams in Assessment Tool	-1			-1			-1					-1		-4
E	Locating proctored exam location														
E	Scheduling exam appointment														
E	Understanding concept of proctored exams														
G	Checking grades, ability to	+2	+2		+2								+2		+4

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													Row Total
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
G	No problems checking grades	+4	+4		+4								+4		+4
G	Monitor throughout course	+1	+1		+1								+1		+4
N	Via Left nav bar	+2	+2	+2	+2			+2		+2		+2	+2		+8
N	Via scrolling	+1	+1	+1	+1			+1		+1		+1	+1		+8
N	Needs site map for overview														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
N	"Thrown" by left nav bar														
N	Needs tutorial in site use														
T	Organizing toolbar	+2	+2	+2	+2			+2		+2		+2	+2		+8
T	Providing calendar tool														
T	Using "More Tools"														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 3		Nielsen's Heuristics													
N = 4		Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
PE	Ease of use due to														
S	Lesson topics not listed in														
S	Too bulky														
S	Content needs to be on Home page														
ET	Posting in discussion area														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
ET	Browsing														
ET	Nothing was hard		+1		+1			+1	+1	+1		+1	+1		+7
ET	Finding grades, using e-mail		+1		+1			+1	+1	+1		+1	+1		+7
ET	Finding number assignments														
MDT	Finding assignment guidelines	-1	-1		-1			-1	-1	-1			-1		-7

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 3 N = 4	Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Navigation-Lack of internal links														
MDT	Nothing was difficult														
MDT	Syllabus does not match users' mental model														
MDT	Locating exams	-1	-1		-1			-1		-1			-1		-6
MDT	Late submission policy														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 3 N = 4		Nielsen's Heuristics Course Heuristic Evaluation Score = 1.85													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.93	2.0	1.94	1.75	1.83	1.27	2.0	1.90	1.50	1.72	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Finding instructor contact info														
MDT	Locating content/Too much info on pages	-1	-1		-1			-1		-1		-1	-1		-7
MDT	Knowing I was on correct site														
Column Total		-5 +11	-3 +13	0 +3	-4 +13	0 0	0 0	-5 +7	-1 +2	-4 +9	0 0	-1 +7	-4 +8	0 0	-27 +73

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4	Nielsen's Heuristics													
	N = 5	Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	Finding assignment guidelines	-1	-1		-1			-1		-1			-1		-6
A	Complexity of	-2	-2		-2			-2		-2			-2		-6
A	No directions in Assign. Tool														
A	Confusing due dates														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag- nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini- malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	Row Total
A	How to submit	-2	-2		-2			-2		-2			-2		-6
A	Need tutorial on submit														
A	Out of date different due dates														
M	Locating contact info classmates														
M	Locating contact info professor	-5	-5		-5			-5		-5			-5		-6

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
M	WebVista e-mail easy to use														
C	Too much text	-1	-1		-1			-1		-1			-1		-6
C	Organization														
C	Accessing course materials	+1	+1		+1			+1		+1			+1		+6

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
C	Locating content	+2	+2		+2			+2		+2			+2		+6
C	Add internal links	-1	-1		-1			-1		-1			-1		-6
C	Using multimedia content														
L	Clear link labels														
L	Unclear link labels	-2	-2		-2			-2		-2			-2		-6

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
L	Does not like term modules														
L	Language doesn't match syllabus	-1	-1		-1			-1		-1			-1		-6
E	Locating exams in Assessment Tool														
E	Locating proctored exam location														
E	Scheduling exam appointment														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag- nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini- malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
E	Understanding concept of proctored exams														
G	Checking grades, ability to	+2	+2		+2				+2	+2		+2	+2		+7
G	No problems checking grades														
G	Monitor throughout course														
N	Via Left nav bar														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
N	Via scrolling														
N	Needs site map for overview														
N	"Thrown" by left nav bar														
N	Needs tutorial in site use														
T	Organizing toolbar														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable, resprctful inter-	Privacy	
T	Providing calendar tool														
T	Using "More Tools"														
PE	Ease of use due to														
S	Lesson topics not listed in														
S	Too bulky														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
S	Content needs to be on Home page														
ET	Posting in discussion area														
ET	Browsing														
ET	Nothing was hard														
ET	Finding grades, using e-														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 4	Nielsen's Heuristics													
	N = 5	Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
	mail														
ET	Finding number assignments														
MDT	Finding assignment guidelines														
MDT	Navigation-Lack of internal links														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 4 N = 5		Nielsen's Heuristics Course Heuristic Mean Score = 1.84													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Nothing was difficult														
MDT	Syllabus does not match users' mental model	-1	-1		-1			-1		-1			-1		-6
MDT	Locating exams														
MDT	Late submission policy	-1					-1								-2
MDT	Finding instructor contact info	-2	-2		-2		-2			-2		-2	-2		-7

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Code	Course 4 N = 5	Nielsen's Heuristics Course Heuristic Mean Score = 1.84													Row Total
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	1.93	1.94	1.89	2.0	1.95	1.83	2.0	1.18	1.78	2.0	1.53	2.0	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Locating content/Too much info on pages	-1	-1				-1			-1		-1	-1		-6
MDT	Knowing I was on correct site														
Column Total		-12 +3	-11 +3	0 0	-10 +3	0 0	-3 0	-9 +2	0 +1	-11 +3	0 0	-2 +1	-11 +3	0 0	-69 +19

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	Finding assignment guidelines	-1	-1	-1	-1			-1		-1			-1		-7
A	Complexity of	-1	-1	-1	-1			-1		-1			-1		-7
A	No directions in Assign. Tool														
A	Confusing due dates		-1		-1			-1		-1			-1		-5
A	How to submit														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	Need tutorial on submit														
A	Out of date different due dates		-2		-2			-2		-2			-2		-5
M	Locating contact info classmates														
M	Locating contact info professor		-1		-1			-1		-1		-1	-1		-6
M	WebVista e-mail easy to														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 5		Nielsen's Heuristics													
N = 6		Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
	use														
C	Too much text		-2		-2			-2	-2	-2			-2		-6
C	Organization	-5	-5		-5			-5	-5	-5			-5		-7
C	Accessing course materials		-2		-2			-2	-2	-2			-2		-6
C	Locating content		-2		-2			-2	-2	-2			-2		-6

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
C	Add internal links														
C	Using multimedia content														
L	Clear link labels	+2	+2		+2			+2	+2	+2			+2		+7
L	Unclear link labels	-4	-4		-4			-4	-4	-4			-4		-7
L	Does not like term modules														
L	Language doesn't match														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5	Nielsen's Heuristics													
	N = 6	Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
	syllabus														
E	Locating exams in Assessment Tool	-1	-1		-1			-1		-1			-1		-6
E	Locating proctored exam location														
E	Scheduling exam appointment														
E	Understanding concept of proctored exams														
G	Checking grades, ability to	N	N	N	N	N	N	N	N	N	N	N	N	N	

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
G	No problems checking grades	N	N	N	N	N	N	N	N	N	N	N	N	N	
G	Monitor throughout course	N	N	N	N	N	N	N	N	N	N	N	N	N	
N	Via Left nav bar	+1	+1		+1			+1		+1			+1		+6
N	Via scrolling														
N	Needs site map for overview														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Code	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													Row Total
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
N	"Thrown" by left nav bar														
N	Needs tutorial in site use (two sites	-3	-3		-3			-3		-3			-3		-6
T	Organizing toolbar		+2		+2			+2		+2			+2		+5
T	Providing calendar tool														
T	Using "More Tools"														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Course 5		Nielsen's Heuristics													
N = 6		Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
PE	Ease of use due to														
S	Lesson topics not listed in	-3	-3		-3			-3		-3			-3		-6
S	Too bulky														
S	Content needs to be on Home page														
ET	Posting in discussion area														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
ET	Browsing														
ET	Nothing was hard														
ET	Finding grades, using e-mail														
ET	Finding number assignments														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5	Nielsen's Heuristics													
	N = 6	Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Finding assignment guidelines														
MDT	Navigation-Lack of internal links														
MDT	Nothing was difficult														
MDT	Syllabus does not match users' mental model														
MDT	Locating exams														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Code	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													Row Total
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Late submission policy														
MDT	Finding instructor contact info														
MDT	Locating content/Too much info on pages														
MDT	Knowing I was on correct site														
Column Total		-7 +2	-13 +3	-2 0	-13 +3	0 0	0 0	-13 +3	-5 +1	-13 +3	0 0	-1 0	13 +3	0 0	-80 +18

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 5 N = 6	Nielsen's Heuristics Course Heuristic Evaluation Mean = 1.79													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	1.77	2.0	1.70	1.94	1.95	1.83	1.96	1.20	2.0	1.0	1.27	1.86	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	Finding assignment guidelines														
A	Complexity of														
A	No directions in Assign. Tool														
A	Confusing due dates														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
A	How to submit	-4	-4		-4			-4		-4			-4		-6
A	Need tutorial on submit														
A	Out of date different due dates														
M	Locating contact info classmates														
M	Locating contact info professor														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
M	WebVista e-mail easy to use														
C	Too much text	-1	-1		-1			-1		-1		-1	-1		-7
C	Organization	-4	-4		-4			-4		-4		-4	-4		-7
C	Accessing course materials	-4	-4		-4			-4		-4		-4	-4		-7
C	Locating content	-4	-4		-4			-4		-4		-4	-4		-7

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
C	Add internal links														
C	Using multimedia content	-4	-4		-4			-4		-4		-4	-4		-7
L	Clear link labels														
L	Unclear link labels	-4	-4		-4			-4		-4		-4	-4		-7
L	Does not like term modules														
L	Language doesn't match														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6	Nielsen's Heuristics													
	N = 4	Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
	syllabus														
E	Locating exams in Assessment Tool	-1	-1		-1			-1		-1			-1		-6
E	Locating proctored exam location														
E	Scheduling exam appointment														
E	Understanding concept of proctored exams														
G	Checking grades, ability to	-4	-4		-4			-4		-4			-4		-6

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
G	No problems checking grades														
G	Monitor throughout course														
N	Via Left nav bar	+4	+4		+4			+4		+4			+4		+6
N	Via scrolling	+4	+4		+4			+4		+4			+4		+6
N	Needs site map for overview														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
N	"Thrown" by left nav bar														
N	Needs tutorial in site use														
T	Organizing toolbar														
T	Providing calendar tool		-1		-1							-1	-1		-4
T	Using "More Tools"	-4	-4		-4			-4		-4			-4		-6

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
PE	Ease of use due to														
S	Lesson topics not listed in	-1	-1		-1			-1		-1		-1	-1		-7
S	Too bulky	-4	-4		-4			-4		-4		-4	-4		-7
S	Content needs to be on Home page														
ET	Posting in discussion area														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

Code	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
ET	Browsing														
ET	Nothing was hard														
ET	Finding grades, using e-mail														
ET	Finding number assignments														
MDT	Finding assignment guidelines														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diag-nose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Mini-malist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Navigation-Lack of internal links														
MDT	Nothing was difficult														
MDT	Syllabus does not match users' mental model														
MDT	Locating exams														
MDT	Late submission policy														

Table 30

Usability Analysis Themes and Students' Verbal Reports Compared to Nielsen's Heuristics, continued

	Course 6 N = 4	Nielsen's Heuristics Heuristic Evaluation Mean Score = 1.83													
	Heuristic	1	2	3	4	5	6	7	8	9	10	11	12	13	Row Total
	Mean Score	2.0	2.0	1.83	1.91	1.90	1.63	1.83	1.67	1.70	1.90	1.54	1.90	2.0	
Code	Theme	Visibility System Status	Match system with real world	User control and freedom	Consistency and Standards	Recognize, Diagnose and Recover from Errors	Error Prevention	Recognition Rather Than ..	Flexibility Minimalist Design	Aesthetic Minimalist	Help	Skills	Pleasurable , resprctful inter-	Privacy	
MDT	Finding instructor contact info														
MDT	Locating content/Too much info on pages	-4	-4		-4			-4		-4		-4	-4		-7
MDT	Knowing I was on correct site														
Column Total		-13 +2	-14 +2	0 0	-14 +2	0 0	0 0	-13 +2	0 0	-13 +2	0 0	-9 0	-14 +2	0 0	-90 +12

Appendix E

Course Materials

Course Descriptions: Group One

Professionally Designed Courses

These three online courses were developed by a professional development group. The group is comprised of instructional designers, course developers, and experts in graphics and video production. These courses are also supported by a Web Assistant who provides technical assistance for instructors and students.

Course 1 Technical Writing Course

Course 2 Science Course

Course 3 Alcohol and Substance Abuse Course

Course 1 Technical Writing Course Materials

Course 1 Tasks

You have registered for an online course. It is the first week of your course. You want to check out the course web site to see how it works.
Task 1
Find out how many assignments are due in the course.
PLEASE REMEMBER TO THINK ALOUD

Task 2
You have a family emergency come up and you will need to submit one of your assignments late. Locate the professor's late submissions policies.

Send an e-mail to explain the situation.
PLEASE REMEMBER TO THINK ALOUD

Task 3
This course uses a peer evaluation process for written assignments. You need to do a peer evaluation of your group's papers for the assignment in module 7.

Locate the evaluation form.
How do you submit the form?
PLEASE REMEMBER TO THINK ALOUD
Task 4
It's the eighth week of class and you want to check your progress in the grade book. Check your grades.
PLEASE REMEMBER TO THINK ALOUD

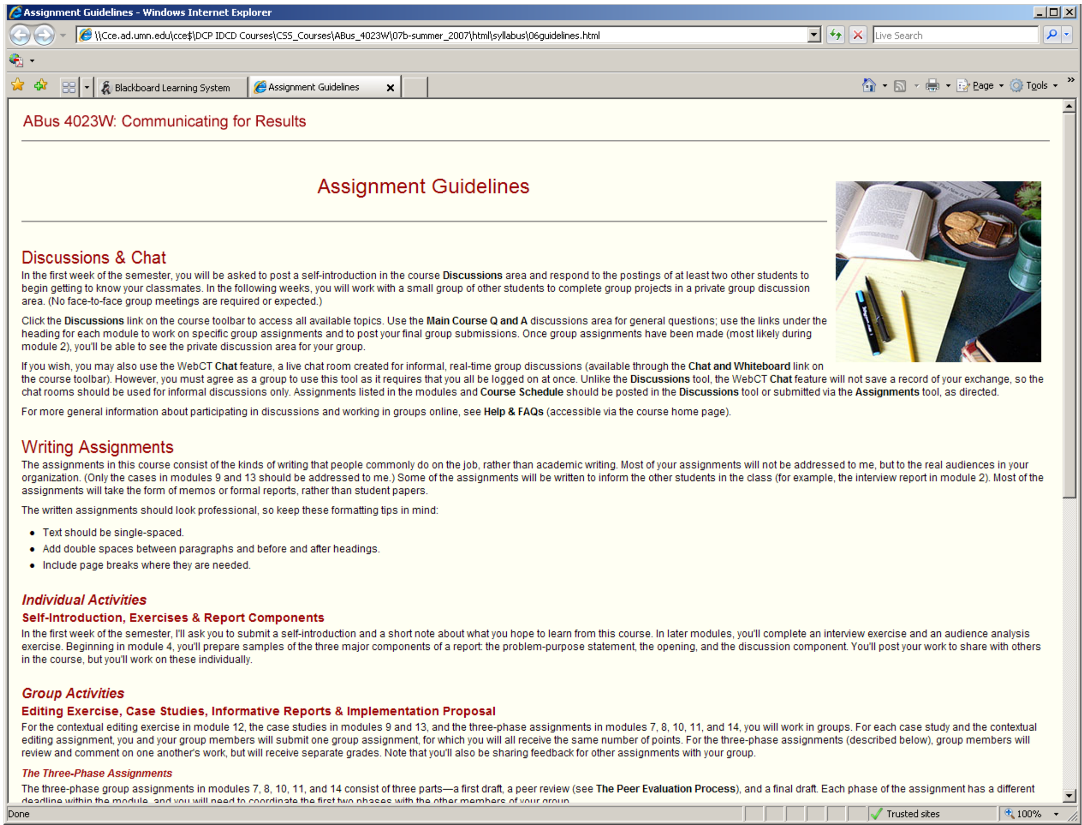
Task 5
Post a self-introduction in the discussion area.
PLEASE REMEMBER TO THINK ALOUD

Task 6
It's mid-semester and you have an assignment to complete. What are the requirements of the mid-term assignment?
How do you submit it?

PLEASE REMEMBER TO THINK ALOUD
Task 7
Locate the assignment for module 14.
PLEASE REMEMBER TO THINK ALOUD

Course 1 Screen Shots

Course 1 Assignment Guidelines



Assignment Guidelines - Windows Internet Explorer

\\Cce.ad.umn.edu\cce$\DCP IDCD Courses\CSS_Courses\ABus_4023W\07b-summer_2007\html\syllabus\06guidelines.html

Blackboard Learning System | Assignment Guidelines

ABus 4023W: Communicating for Results

Assignment Guidelines

Discussions & Chat

In the first week of the semester, you will be asked to post a self-introduction in the course **Discussions** area and respond to the postings of at least two other students to begin getting to know your classmates. In the following weeks, you will work with a small group of other students to complete group projects in a private group discussion area. (No face-to-face group meetings are required or expected.)

Click the **Discussions** link on the course toolbar to access all available topics. Use the **Main Course Q and A** discussions area for general questions; use the links under the heading for each module to work on specific group assignments and to post your final group submissions. Once group assignments have been made (most likely during module 2), you'll be able to see the private discussion area for your group.

If you wish, you may also use the WebCT **Chat** feature, a live chat room created for informal, real-time group discussions (available through the **Chat and Whiteboard** link on the course toolbar). However, you must agree as a group to use this tool as it requires that you all be logged on at once. Unlike the **Discussions** tool, the WebCT **Chat** feature will not save a record of your exchange, so the chat rooms should be used for informal discussions only. Assignments listed in the modules and **Course Schedule** should be posted in the **Discussions** tool or submitted via the **Assignments** tool, as directed.

For more general information about participating in discussions and working in groups online, see **Help & FAQs** (accessible via the course home page).

Writing Assignments

The assignments in this course consist of the kinds of writing that people commonly do on the job, rather than academic writing. Most of your assignments will not be addressed to me, but to the real audiences in your organization. (Only the cases in modules 9 and 13 should be addressed to me.) Some of the assignments will be written to inform the other students in the class (for example, the interview report in module 2). Most of the assignments will take the form of memos or formal reports, rather than student papers.

The written assignments should look professional, so keep these formatting tips in mind:

- Text should be single-spaced.
- Add double spaces between paragraphs and before and after headings.
- Include page breaks where they are needed.

Individual Activities

Self-Introduction, Exercises & Report Components

In the first week of the semester, I'll ask you to submit a self-introduction and a short note about what you hope to learn from this course. In later modules, you'll complete an interview exercise and an audience analysis exercise. Beginning in module 4, you'll prepare samples of the three major components of a report: the problem-purpose statement, the opening, and the discussion component. You'll post your work to share with others in the course, but you'll work on these individually.

Group Activities

Editing Exercise, Case Studies, Informative Reports & Implementation Proposal

For the contextual editing exercise in module 12, the case studies in modules 9 and 13, and the three-phase assignments in modules 7, 8, 10, 11, and 14, you will work in groups. For each case study and the contextual editing assignment, you and your group members will submit one group assignment, for which you will all receive the same number of points. For the three-phase assignments (described below), group members will review and comment on one another's work, but will receive separate grades. Note that you'll also be sharing feedback for other assignments with your group.

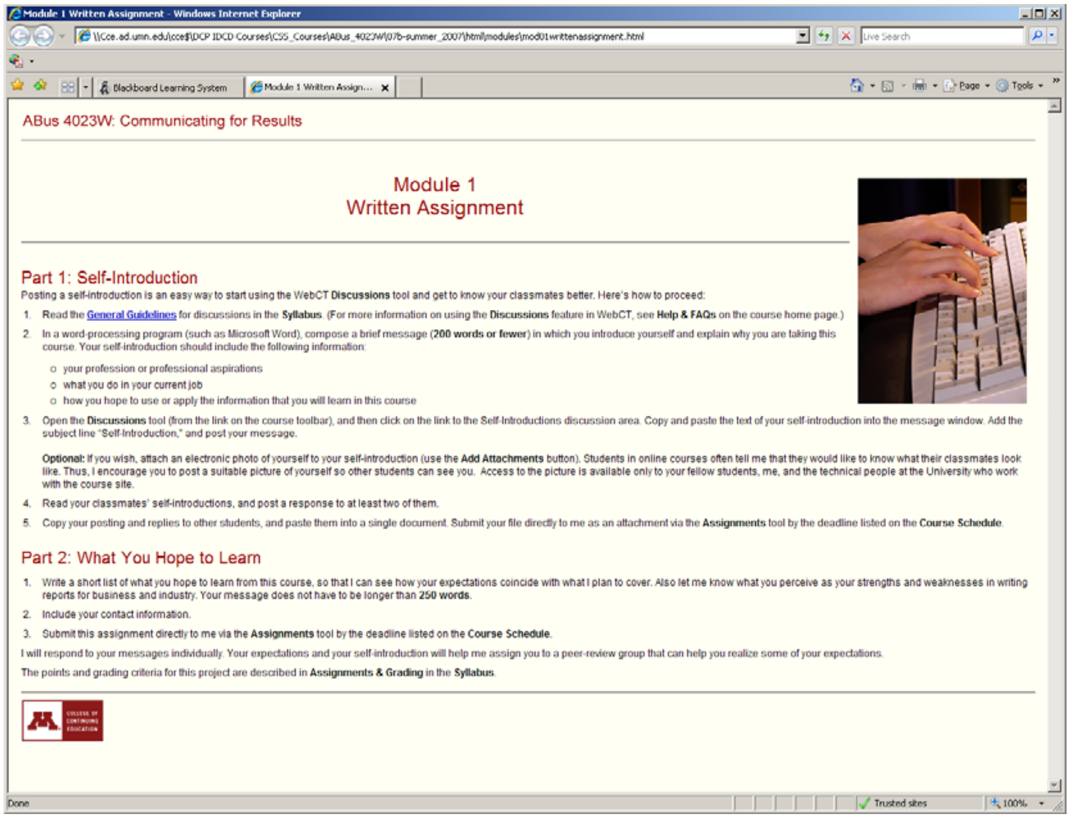
The Three-Phase Assignments

The three-phase group assignments in modules 7, 8, 10, 11, and 14 consist of three parts—a first draft, a peer review (see **The Peer Evaluation Process**), and a final draft. Each phase of the assignment has a different

Done | Trusted sites | 100%

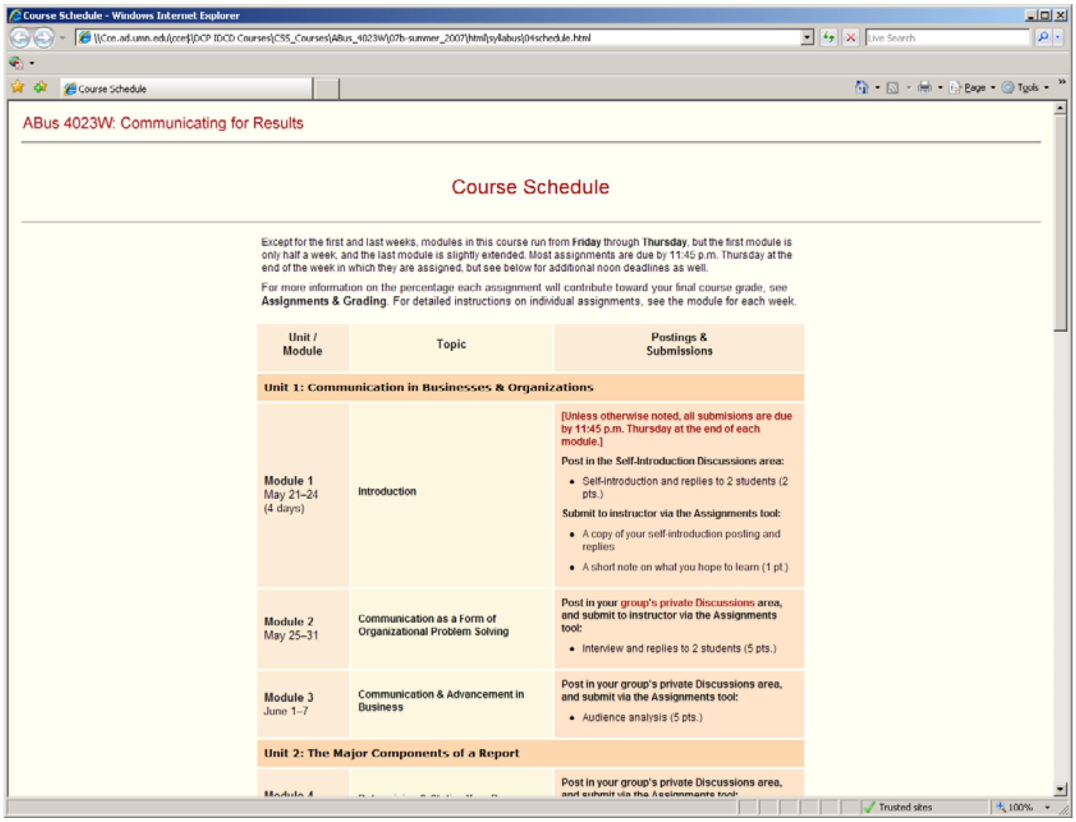
This page is an example of the detailed guidelines for the assignments and activities in the course. After the general instructions and expectations for the Discussions, Chat, and Writing Assignments, activities are broken down into individual and group assignment categories.

Course 1 Module 1 Written Assignment



This page is an example of the detailed guidelines for the assignments and activities in the course. After the general instructions and expectations for the Discussions, Chat, and Written activities, assignments are broken down into individual and group assignment categories.

Course 1 Course Schedule



This page is an example of the Course Schedule page that appears in each of the Group One courses. This page is part of the professional development group standard template and information architecture. This page is organized by week, topic, discussion postings and submissions due for each week. General instructions for assignment due dates and times appear at the top of this page. These instructions are customized for each course; due dates and times may vary by course.

Course 1: Technical Writing Course Description

Heuristic Evaluation Rank: 1 of 6

Heuristic Evaluation Mean 1.89

Six students participated in usability testing sessions

Overview

Six students participated in usability testing sessions. This online technical writing course was designed and developed by a professional online course development group in the WebVista CMS. The audience is composed of students from various disciplines. Most students in the program are working adults who have returned to higher education to earn their bachelor degree. There are no specific course prerequisites other than having earned 45 undergraduate degree credits.

The course home page has the following content links: Syllabus, Lessons, Assignment Resources, Instructor Support, and Help and FAQs. All courses developed by this professional group are designed using a standard template and information architecture. This information architecture, now in its second iteration, was designed based on current research in usability and pedagogy.

The syllabus contains these pages: Meet Your Instructor, Course at a Glance, Course Introduction, Course Materials (including a link to the Pathology Review), Assignments and Guidelines, and the institution’s Academic Integrity Policy.

The 14 lessons are organized into semester weeks. The course content begins with an audience analysis and an introduction to the overall writing process then moves to more specific types of writing. Course lectures are delivered via textual study notes. There are no multimedia resources. Course interaction takes place in the discussion area in groups. Students use a peer review process to critique the work of other members of their group before it is submitted to the professor. The assessments in this course are 8 writing assignments. There are no exams or quizzes in the course.

Assignments

S1: “The group assignments look very complex.”

S2: “I did not find it easy to find the requirements for the assignments.”

S3: “The assignments were not clear. I had a hard time figuring that out.” This student never located the complete guidelines for the assignments. They never went to the modules to look for guidelines.

S4: “I did not like that assignment descriptions were not on the assignment submission page.” (The assignment submission page is located within the assignments tool.)

S5: “The modules and the assignments were easy to find.”

S6: “The assignments don’t match what it says in the syllabus.”

Content

S1: “It was easy to find things in the site. The term “modules” is confusing.”

S2: “The term “modules” is confusing.” The student prefers the term “weeks.”

S3: “I don’t like having to read all the (text) information to find what I need.”

S4: “Finding content on the course site is easy. Once you know the layout.” This student is familiar with online courses because they have previously taken a course in WebVista.

S5:” I like that the content is broken up into modules. Everything was easy to find probably because I have taken an online course in WebVista before.”

S6: “I think that the syllabus is too bulky—there is too much text.”

Messaging

Course messaging was via the internal WebVista mail tool. The instructor explicitly states in the syllabus she only was to be contacted via the internal e-mail system.

S1: “It’s very easy to use WebVista e-mail.”

S2: “Using the WebVista e-mail tool is easy.”

S3: “Using e-mail is easy.”

S4: “Using the mail tool is easy.”

S5: “Easy to use the mail tool.”

S6: “Using the e-mail tool is easy. I like that it’s separate from my other e-mail.”

Exams

The course does not have any exams or quizzes.

Grades

All students found the location of their grades quickly.

One student (S2) commented that they like being able to see their progress if the professor keeps up with the grading."

Another student (S5) commented, "I like being able to see my grades online and what I have submitted."

Navigation

The course has multiple types of navigation available for student use. These navigational tools are built into the WebVista CMS and include: Breadcrumbs, Left navigation table of contents (TOC), Home button, Back button, Drop down menu, Scrolling, and Search. Students particularly like the left navigation TOC. All students used left navigation bar TOC to get to a particular page and then the scroll bar to navigate through the pages of content.

S1: The site is easy to navigate. It's easy to locate things because the links are labeled well. I think the course needs a site map so I can get an overview of the whole site."

S2: "It's easy to see what you need to do, but the words (modules) are difficult."

S3: "It's easy to go to different parts of the course."

S4: "I like the left navigation bar in the modules. You have everything you need on a weekly basis."

S5: “It was easy to find things in the course. That’s probably because I’ve taken another online course before so I am familiar with the interface.”

S6: “I like that there are multiple ways to get to things, but I was thrown by the left navigation bar.”

Student Recommendations

One of the debrief interview questions asked students for their recommendations for improving the site.

S1: “I found having (several) different due dates for assignments difficult. I would recommend that you change the clarity of the wording about the due dates in the modules.”

S2: “Make it clear how to download the assignment forms and how to submit them. Maybe have a tutorial.”

S3: “I would like more links in the modules (pages) that link to other pages.”

S4: “Put a description in the assignments tool about each assignment.”

S5: “I don’t know that I would make any changes.”

S6: “I would like pictures to go along with the links.”

Single Most Important Change

In the debriefing interview, after students were asked for recommended changes, they were asked to identify the single most important change they would make to the course site. This is how they responded.

S1: “Change the terminology of modules to week.”

S2: “Make it clear how to download and submit a form.”

S3: “Place links in the (module) pages.”

S4: “Place a description of the assignment on the assignment form in the Assignments Tool.”

S5: “I wouldn’t recommend any changes. It was easy to use.”

Tasks

During the debriefing interview students were asked to identify both the easiest task and the most difficult task they were asked to complete during the testing session. Here are their responses.

Easiest Task

S1: “Posting in the discussion area.”

S2: “Browsing through the site.”

S3: “Easiest to go to different places in the site.”

S4: “Finding out how many assignments there are.”

S5: “Nothing was hard for me to do.”

S6: “Finding grades and using e-mail.”

Most Difficult Task

S1: “Finding the assignment guidelines.”

S2: “Finding the guidelines for certain assignments.”

S3: “Having to go back to the home page all the time to access the modules.”

S4: “Finding a description of the midterm assignment.”

S5: “Nothing was hard for me to do.”

S6: “There is too much information on one page. The syllabus bothers me. I don’t know why, it just doesn’t seem like my definition of a syllabus.”

Tools

All students thought that any tools used in the course should be visible in the toolbar.

Course 2 Science Course Materials

Course 2 Tasks

You have registered for an online course. It is the first week of your course. You want to check out the course web site to see how it works.
Task 1
Find out what type of and how many assignments are due in the course.
PLEASE REMEMBER TO THINK ALOUD

Task 2
You have a family emergency come up and you will need to postpone your exam.

Send an e-mail to explain the situation to your professor.
PLEASE REMEMBER TO THINK ALOUD

Task 3
This course uses a series of videotaped lectures. You need to view the first lecture for Module 5.

What is the name of this lecture presentation?

Please go to the beginning of this lecture and start the presentation.

You decide you need to review the “Clinical Vignette” slide. Please go to this part of the lecture presentation.
PLEASE REMEMBER TO THINK ALOUD

Task 4
It's the eighth week of class and you want to check your progress in the grade book. Check your grades.
PLEASE REMEMBER TO THINK ALOUD

Task 5
This class uses proctored examinations.

Locate the form you need to use to set up taking your exams.

When is this form due?

Where do you submit it?
PLEASE REMEMBER TO THINK ALOUD

Task 6
You have completed Unit II of the course. By what date do you have to take your Unit II exam?

Find the evaluation form that goes with this unit. When is it due?

How do you submit it?
PLEASE REMEMBER TO THINK ALOUD

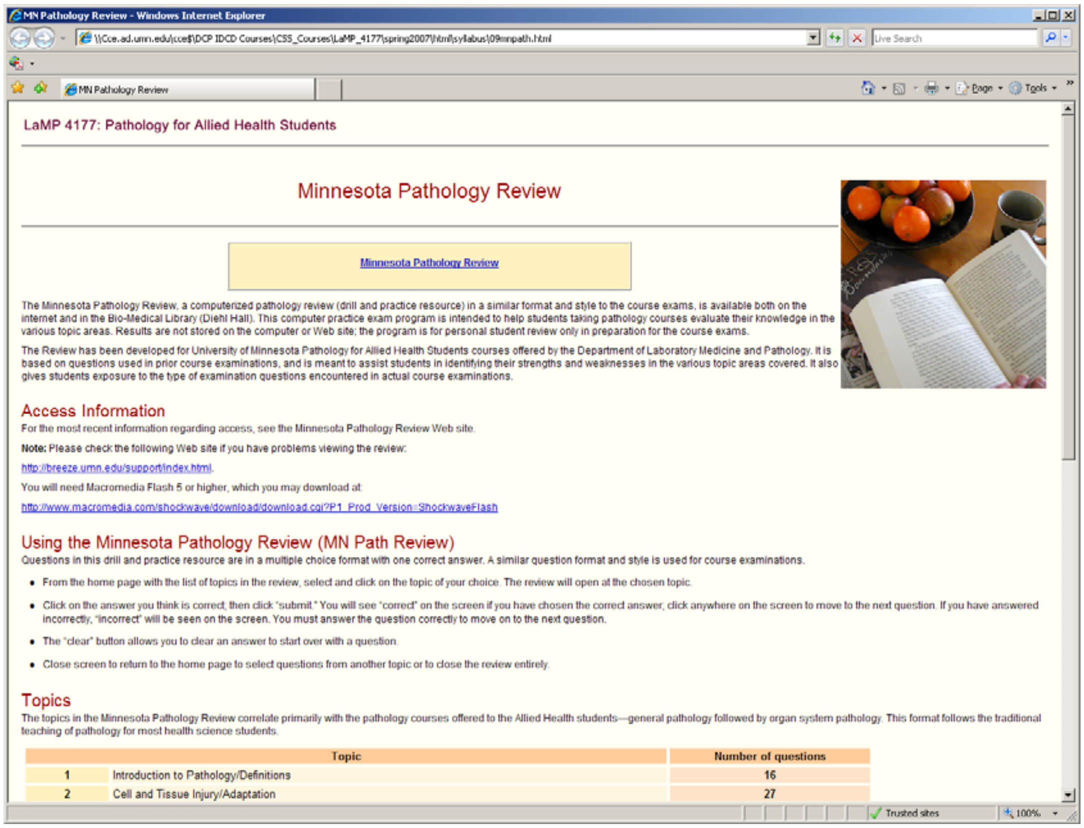
Task 7
Access the Pathology Review.

What subject is covered in Topic 25?

What is the purpose of this part of the course?
PLEASE REMEMBER TO THINK ALOUD

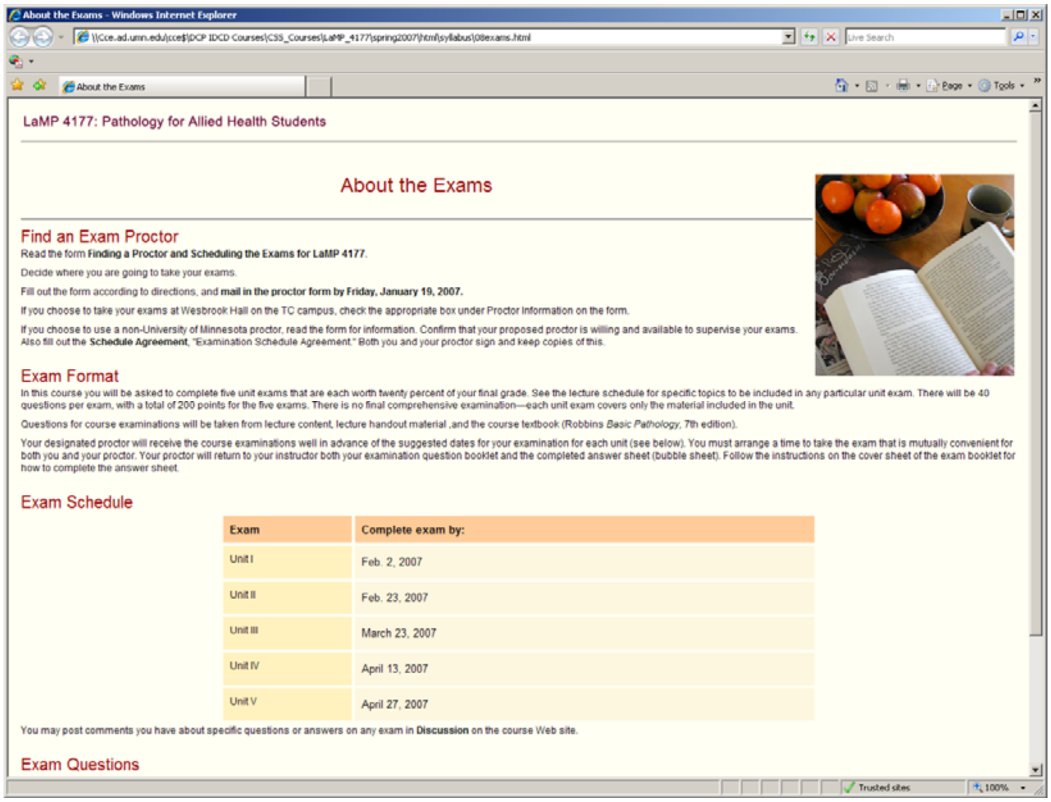
Course 2 Science Course Screen Shots

Minnesota Pathology Review



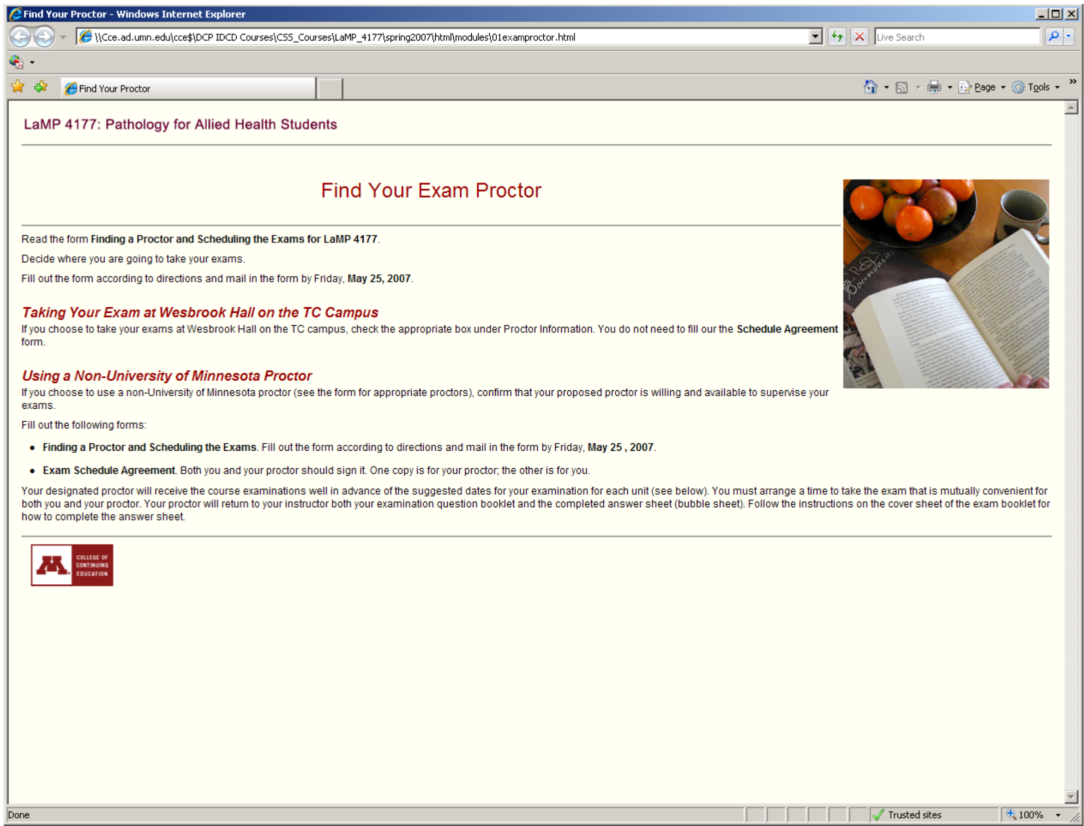
This page describes and provides access to the Minnesota Pathological Review in this science course. The review is a drill and practice resource which helps students learn the course concepts. The student audience is undergraduate students in the Allied Health field.

About the Exams



This page provides information concerning the proctored exams which are a requirement for this course. In the usability testing sessions and the summary interviews, many students reported that they had questions concerning the proctored exam, (i.e., what a proctored exam was, how to schedule the exams, and the location of the exam administration).

Find Your Exam Proctor



This page provides instructions on finding a proctor for the proctored exams, whether the students takes the exam on- or off-campus.

Course 2 Science Course Description

Heuristic Evaluation Rank: 2 of 6

Heuristic Evaluation Mean 1.88

Five students participated in usability testing sessions

Overview

This online science course was designed and developed by a professional online course development group in the WebVista CMS. The audience is composed of health science students from various disciplines in allied health professions. Course prerequisites include courses in the subjects of Cell Biology, Anatomy, and Physiology.

The course home page has the following content links: Syllabus, Lessons, Assignment Resources, Pathology Review, Instructor Support, and Help and FAQs. All courses developed by this professional group are designed using a standard template and information architecture. This information architecture, now in its second iteration, was designed based on current research in usability and pedagogy.

The syllabus contains these pages: Meet Your Instructor, Course at a Glance, Course Introduction, Course Materials (including a link to the Pathology Review), Assignments and Guidelines, and the institution's Academic Integrity Policy.

The 14 lessons are organized into 5 units. The course content begins with general principles and moves through the various organ systems in the body. Course lectures are delivered via audio lectures by instructors who are experts in the various topics covered in the course. The Pathology Review is a computerized drill and practice resource. Its purpose is to help students prepare for the course exams by identifying their strengths and weaknesses on 32 different topics and to expose students to the types of questions they are required to answer on the exams. The assessments in this course are 5 proctored, face-to-face exams. Each exam is worth 20 percent of the students' final grade.

Assignments

S1: "I found the assignments and grading and schedule difficult to find. It's hard to see when things are actually due."

S2: "I did not find it easy to find the assignments."

S3: "The assignments were not clear. I had a hard time figuring that out."

S4: "I had to search a little to find the assignments."

S5: This student did not comment on the assignments. She found them easily.

Content

S1: Student had no trouble accessing the audio lectures. Student also had no problems accessing the correct topic in the Pathology Review.

S2: Student easily found the audio lectures and used the left table of contents in the slide player to correctly navigate to the lecture identified in the task. However, the student did not recognize that the audio player opens in a new browser window. The student stated that they would like "cross-referencing' links within the pages to connect pages to other content."

S4: "Finding content on the course site is easy."

S5: "I like that the content is broken up into modules and that the content on the pages is not too long."

Messaging

Course messaging was via the internal WebVista mail tool. The instructor explicitly states in the syllabus she only was to be contacted via the internal e-mail system.

S1: "It's very easy to communicate with others in the class."

S2: "Using the WebVista e-mail tool is easy."

S3 "Using e-mail was easy."

S4: "I had a hard time figuring out how to e-mail the professor. I don't see where to contact her in the syllabus. I don't know how to send a message to someone (i.e., use the mail tool). I need more detail on using the mail tool."

S5: "Everything was easy except how to use the mail tool."

Exams

The course had a total of 5 exams. Each exam was worth 20% of their grade.

S1: It did not register with this student that the exams were proctored, face-to-face exams rather than online exams. Student had a hard time finding the form for the proctored exam and, once they found it, did not understand its function. “I can’t find how you submit the exams. My best guess would be under Assessments.”

S2: Student immediately found exam information under the Assignments and Grading link. They did not comment on the exams.

S3: Student had difficulty locating information on the exams. “There should be one link that has all the exam information in one place.”

S4: Student did not have any trouble finding exam information however, they stated, “I’m unsure how to submit the form for the proctored exam.” The proctored exam form must be completed and submitted before a student can schedule an appointment to take their exam.

S5: Student did not have any trouble finding exam information and did not comment on the exams.

Grades

All students found the location of their grades quickly. One student commented, “Finding grades and using e-mail was easy.”

Navigation

The course has multiple types of navigation available for student use. These navigational tools are built into the WebVista CMS and include: Breadcrumbs, Left navigation table of contents (TOC), Home button, Back button. Drop down menu, Scrolling, and Search.

Students particularly like the left navigation TOC. All students used left navigation bar TOC to get to a particular page and then the scroll bar to navigate through the pages of content.

S1: “The site is easy to navigate.”

S2: “It’s easy to see what you need to do, but the words (link labels) are difficult.”

S3: “I would like to see internal links in the pages that would make it easier to connect to different parts of the course.”

S4: “It’s really nice to have the left navigation bar in the modules. It’s easy to use.”

S5: “Although I’ve never taken an online course before, this is easy to navigate.”

Student Recommendations

One of the debrief interview questions asked students for their recommendations for improving the site.

S1: “I hoped that it would say in the course description that the exams are proctored and recommends calendar in WebVista with more information and the due dates for assignments.”

S2: “It took me a long time to find the evaluation form and it would be helpful to have a ‘Submit’ button right there on the form.”

S3: “I would like more links in the pages that go to other pages.” (i.e., cross-referencing)

S4: “Provide instructions on how to submit assignments.”

S5: “I would like a different set-up for the home page. I would like the entire syllabus on the home page.”

Single Most Important Change

In the debriefing interview, after students were asked for recommended changes, they were asked to identify the single most important change they would make to the course site. This is how they responded.

S1: “A calendar filled out with the assignment due dates. It’s easy to overlook things on the Internet.”

S2: “Placing a ‘Submit’ button on the evaluation forms. I never found how to submit the evaluations.”

S3: “Place links in the pages and cross-reference pages.”

S4: “Place information on how to contact instructor in the syllabus—I don’t know how to use mail. I need more detail.”

S5: “Place the actual syllabus on the home page.”

Tasks

During the debriefing interview students were asked to identify both the easiest task and the most difficult task they were asked to complete during the testing session. Here are their responses.

Easiest Task

S1: “To communicate with others—it’s easy to use the mail tool and the discussion area.”

S2: “E-mail and grades.”

S3: “Finding grades and using the mail tool.”

S4: “Finding modules and the (audio) lectures.”

S5: “The site is fairly easy to navigate—I’ve never taken an online course before.”

Most Difficult Task:

S1: “Hard to find exact things (asked for in the tasks). It was hard to find information about the exams.”

S2: “Hard to see things on the screen the content was only about 2/3s of the screen.” (The rest of the screen real estate was used by the standard CMS elements.)

S3: “Finding exactly what the assignments are.”

S4: “Figuring out how to use the (internal) mail to e-mail the professor.”

S5: “Printing things from the course site—I do not like the compile and print—that it runs all the pages together. I would rather have the pages separate.”

Tools

All students thought that any tools used in the course should be visible in the toolbar.

Course 3 Alcohol and Substance Abuse Course

Course 3 Tasks

You have registered for an online course. It is the first week of your course. You want to check out the course web site to see how it works.

Task 1
Find out how many graded assignments are due in the course.
PLEASE REMEMBER TO THINK ALOUD

Task 2
You have a family emergency come up and you will need to submit one of your assignments late. Locate the professor's late submissions policies.

Send an e-mail to explain the situation.
PLEASE REMEMBER TO THINK ALOUD

Task 3
Access the Comprehension Check Quiz.

How long do you have to take the quiz?
When is the last day you can take this quiz?
What class materials do you need to study to prepare for the Comprehension Check?
PLEASE REMEMBER TO THINK ALOUD

Task 4
It's the eighth week of class and you want to check your progress in the grade book. Check your grades.
PLEASE REMEMBER TO THINK ALOUD

Task 5
Access the audio lecture in Lesson 6.

Find the part of the lecture which discusses the long-term effects of chemical use on the adolescent brain.
PLEASE REMEMBER TO THINK ALOUD

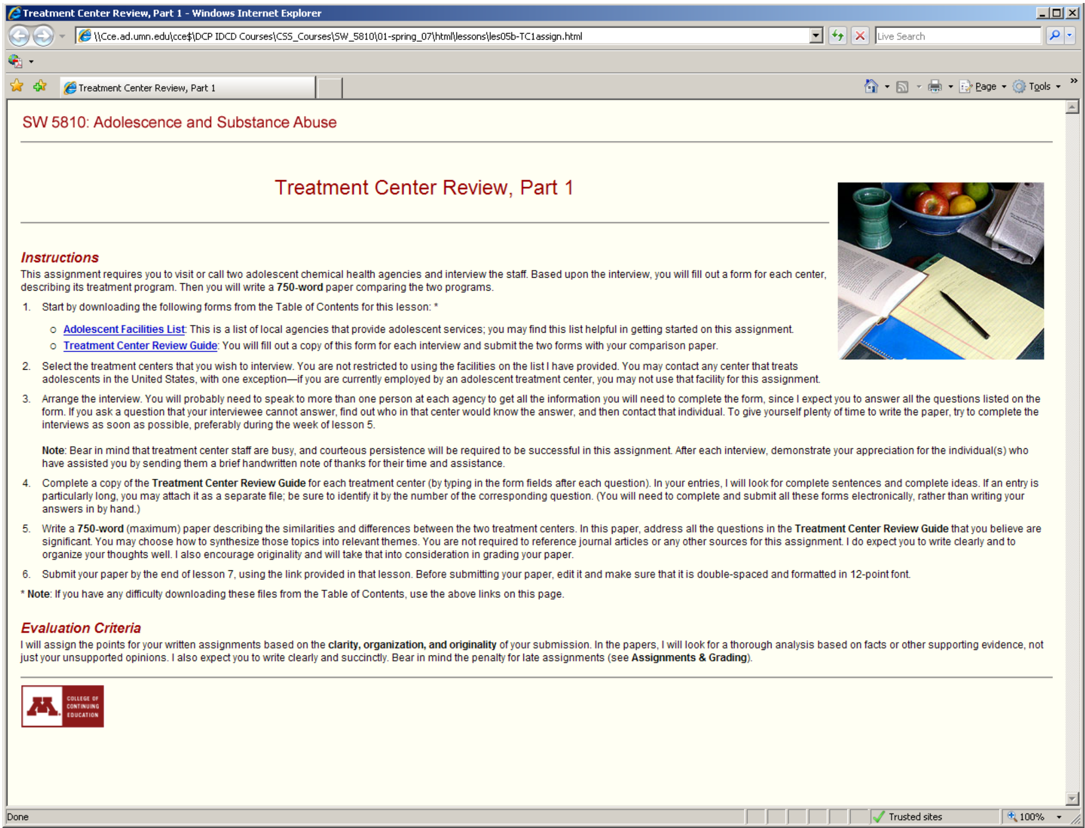
Task 6

This course has two text books and other articles that are required readings. How do access the readings that are not found in the two texts?
PLEASE REMEMBER TO THINK ALOUD
Task 7
In Lesson 12 you will learn about screening and assessment options.

Identify the twelve levels of care described in TIP 32?
PLEASE REMEMBER TO THINK ALOUD

Course 3 Alcohol and Substance Abuse Course Screen Shots

Treatment Center Review, Part 1



Treatment Center Review, Part 1 - Windows Internet Explorer

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SW 5810: Adolescence and Substance Abuse

Treatment Center Review, Part 1

Instructions

This assignment requires you to visit or call two adolescent chemical health agencies and interview the staff. Based upon the interview, you will fill out a form for each center, describing its treatment program. Then you will write a **750-word** paper comparing the two programs.

1. Start by downloading the following forms from the Table of Contents for this lesson: *
   - Adolescent Facilities List: This is a list of local agencies that provide adolescent services; you may find this list helpful in getting started on this assignment.
   - Treatment Center Review Guide: You will fill out a copy of this form for each interview and submit the two forms with your comparison paper.
2. Select the treatment centers that you wish to interview. You are not restricted to using the facilities on the list I have provided. You may contact any center that treats adolescents in the United States, with one exception—if you are currently employed by an adolescent treatment center, you may not use that facility for this assignment.
3. Arrange the interview. You will probably need to speak to more than one person at each agency to get all the information you will need to complete the form, since I expect you to answer all the questions listed on the form. If you ask a question that your interviewee cannot answer, find out who in that center would know the answer, and then contact that individual. To give yourself plenty of time to write the paper, try to complete the interviews as soon as possible, preferably during the week of lesson 5.

   Note: Bear in mind that treatment center staff are busy, and courteous persistence will be required to be successful in this assignment. After each interview, demonstrate your appreciation for the individual(s) who have assisted you by sending them a brief handwritten note of thanks for their time and assistance.
4. Complete a copy of the **Treatment Center Review Guide** for each treatment center (by typing in the form fields after each question). In your entries, I will look for complete sentences and complete ideas. If an entry is particularly long, you may attach it as a separate file; be sure to identify it by the number of the corresponding question. (You will need to complete and submit all these forms electronically, rather than writing your answers in by hand.)
5. Write a **750-word** (maximum) paper describing the similarities and differences between the two treatment centers. In this paper, address all the questions in the **Treatment Center Review Guide** that you believe are significant. You may choose how to synthesize those topics into relevant themes. You are not required to reference journal articles or any other sources for this assignment. I do expect you to write clearly and to organize your thoughts well. I also encourage originality and will take that into consideration in grading your paper.
6. Submit your paper by the end of lesson 7, using the link provided in that lesson. Before submitting your paper, edit it and make sure that it is double-spaced and formatted in 12-point font.

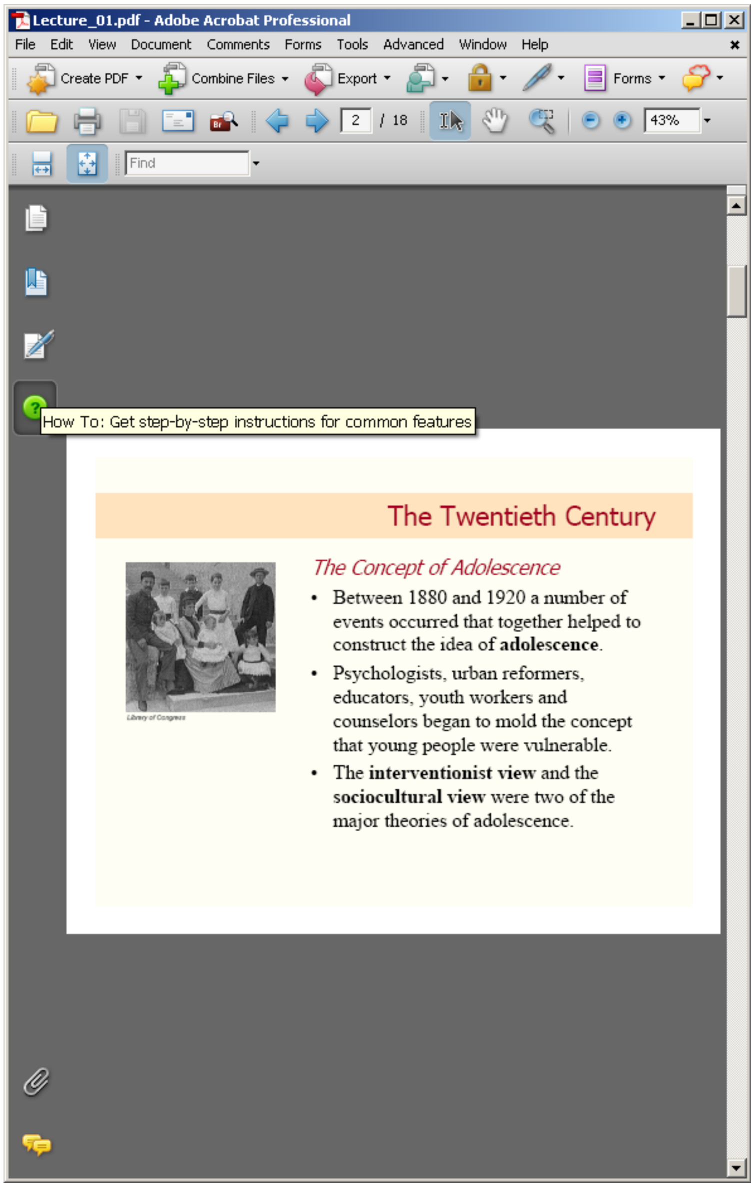
* **Note**: If you have any difficulty downloading these files from the Table of Contents, use the above links on this page.

Evaluation Criteria

I will assign the points for your written assignments based on the **clarity, organization, and originality** of your submission. In the papers, I will look for a thorough analysis based on facts or other supporting evidence, not just your unsupported opinions. I also expect you to write clearly and succinctly. Bear in mind the penalty for late assignments (see **Assignments & Grading**).

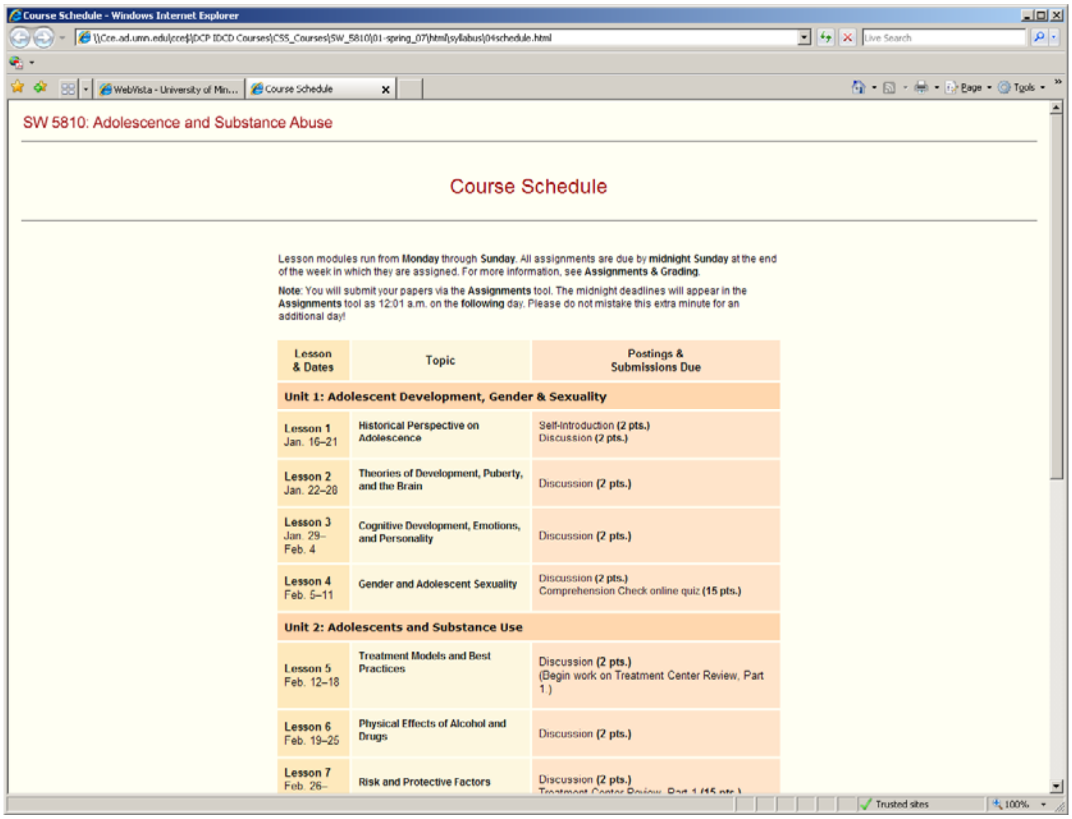
COLLEGE OF CONTINUING EDUCATION

This page contains the instructions for the Treatment Center Review assignment, a major project students complete for the course. The assignment and the instructions are broken into two parts.



A printable version of the Breeze presentation slides.

Course Schedule



SW 5810: Adolescence and Substance Abuse

Course Schedule

Lesson modules run from **Monday** through **Sunday**. All assignments are due by **midnight Sunday** at the end of the week in which they are assigned. For more information, see **Assignments & Grading**.

Note: You will submit your papers via the **Assignments** tool. The midnight deadlines will appear in the **Assignments** tool as 12:01 a.m. on the **following** day. Please do not mistake this extra minute for an additional day!

Lesson & Dates	Topic	Postings & Submissions Due
Unit 1: Adolescent Development, Gender & Sexuality		
Lesson 1 Jan. 16–21	Historical Perspective on Adolescence	Self-Introduction **(2 pts.)** Discussion **(2 pts.)**
Lesson 2 Jan. 22–28	Theories of Development, Puberty, and the Brain	Discussion **(2 pts.)**
Lesson 3 Jan. 29–Feb. 4	Cognitive Development, Emotions, and Personality	Discussion **(2 pts.)**
Lesson 4 Feb. 5–11	Gender and Adolescent Sexuality	Discussion **(2 pts.)** Comprehension Check online quiz **(15 pts.)**
Unit 2: Adolescents and Substance Use		
Lesson 5 Feb. 12–18	Treatment Models and Best Practices	Discussion **(2 pts.)** (Begin work on Treatment Center Review, Part 1.)
Lesson 6 Feb. 19–25	Physical Effects of Alcohol and Drugs	Discussion **(2 pts.)**
Lesson 7 Feb. 26–	Risk and Protective Factors	Discussion **(2 pts.)**

This page is an example of the Course Schedule page that appears in each of the Group One courses. This page is part of the professional group’s information architecture. This page is organized by week, topic, discussion postings and submissions due for each week. General instructions for assignment due dates and times appear at the top of this page. These instructions are customized for each course; due dates and times may vary by course. Notice its similarity to the Course One Course schedule.

Course 3 Alcohol and Substance Abuse Course Description

Heuristic Evaluation Rank: 3 of 6

Heuristic Evaluation Mean 1.83

Four students participated in usability testing sessions

Overview

This online alcohol and drug course was designed and developed by the professional development group in the WebVista CMS. The intended audience is composed of education, health science and counseling students from several different disciplines. There are no course prerequisites.

Assignments

S1: "Went straight to assignments."

S2: "I love how this course is set up. The assignments are easy to find."

S3: "Need more detail in the labeling of the assignments in the Assignments Tool."

S4: "Place a link in the assignments so that students can always e-mail the professor to ask questions as they do their assignments."

Content

The content is broken down into a syllabus folder and 14 lesson folders, one folder for each week. Syllabus materials include: Meet Your Instructor, Course at a Glance, Course Materials, and the Assignments and Grading pages. The lesson content includes an overview page for each lesson with a summary of the lesson, lesson objectives, and learning activities which includes the reading assignments and any exercises, written assignments, or quizzes assigned for each lesson. The lecture content is a Breeze presentation of PowerPoint slides with an accompanying audio lecture. Slides include contextual graphics for individual slide content. The content is well organized and clearly labeled. The students who tested this course made the comments below.

S1: “I can conveniently find content without going through lots of links. I really like the audio lectures, they are much more enhanced.”

S2: “I think that the audio lectures should advance by themselves. Is there a pause at the end?”

S3: “I like the way that the course is set up. I especially like the overview pages.”

S4: “I like that there are lots of links and lots of multimedia. Most online courses just have you read and discuss.”

Messaging

Course messaging was via the internal WebVista mail tool. Students were instructed in the syllabus to contact the professor with any questions and were told course e-mail is checked on Mondays and Fridays and that students can expect a response on those days.

S1: Student went directly to the mail tool and created a message.

S2: Student went directly to the mail tool and created a message.

S3: Student went directly to the mail tool and created a message.

S4: Student went directly to the mail tool and created a message.

Exams

The course had one quiz that asked multiple choice questions on the content of the lessons 1-7, specifically the required readings, in the two texts. The remaining readings which were articles and National Institutes of Health publications were used in the written assignments.

S1: “I’m not sure what is covered on the quiz.”

S2: “I’m not sure where to find the quiz.”

S3: This student did not make any comments on the quiz.

S4: This student did not make any comments on the quiz.

Grades

All students found the location of their grades quickly. However, several students mentioned that the “My Grades” tool should be visible on the toolbar with the other tools there rather than hidden under the “More Tools” tab.

“It would be helpful if all tools were visible in the toolbar—right now ‘My Grades’ are under ‘More Tools’ a tab that contains any tools not visible in the toolbar.”

S1: “I like that I can check my grades online. It’s much more convenient.”

Although Student 2 had prior experience with an online course housed within the WebVista CMS, they did not look for grades under the My Grades tool on the home page. Rather, they looked on the assignments page under the “Graded” tab where the scores of graded assignments would be recorded for each assignment. When I pointed out the “My Grades” tab to access grades, they thought that “the location on the home page was very convenient.”

Student 3 went directly to the “My Grades” tab under “More Tools” but questioned why the grade tool did not have grades listed by each week.

Student 4 also went directly to the “My Grades” tab under “More Tools” and commented that they like the ability to check grades online.

Navigation

The course has multiple types of navigation available for student use. These navigational tools are built into the WebVista CMS and include: Breadcrumbs, Left navigation TOC, Home button, Back button. Drop down menu, Scrolling, and Search. Students particularly like the left navigation TOC. All students commented on liking the multiple ways of navigating through the course site and specifically commented on how much they liked the left navigation bar TOC.

S1: “I loved the course site. Comparing it to the one that I took last spring, I am very impressed. It was so much easier to navigate. I really like the way everything is set up.”

S2: “Overall the course is easy to use. The left-hand navigation is good. Everything is always right there and you can jump to anything from there.”

S3: “Likes the ease of navigation and the ‘handiness’ of the site.”

S4: “I like being able to use the various, different methods of navigation.”

Student Recommendations

S1: “I did not find anything I disliked in the course.”

S2: “I would like the readings and slides to be in a separate folder so they can be downloaded and printed all at once. However, I also like that they are in the individual lessons, too. That‘s convenient. I would like the separate folder to be in addition to the readings and slides in the lessons.”

S3: “Make ‘FAQs and Help’ a link.”

S4: “Place a link in the assignments to make sure that students always can easily e-mail the professor if they have a question.”

Single Most Important Change

S1: “I don’t know. I liked finding the assessments in the Toolbar rather than in “More Tools.”

S2: “I would like all the readings and slides to be in one folder so I could download them all at once. It would be easier if they were all in one place.”

S3: “The home page looks very generic, it should look friendlier. The numbering of the lessons is confusing because it’s organized horizontally rather than vertically. It’s confusing.”

S4: “Make sure that the quiz information is in the lesson overview page in bold with the before midnight deadline.”

Easiest Task

S1: “Checking grades.”

S2: “Finding the modules and syllabus.”

S3: “Navigation is the easiest with the left nav bar table of contents.”

S4: “Accessing the lessons and assignments.”

Most Difficult Task

S1: “I did not find any of it hard.”

S2: “Finding the quiz.”

S3: “Finding where the lessons were—the screen is so generic—I was vertically lost on the screen until I got used to it. However, the course is definitely better than what they have seen in other courses.”

S4: “Finding the details on the writing assignments.” (These are in the Assignments Guidelines which are linked from the Assignments and Grading page in the Syllabus.)

Tools

All students thought that any tools used in the course should be visible in the toolbar.

Course Descriptions:

Group Two Courses

Nonprofessionally Developed Courses

These online courses were developed by academic department personnel—instructors, department staff, or student workers. The format of these courses varies. Two of the courses are developed in the WebVista CMS and the third course is developed in HTML on individual pages and delivered through the academic department's home page and another online course page.

Course 4 Technical Writing Course

Course 5 Science Course

Course 6 Alcohol and Substance Abuse Course

Course 4 Technical Writing Course Tasks

You have registered for an online course. It is the first week of your course. You want to check out the course web site to see how it works.

Task 1
Find out how many graded assignments are due in the course.
PLEASE REMEMBER TO THINK ALOUD

Task 2
You have a family emergency come up and you will need to submit one of your assignments late. Locate the professor's late submissions policies.

Send an e-mail to explain the situation.
PLEASE REMEMBER TO THINK ALOUD

Task 3
This course uses a peer evaluation process for written assignments. You need to do a peer evaluation of your group's papers for the assignment in module 7.

Locate the evaluation form.
How do you submit the form?
PLEASE REMEMBER TO THINK ALOUD

Task 4
It's the eighth week of class and you want to check your progress in the grade book. Check your grades.
PLEASE REMEMBER TO THINK ALOUD

Task 5
Post a self-introduction in the discussion area.
PLEASE REMEMBER TO THINK ALOUD

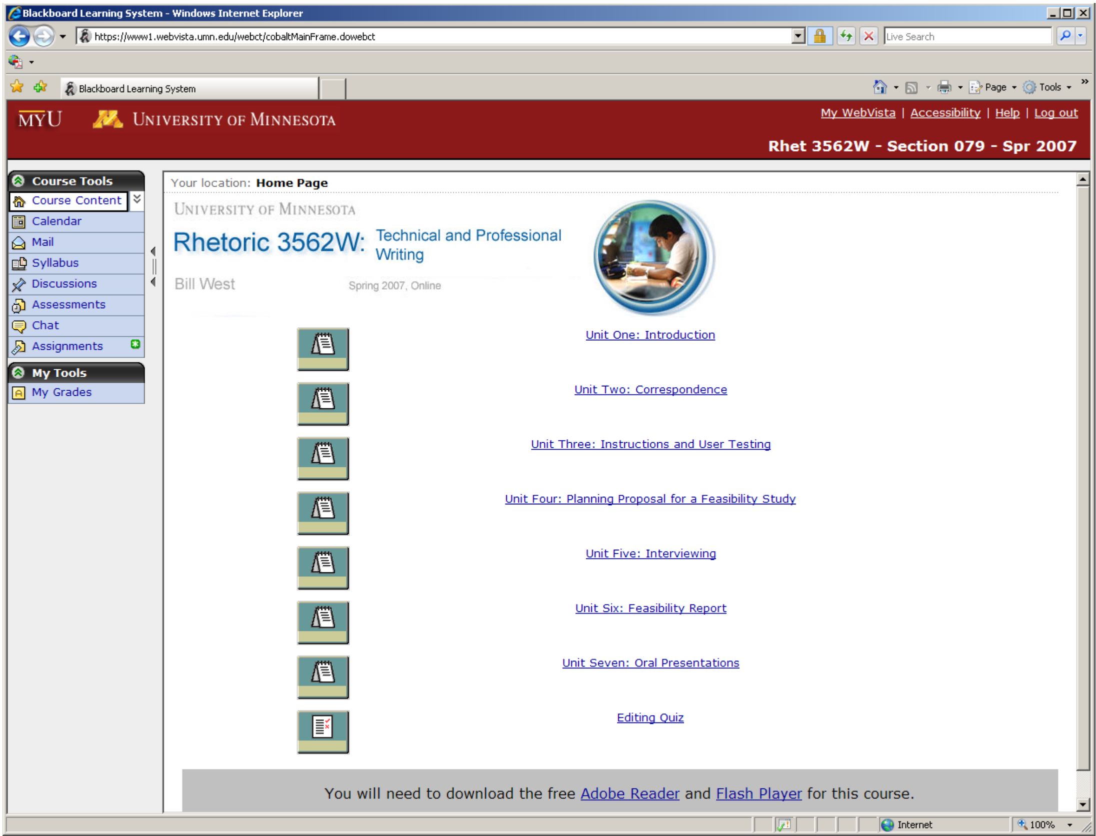
Task 6
It's mid-semester and you have an assignment to complete. What are the requirements of the mid-term assignment?

How do you submit it?
PLEASE REMEMBER TO THINK ALOUD

Task 7
Locate the assignment for module 14.
PLEASE REMEMBER TO THINK ALOUD

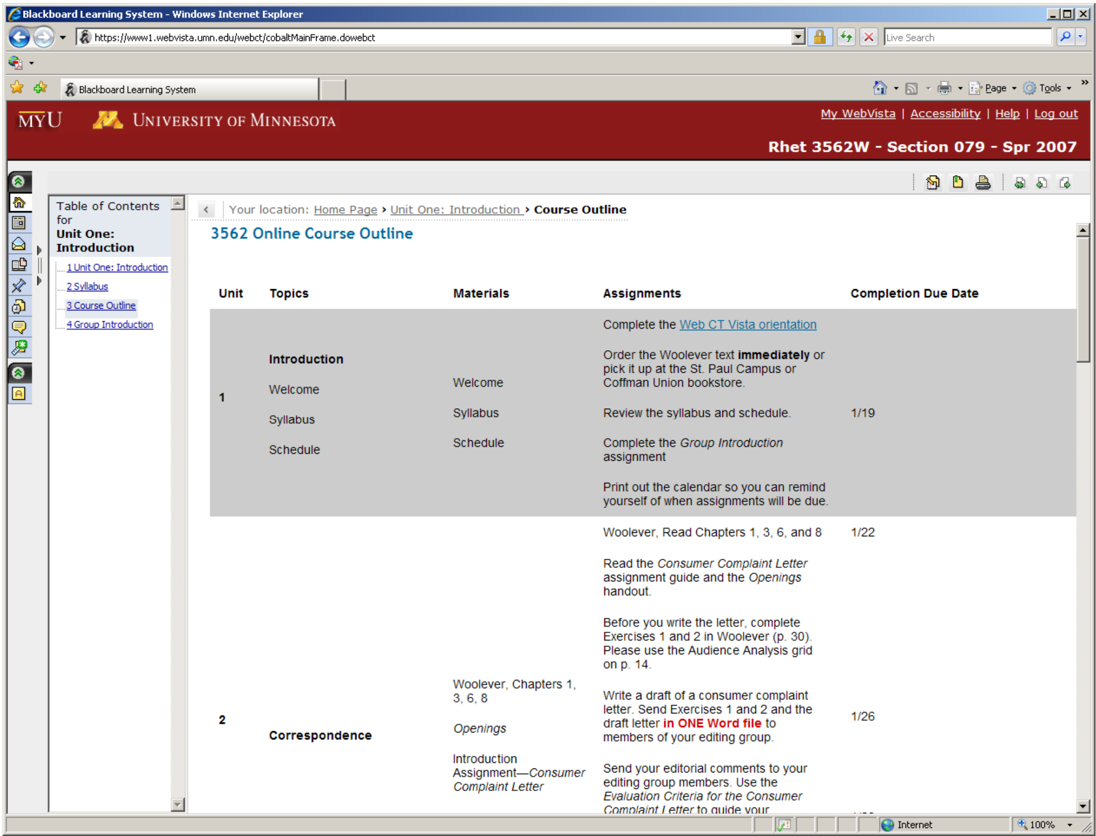
Course 4 Technical Writing Course Screen Shots

Home Page



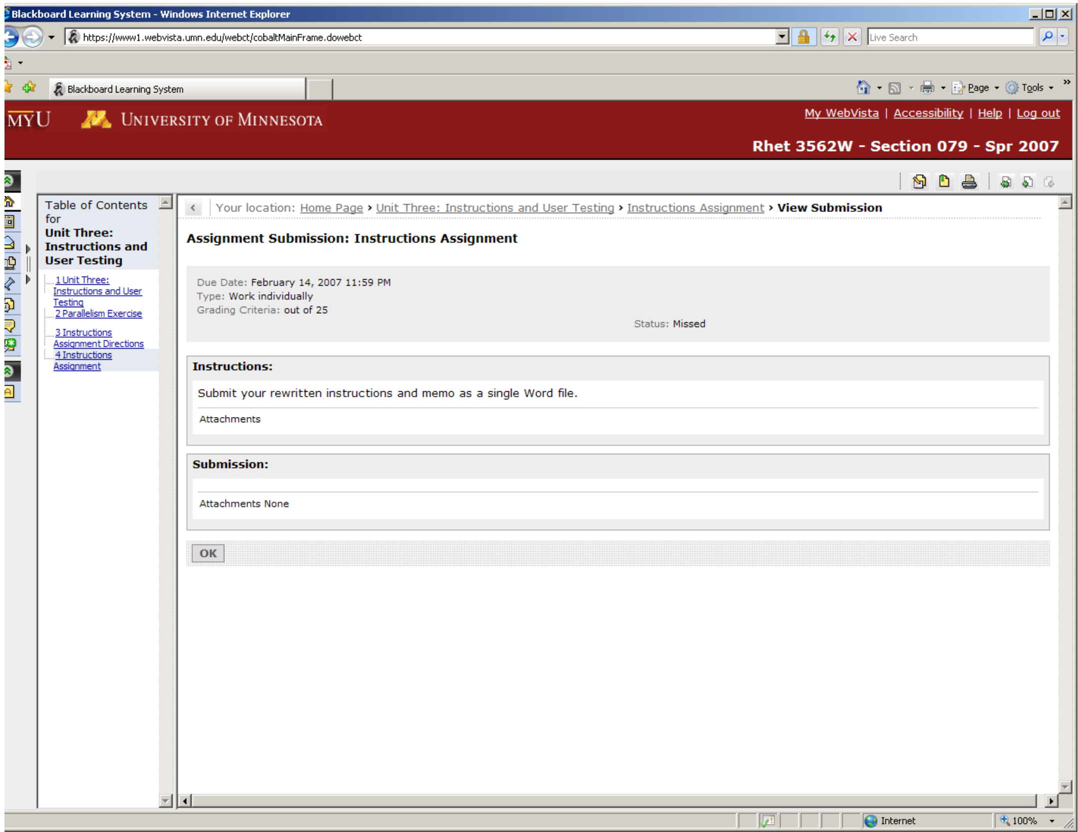
This is the course home page, the first page viewed by students. There is no indication of the number of *weeks*, the common category used to organize course materials, activities and assignments in a syllabus for a face-to-face class or of the number of lessons in the course. Instead, the content is broken down into "Units," a term that does not match course organization in the "real world."

Course Outline



This is the course outline for Course 4, which corresponds to the Course Schedule page in the professionally developed courses.

Assignments Tool



Note that the instructions written in the Assignments Tool are generic, simple, and only describe how to submit the assignment submission. To access and view the instructions for the assignment itself, students must click to another page in the course site. There is a link to the instructions in the left navigation bar table of contents.

Course 4: Technical Writing Course Description

Heuristic Evaluation Rank: 4 of 6

Heuristic Evaluation Mean 1.84

Five students participated in usability testing sessions

Overview

This online technical writing course was designed and developed by personnel in the academic department in the WebVista CMS. The audience is composed of students from various disciplines. There are no course prerequisites.

The course is divided into 7 units; these links (Unit One, Introduction; Unit Two, Correspondence; Unit Three, Instructions and User Testing; and listed on the home page with a link to the Editing Quiz.

The syllabus is part of Unit One and contains these page sections: Goals, Learning Online, Electronic Tools, Online Editing Groups, Course Rules, Grades, How to Succeed in this Class. The Course Outline which functions as the course schedule and the Group Introduction Assignment are the other pages in the first unit.

The lessons are organized into the remaining 6 units. The course content begins with writing various types of correspondence and moves through writing different types of instructions, planning and designing a feasibility study, the course project, interviewing, writing different types of reports and oral presentations. The students do not have to give an oral presentation; they only have to prepare a written document of the 5-10 minute presentation they would give on their project as if they were presenting to a face-to-face class. Course lectures are delivered via written study notes. The class is divided into peer review groups who review and critique each others' work before it is submitted. The assessments in this course are the written assignments and the editing quiz. The written assignments are submitted through the WebVista Assignments Tool and the Editing Quiz is completed via the WebVista Assessments Tool. The grades are based upon eight assignments, the editing quiz, and a class participation grade.

Assignments

S1: This student completed all of the tasks related to the assignments. They did not make any comments on the assignments during the usability testing session.

S2: This student completed all of the tasks related to the assignments. They did not make any comments on the assignments during the usability testing session.

S3: "The assignments are broken down into so many parts that you have to go back and forth between pages. I don't like having to go back and forth between the pages."

S4: "This was a little confusing. I would expect that the site would explain more about the assignments."

S5: "I don't know how to submit the assignments."

Content

Course content was presented in 6 units. Each unit covered a general topic with several different sub-topics within each unit.

S1: This student completed all of the tasks related to the content. They did not make any comments on the content during the usability testing session.

S2: This student completed all of the tasks related to the content. They did not make any comments on the content during the usability testing session.

S3: “It would be easier if the syllabus had more headings and if the assignments were all together. We don’t read the whole thing. We only look for the answers.”

S4: “This course is a little confusing. I expected the syllabus to go into more depth. I don’t like that it does not look like a regular syllabus. They had to figure out that they could find things (the content contained in the unit links) from the home page.”

S5: “I would like more guidelines on how to use the course site. I would like the language to be more consistent.” (In the syllabus students were instructed to refer to the WebVista tutorial for help in using the course site.)

Messaging

It was not clear (to the researcher) in the syllabus about the messaging system used in the course. There is a link on the toolbar to the internal WebVista mail tool. Students were instructed in the syllabus to contact their peer group members in their “group space.”

S1: “I had trouble finding the instructor’s e-mail address. That should be at the top of the (syllabus) page.”

S2: “I am surprised that the instructor’s e-mail address is not in the syllabus.”

S3: “I can’t find the instructor’s e-mail (in the syllabus). I’m hoping to find it without having to read the entire (syllabus) page.”

S4: “I could not find the instructor’s e-mail in the course. I would use the university e-mail system instead.” (The student went back to the course to find the professor’s name and looked it up using the search function on the university site.)

S5: “How to contact the instructor is not clear.”

Exams

The course had a one editing quiz accessed via the Assessments Tool that required students to answer questions on editing documents.

None of the students made any comments on the editing quiz.

Grades

All students found the location of their grades quickly. However, several students mentioned that the “My Grades” tool should be visible on the toolbar with the other tools there rather than hidden under the “More Tools” tab.

S5: “The grading was frustrating because I would like to see grades with points and total points listed for each assignment. I would probably not look check under ‘More

Tools' (a tab that contains any tools not visible in the toolbar). It would be helpful if all tools were visible in the toolbar."

Navigation

The course has multiple types of navigation available for student use. These navigational tools are built into the WebVista CMS and include: Breadcrumbs, Left navigation TOC, Home button, Back button. Drop down menu, Scrolling, and Search. Most students particularly like the left navigation TOC except for one student who did not like the "expand and collapse" feature of the TOC. This feature hides the links within an "expandable" category. An expandable category is indicated by a plus sign to the left of the main category link. To see the full range of categories and links, students must click on the small plus sign icon. When the category is expanded, it may be collapsed by clicking on the same icon which has become a "minus" sign.

All students used scrolling to navigate through the pages of content, since a large quantity of content was below the bottom of the screen and not visible.

S1: This student completed all tasks. They did not make any comments on the navigation during the usability testing session.

S2: "Overall, it (the site) was OK to use."

S3: "It was pretty easy to find out where you had to go. The course was easy to navigate, but I didn't like having to go back and forth because the assignments were broken down."

S4: “I kind of forgot about the home page and forgot to go back there.”

S5: “I would like different terminology and easier links.”

Student Recommendations

One of the debrief interview questions asked students for their recommendations for improving the site.

S1: This student did not make any recommendations.

S2: This student did not make any recommendations.

S3: “Place more headings in the syllabus.”

S4: “I would not have ‘Units’ on the home page. I did not understand that it was the actual course.”

S5: “Figuring out how to submit assignments was hard. I’m the kind of person who would not understand the assignment tool.”

Single Most Important Change

In the debriefing interview, after students were asked for recommended changes, they were asked to identify the single most important change they would make to the course site. This is how they responded.

S1: This student did not make any recommendations.

S2: This student did not make any recommendations.

S3: “Place more headings in the syllabus.”

S4: “Explain how to contact the group members.”

S5: “Use a consistent terminology and make the links easier. How to contact the instructor is not clear.”

Tasks

During the debriefing interview students were asked to identify both the easiest task and the most difficult task they were asked to complete during the testing session. Here are their responses.

Easiest Task

S1: “Checking grades.”

S2: “Checking my grades was the easiest.”

S3: “The site is easy to navigate. The left navigation bar and the tools are easy to use.”

S4: “I like the way the site is organized. You know what you have to do for the assignments.”

S5: “Locating the syllabus and finding the grades.”

Most Difficult Task

S1: “Finding the instructor’s e-mail and how to contact them.”

S2: “Finding out how to e-mail the instructor. The syllabus does not have the contact information.”

S3: “Trying to find the late submission policy.”

S4: “Finding where the class content was located. The home page was confusing.”

S5: “Finding out how to submit assignments.”

Tools

All students thought that any tools used in the course should be visible in the toolbar.

Course 5 Science Course Tasks

You have registered for an online course. It is the first week of your course. You want to check out the course web site to see how it works.

Task 1
Find out how many exams are required for the course.

Where do you take the exams?

Which exam occurs from 7/23-8/1?
PLEASE REMEMBER TO THINK ALOUD

Task 2
You have a family emergency come up and are unable to take an exam during the scheduled time frame.

Find the professor's contact information so you can explain the situation.
PLEASE REMEMBER TO THINK ALOUD

Task 3
The lectures in this course are delivered online.
Access the lecture for "Purification Techniques and Analysis."

Where do you find the written lecture notes?
PLEASE REMEMBER TO THINK ALOUD

Task 4
You need to read the essay, "Dissociation of Weak Acids."
Locate the essay on the course site.
PLEASE REMEMBER TO THINK ALOUD

Task 5
Locate the thermodynamics problems assignment.
PLEASE REMEMBER TO THINK ALOUD

Task 6
It's mid-semester and you need to study for an exam.

Access the practice quizzes and tutorials provided on the course site.

PLEASE REMEMBER TO THINK ALOUD

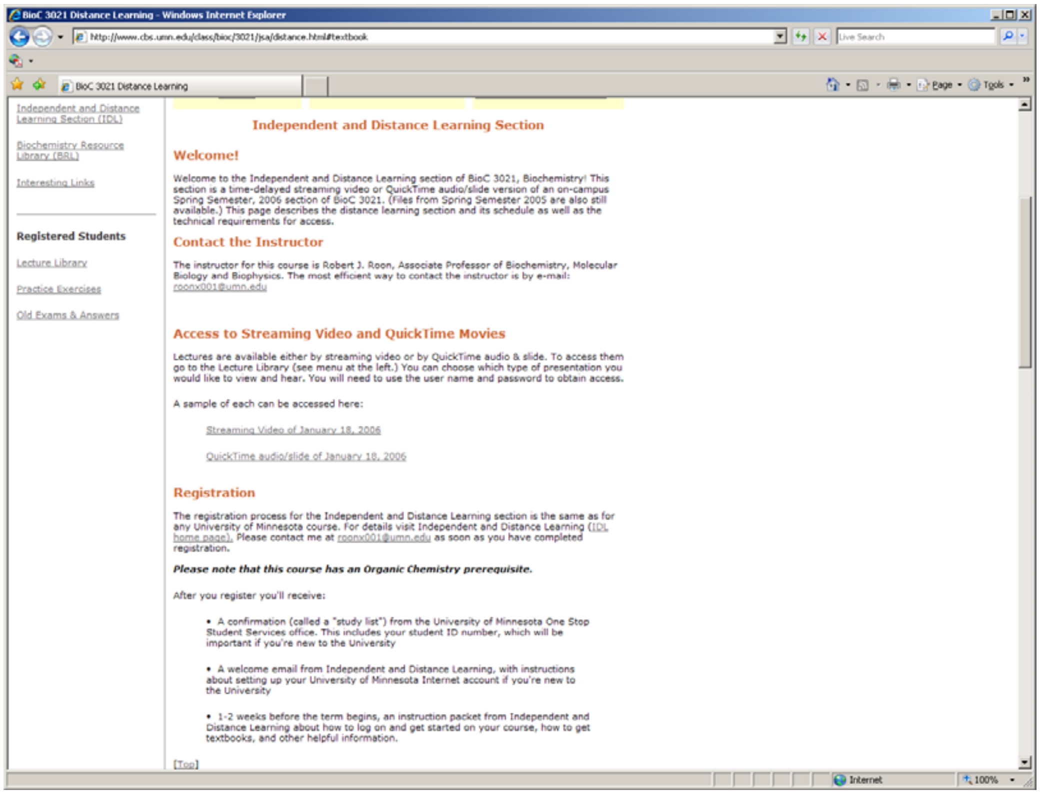
Task 7
Locate the thermodynamics problems quiz.
PLEASE REMEMBER TO THINK ALOUD

Course 5 Science Course Screen Shots

Syllabus

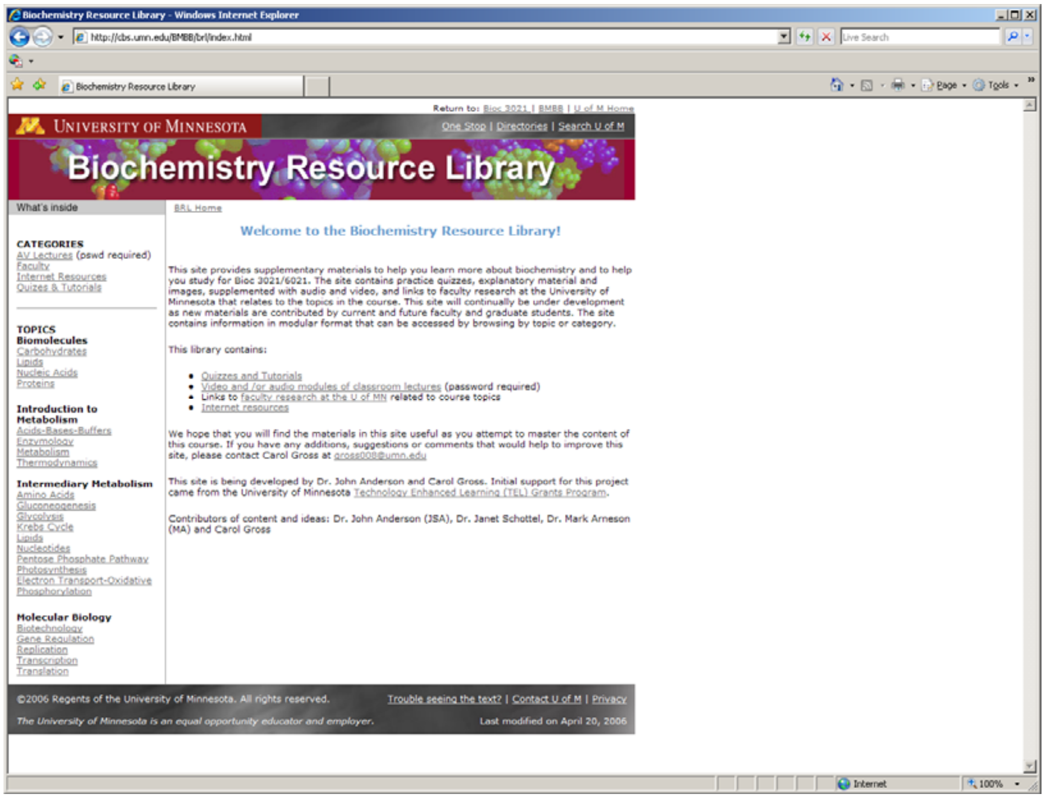
This is the science course syllabus of the nonprofessionally developed course group. This is one long web page broken up by headings as seen above. To access and view content situated below the bottom of the screen students must scroll down through the content to find the applicable section.

Home Page



This is the science course home page of the nonprofessionally developed course group. Again, this is one long web page broken up by headings as seen above. To access and view content situated below the bottom of the screen students must scroll down through the content to find the applicable section.

Resource Library



This is the resource library for the science course of the nonprofessionally designed course group. It is a separate web page which is accessible from the left navigation bar table of contents. This page was confusing to students because it resides on the academic department rather than course web site.

Course 5: Science Course Description

Heuristic Evaluation Rank: 6 of 6

Heuristic Evaluation Mean 1.79

Six students participated in usability testing sessions

Overview

This online science course was designed and developed by academic department personnel in HTML without the use of a CMS. Course content was served on individual web pages. The content was not organized in folders visible to students. Students see two different sites. There is the main department site home page that links to a portion of the course content and the separate password-protected portion of the site. This jump between different sections of the site caused confusion for students because they were not sure whether or not they were still in the same, correct, course site.

Since this course was not housed in a CMS, there was no set of course tools, no special navigation features, and no course calendaring tool. Any messaging occurred outside the course site using the students' individual e-mail client.

Course content included a lecture library containing audio lectures, QuickTime movies, readings, a resource library containing tutorials, practice problems, and practice questions for exams. The majority of the dates on the course web pages were not current. The course site has been used for years and this prior use was evident in the dates from previous semesters still present on course content pages to be used by students enrolled in the current semester course. Students had to search through the site to find any course sections with the current date. Course pages, (most notably the syllabus, with previous semester dates) were used in the current course, even though the dates had past. Also, the same course site is used by several different faculty and faculty names other than the professor teaching the current course were present. This discrepancy caused confusion for students registered in the current course because it did not match their expectation, that is, to see their professor's name on course materials relevant to *their* course.

A syllabus page included an embedded course schedule. Site navigation was via links embedded in the content pages, links in the left navigation bar, or by scroll bars on the web pages. This navigation provided the way for students to find course content. Assessment for the course was a series of five face-to-face proctored exams which were to be completed by a prescribed due date. Students scheduled exams by appointment on campus in the online and distance learning program supervised exam room or off-campus at a site with a proctor. The off-campus site and the proctor must be pre-approved in writing by online and distance learning program personnel before the student may sit for the examination.

Assignments

The course assignments included reading, listening to audio lectures, tutorials, practice problems, and the exams. However, the only graded assignments for the course were the proctored exams.

S1: “The first task (about the assignments) is confusing because the dates aren’t current.”

S2: “I’m surprised that I can’t find any information about the exams in the syllabus.”

S3: “The practice quizzes and tutorials (to prepare for the exams) were hard to find.”

S4: This student quickly navigated to the Summer session 2007 section and correctly identified the number of exams, the proctor information, and the location of the examination room on campus. The student did not make any comments about this task.

Content

Syllabus materials were on one page which is broken down with headings, but it is text heavy and students had to navigate by scrolling through the page several times to find information they were asked to find in the tasks.

S1: “I don’t like the way the content is on the course pages. It is too busy; there is too much here. When there are huge paragraphs on the home page you do not read them. It’s better just to have links on the home page.”

S2: “I thought the content was fairly organized, but I was never quite sure where I should go; there were lots of choices and I was not sure which path to take. The words used to label the content were confusing. [There are] Too many choices not sure where to look—it was hard for me to find what I was looking for—it was not obvious to me what things were. It was hard to find specific things in the syllabus."

S3: "It would be easier if the lessons had topic titles."

S4: "It was hard to find some (content) pages. Once I was on the correct page it was easy to find things."

S5: "The lecture library is confusing. The labeling on the lectures is a problem."

S6: "I think that there should be a link for the written lecture notes in the course site. If they put the lecture notes online, they would not have to have a separate packet."

Messaging

Course messaging was via the students' individual e-mail client. Students did not have any comments on sending messages through their regular e-mail versus a dedicated course mailbox or system.

Exams

The course had a total of five examinations which are proctored and face-to-face. The site provides multiple ways for students to practice the course content covered on the exams. There are practice problems, practice quizzes, and old exams with the answer keys posted in the course site.

S1: "All the exam materials should be in one place."

S2: “I would like all the exam material in one place.”

S3: “I assume that the practice exams are the same as the practice quizzes and tutorials.” They are not the same. The student made an erroneous assumption.

S4: Did not comment on the exams.

S5: “Finding the exam information was difficult. I would assume that all exam information would be in one place.”

S6: “I like that there is so much material to study from—practice quizzes and problems, the old exams and the answer keys. I like that there is material to study from previous semesters.”

Grades

This category is not applicable to this course site. Students receive their grades on proctored exams which are taken face-to-face on campus, scored by the professor, and mailed back to students by online and distance learning program personnel. Several students mentioned that they would like to have access to their grades online.

Navigation

The use of both the main academic department page and a different page for the online and distance learning program course section caused navigation problems for students. When students navigated between the two different parts of the course site (which had distinctly different interfaces) students were unsure whether or not they were still in the correct site or not. In an attempt to get back to the correct page, one student clicked on the browser back button and was bumped to the College's main page. A lab staff member helped the student return to the correct page to continue with the usability test session.

S1: "Too much different information in the course site makes it hard to find things."

S2: "Did not realize that there was a regular site and an online and distance learning program course site."

S3: "Unclear meaning that there is a separate online and distance learning program course page."

S4: "Likes the links at the top of the screen."

S5: "I had no idea where to find the written lecture notes." (They are paper-based course materials which are mailed out to students in a packet.)

S6: "I like the examinations link in the left navigation bar."

Student Recommendations

One of the debrief interview questions asked students for their recommendations for improving the site.

S1: "Get rid of the information that is not needed for this semester. Seeing the other dates is confusing. The student doesn't want to deal with wading through all that extra information."

S2: “Compartmentalize things more and differentiate the regular and the online and distance learning program site more.”

S3: “Include the quizzes and tutorials with the lecture schedule—link to them from the lecture schedule.”

S4: “Combine the lecture schedule and the videos.”

S5: “Put all the information on the course site so you don’t have to send out a packet.”

S6: “Place the written lecture notes online.”

Single Most Important Change

In the debriefing interview, after students were asked for recommended changes, they were asked to identify the single most important change they would make to the course site. This is how they responded.

S1: “All items needed for the class should be organized with things only in one place.”

S2: “Organize and compartmentalize things more. You don’t need all that writing (text) because students just scroll through it anyway.”

S3: “Re-grouping (organizing) the quizzes and tutorials.”

S4: “Organize the lectures and the assignments on one page.”

S5: “Putting all the exam information in one place is the most important.”

S6: “Place a link to student grades to give us access online.”

Tasks

During the debriefing interview students were asked to identify both the easiest task and the most difficult task they were asked to complete during the testing session. Here are their responses.

Easiest Task

S1: “Finding the professor’s contact information and finding the assignments.”

S2: “Finding the assignments once I got into the swing of it.”

S3: “I could find anything from the first page.”

S4: “Finding the menu. I like the menu (links) at the top of the page because then I don’t have to scroll up and down the page.”

S5: “I like that the site is available prior to the start of class, however overall the site is difficult to use.”

S6: “Finding the professor’s contact information—it was right there.”

Most Difficult Task

S1: “Locating the first assignment. That was hard to do.”

S2: “Knowing whether or not I was on the correct web site due to the different dates, and wading through all the information.”

S3: “Finding the practice quizzes and tutorials.” When asked the follow-up question, “Why?” The student replied, “Not sure.”

S4: “It was hard to find the correct information.”

S5: “Finding the exam information was the most difficult.”

S6: “Hard to find the exam information.”

Tools

This category is not applicable for this course; there were no tools in this course site.

Course 6 Alcohol and Substance Abuse Course Tasks

Task 1
Find out what type of and how many assignments are due in this course.
PLEASE REMEMBER TO THINK ALOUD

Task 2
You have a family emergency come up and you will need to postpone your exam.
Send an e-mail to explain the situation to your professor.
PLEASE REMEMBER TO THINK ALOUD

Task 3
Find the first assignment to be submitted in the course.
How will you prepare and submit this assignment?
PLEASE REMEMBER TO THINK ALOUD

Task 4
It's the eighth week of class and you want to check your progress in the grade book.
Check your grades.
PLEASE REMEMBER TO THINK ALOUD

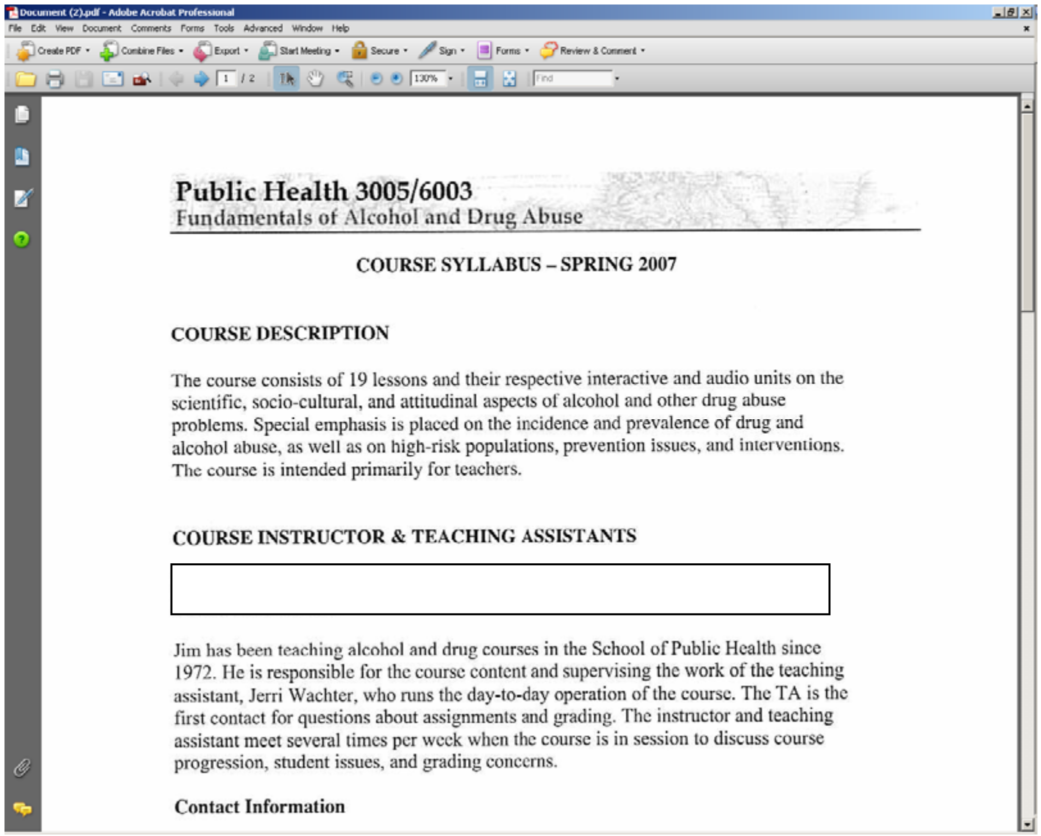
Task 5
What are the three models that form the basis of most alcohol and drug courses?
What models will be used in this course?
PLEASE REMEMBER TO THINK ALOUD

Task 6
It's mid-semester and you have an assignment to complete. What are the requirements of the mid-term assignment?
How do you submit it?
PLEASE REMEMBER TO THINK ALOUD

Task 7
Locate the audio lecture on alcohol and drug use in the elderly.
PLEASE REMEMBER TO THINK ALOUD

Course 6 Alcohol and Substance Abuse Course Screen Shots

Course Syllabus



Public Health 3005/6003
Fundamentals of Alcohol and Drug Abuse

COURSE SYLLABUS – SPRING 2007

COURSE DESCRIPTION

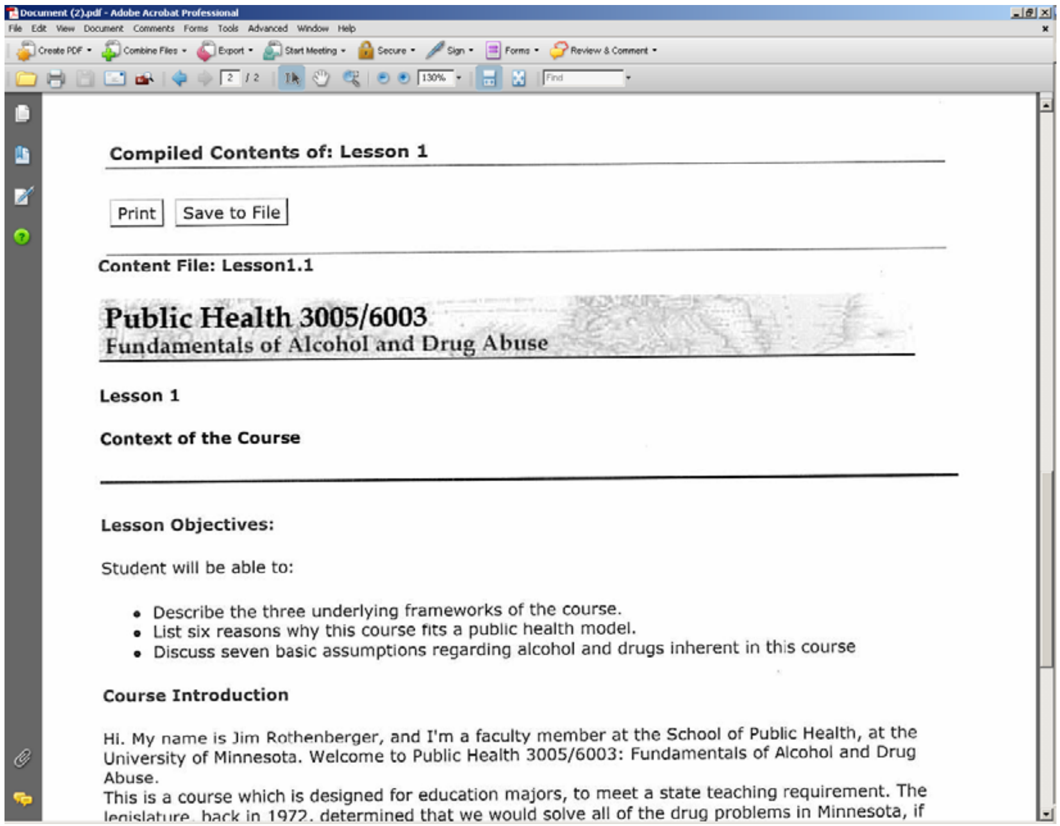
The course consists of 19 lessons and their respective interactive and audio units on the scientific, socio-cultural, and attitudinal aspects of alcohol and other drug abuse problems. Special emphasis is placed on the incidence and prevalence of drug and alcohol abuse, as well as on high-risk populations, prevention issues, and interventions. The course is intended primarily for teachers.

COURSE INSTRUCTOR & TEACHING ASSISTANTS

Jim has been teaching alcohol and drug courses in the School of Public Health since 1972. He is responsible for the course content and supervising the work of the teaching assistant, Jerri Wachter, who runs the day-to-day operation of the course. The TA is the first contact for questions about assignments and grading. The instructor and teaching assistant meet several times per week when the course is in session to discuss course progression, student issues, and grading concerns.

Contact Information

This is the first page of the course syllabus for the Alcohol and Substance Abuse course in the nonprofessional course development group.



Compiled Contents of: Lesson 1

Print | Save to File

Content File: Lesson1.1

Public Health 3005/6003
Fundamentals of Alcohol and Drug Abuse

Lesson 1

Context of the Course

Lesson Objectives:

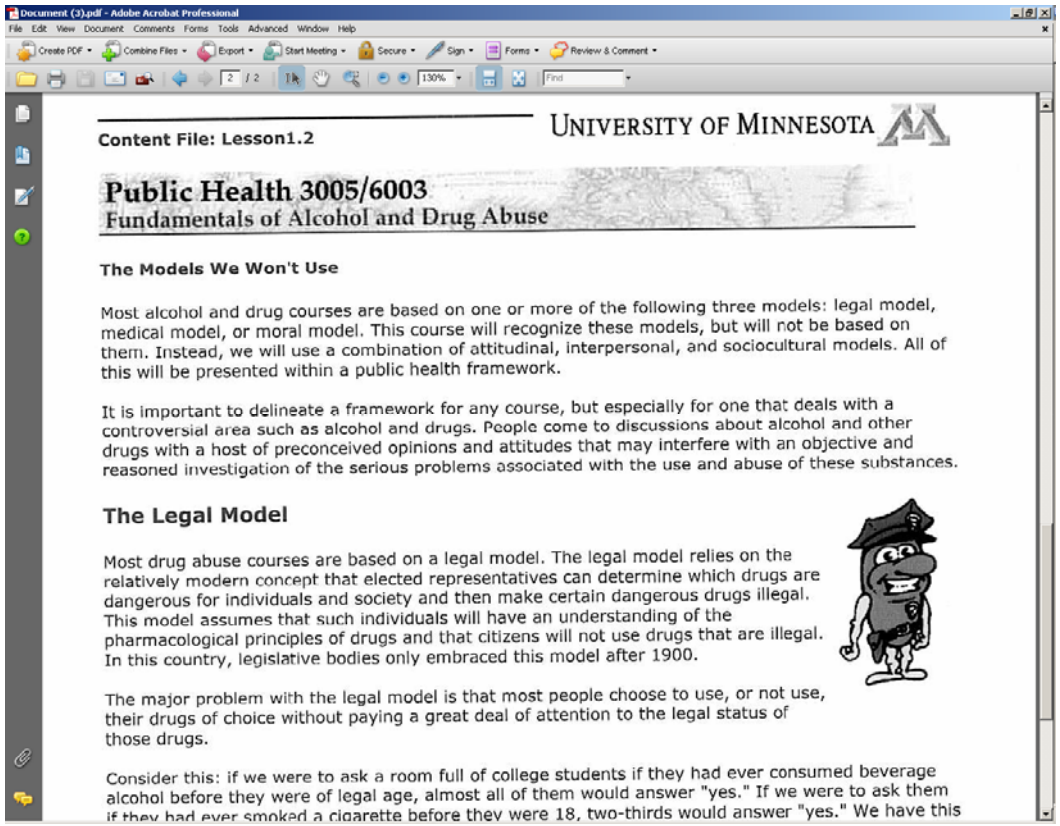
Student will be able to:

- Describe the three underlying frameworks of the course.
- List six reasons why this course fits a public health model.
- Discuss seven basic assumptions regarding alcohol and drugs inherent in this course

Course Introduction

Hi. My name is Jim Rothenberger, and I'm a faculty member at the School of Public Health, at the University of Minnesota. Welcome to Public Health 3005/6003: Fundamentals of Alcohol and Drug Abuse.
This is a course which is designed for education majors, to meet a state teaching requirement. The legislature, back in 1972, determined that we would solve all of the drug problems in Minnesota, if

This is the first page of Lesson 1 for the Alcohol and Substance Abuse course developed by the nonprofessional course development group. Note that there is no content topic listed in the lesson title. This non-labeling of topics issue was consistent throughout the course. All lesson content in the course were labeled numerically, i.e., Lesson 1, Lesson 1.1, Lesson 1.2, Lesson 2, Lesson 2.1 and so on. To find a lesson by content topic, students must open the lesson links and search through *each and every link* to find the content they seek.



Content File: Lesson1.2

UNIVERSITY OF MINNESOTA

Public Health 3005/6003
Fundamentals of Alcohol and Drug Abuse

The Models We Won't Use

Most alcohol and drug courses are based on one or more of the following three models: legal model, medical model, or moral model. This course will recognize these models, but will not be based on them. Instead, we will use a combination of attitudinal, interpersonal, and sociocultural models. All of this will be presented within a public health framework.

It is important to delineate a framework for any course, but especially for one that deals with a controversial area such as alcohol and drugs. People come to discussions about alcohol and other drugs with a host of preconceived opinions and attitudes that may interfere with an objective and reasoned investigation of the serious problems associated with the use and abuse of these substances.

The Legal Model

Most drug abuse courses are based on a legal model. The legal model relies on the relatively modern concept that elected representatives can determine which drugs are dangerous for individuals and society and then make certain dangerous drugs illegal. This model assumes that such individuals will have an understanding of the pharmacological principles of drugs and that citizens will not use drugs that are illegal. In this country, legislative bodies only embraced this model after 1900.

The major problem with the legal model is that most people choose to use, or not use, their drugs of choice without paying a great deal of attention to the legal status of those drugs.

Consider this: if we were to ask a room full of college students if they had ever consumed beverage alcohol before they were of legal age, almost all of them would answer "yes." If we were to ask them if they had ever smoked a cigarette before they were 18, two-thirds would answer "yes." We have this

An example of an interior content page for Lesson 1 for the Alcohol and Substance Abuse course in the nonprofessional course development group. Note that there is no content topic listed in the lesson title.

Course 6: Alcohol and Substance Abuse Course Description

Heuristic Evaluation Rank: 5 of 6

Heuristic Evaluation Mean 1.83

4 student usability testing participants

Overview

This online alcohol and drug course was designed and developed by academic department personnel in the WebVista CMS. The intended audience is primarily educators. Course prerequisites are that students are undergraduates in one of these disciplines: agriculture education, business/marketing education. career/technical education, foundations of education, technology education, music education, or kinesiology/pre-PE. There are no specific course prerequisites listed in the course site. The course consists of 19 lessons which include text, interactive exercises, and audio clips. Students are responsible for the content of all of these materials for assignments and quizzes. There are links to external web sites and supplemental readings posted in the discussion area, but students are not expected to be responsible for this external content. There is no required text for the course. A textbook is suggested in the syllabus. The course starts with “Module 0.” Two required assignments, a quiz “0” and assignment “0” are associated with the module. 75% students found this confusing even though it was labeled on the course home page “Start Here”. The assessments for the course include 7 quizzes labeled “Quiz 0-6” and 5 required assignments labeled “Assignment 0-Final Assignment.”

Assignments

100% Student testers did not know how to submit assignments.

S1: “I’m not sure how to submit the assignments.”

S2: “I don’t know how to submit the assignments.”

S3: “Need instructions on how to attach and submit the assignments.”

S4: Student quit task because he “could not complete it in a reasonable time” (3 minutes per the time log). “I don’t know how to submit assignments; I would e-mail TA and just ask her how to do it.”

Content

100% students mentioned that content was not easy to find due to it not being labeled. Lessons were grouped in folders containing several lessons—students had to open several folders to find the lesson that they were looking for—the content was not clearly labeled.

Syllabus materials were on one page which is broken down with some headings, but it is text heavy and students had to navigate by scrolling through the page several times to find information they were asked to find in the tasks.

In left navigation bar table of contents the links used to access lesson sections were labeled Lesson 1.1, Lesson 1.2, Lesson 1.3, etc. These generic link names gave no indication of the content contained in each lesson section. All students found this frustrating. To find the section title and topic—the content necessary to complete a task, students were forced to go through and open each link to find the content

S1: “I liked how the lessons are in folders on the home page.”

S2: “I thought the content was fairly organized, but I was never quite sure where I should go; there were lots of choices and I was not sure which path to take. The words used to label the content were confusing. I would like more detail on the module pages.”

S3: [There are] “Too many choices not sure where to look—it was hard for me to find what I was looking for—it was not obvious to me what things were. It was hard to find specific things in the syllabus.”

S4: “It would be easier if the lessons had topic titles."

Messaging

Course messaging was through the mail system available to all students, faculty, and staff associated with the university. Students were told that the instructor and TA would not respond to any messages outside the university. Students were instructed in the syllabus to contact the teaching assistant with any questions.

Students stated they would e-mail TA to ask how to complete basic course tasks such as submitting their assignments.

Exams

The course had a total of six quizzes that asked questions on the content of the lessons, required readings, interactive units, and the audio clips. Each quiz contained 10 multiple choice questions. Students had 12 minutes to complete each quiz and were allowed one attempt on each quiz. The quizzes are closed book, but students are allowed to use notes to answer the questions. However, they are advised in the syllabus “to become very familiar with the content covered on each quiz because 12 minutes does not give them much time to shuffle through their notes.”

From a student who had previously taken a class offered in the Moodle CMS:

S1: Overall the site was difficult to use. Content was not clearly labeled, nor was it clearly laid out like it is in Moodle.”

All 100% Students like having several options from which to choose to navigate the site

Students had difficulty locating the audio files. The files were mentioned in the Syllabus, but were not listed wither on the home page or in the Left Navigation TOC.

S3: “It would be easier if all the audio clips were in one folder.”

S4: “Syllabus doesn't even tell me what subject matter is covered in each lesson.”

Grades

All students found the location of their grades quickly. However, several students mentioned that the “My Grades” tool should be visible on the toolbar with the other tools there rather than hidden under the “More Tools” tab.

“It would be helpful if all tools were visible in the toolbar—right now ‘My Grades’ are under ‘More Tools’ a tab that contains any tools not visible in the toolbar.”

Navigation

The course has multiple types of navigation available for student use. These navigational tools are built into the WebVista CMS and include: Breadcrumbs, Left navigation TOC, Home button, Back button. Drop down menu, Scrolling, and Search. Students particularly like the left navigation bar TOC.

All students used scrolling to navigate through the pages of content, since a large quantity of content was below the bottom of the screen and not visible.

One student (S2) complained that the more content was not visible on each screen and that “too much of the screen real estate was taken up by the Vista CMS.”

S4: “I like being able to use the various, different methods of navigation.”

Recommendations

S1: “Would like a checklist of assignments to print out”

S2: “Recommends calendar in WebVista with more information and the due dates for assignments.”

S3: “Provide more detail on module pages and instructions on how to submit assignments.”

S4: “Provide instructions on how to submit assignments.”

Single Most Important Change

S1: “A calendar filled out with the assignment due dates.”

S2: “Change the language—the words used i.e., use ‘graded’ rather than ‘submitted’. Also I would like to see more of the page so I can more easily scroll through and find what I’m looking for.”

S3: “Have all tools for course visible on toolbar.”

S4: “Make the audio files more accessible.”

Easiest Task

S1: “Checking grades.”

S2: “Find the modules and syllabus.”

S3: “Easy to navigate. Just knew where to find things.”

S4: “Navigating through the site because there were different ways of doing it.”

Most Difficult Task

S1: “Locating the first assignment. That was hard to do.”

S2: “Hard to find specific things in the syllabus.”

S3: “Figuring out stuff about the assignments—which was attributed to the course not being “live yet” by the student.”

S4: “Finding the audio files”

Tools

All students thought that any tools used in the course should be visible in the toolbar.

Video and audio recordings were reviewed by the researcher after the testing sessions. After reviewing the video and audio recordings, a coding scheme was developed, reviewed, and discussed with a professional colleague familiar with the usability testing protocol and sessions. The interviews were coded and placed into a spreadsheet.

Appendix F

Professionally Developed Courses Information Architecture

Professionally-Developed Course

Information Architecture R2

September, 2005

Contents

Vista Tools & Layouts

Organizer Page Layouts

On the site home page in Vista, select **Course Customization-Page Layouts**. Select "3" for the number of columns, and check the box "Use these settings for all organizers." Click Save.

The home page and lessons/modules organizer pages should always be three columns.

If you put a list of download files on an organizer page, you can overwrite this default and use one column if you prefer. However, this would be an exception, since our standard is to use only learning modules (other than the course home page and lessons/modules home page).

Organizer Page Headers

Click the "Edit header/footer" icon for the home page header.

Select the box "Use this as the default header for the entire course"(which really only affects the other organizer pages).

Click Save. This will apply the header to the **Lessons/Modules** organizer page. (The checkmark won't be there the next time you open the edit header link.)

Optional:

- Copy the code for the "This course site is under construction . . ." message from the file <course under construction code.htm> in the **editors model** folder or from the home page header in the model Vista site, **Development - Model - R2**. (Use **password** to access this site.)
- Paste the code into the home page header (above the code for the course title).

Home Page Footer

- Make sure that there are no error boxes in the home page footer. If there are, troubleshoot as follows:
    1. Copy the latest shared folder into the course from the editors model. Refresh your screen. If the error boxes are still there, go to step 2.
    2. Recopy the code for the home page footer from the editors model. The error boxes should be gone when you refresh your screen.
- Don't apply the home page footer to the **Lessons/Modules** organizer page (this footer is what differentiates the home page from the other organizer pages). Check to see if the footer is on the other organizer pages. If it is, click the "Edit header/footer" icon for those footers and delete the contents of the footer.

Course Toolbar

Standardize the course toolbar as follows:

Priority Links

- **Assessments, Assignments,* Discussions, Mail, My Grades, Search.** The first four tools that you select will be shown on the main toolbar. Select the first four tools on this list that are relevant to the course, and put them in alphabetical order. If all the links are relevant, alphabetize the last two tools under the **More Tools** link. If fewer than four of these tools are used in the course, add the **Announcements** tool and alphabetize it as one of the four priority links.

More Tools

- **Announcements, Calendar, Chat and Whiteboard** (remove Whiteboard option), **Local Content, My Files/File Manager,* My Progress, Notes.** These tools should all be available to students under **More Tools,** in alphabetical order.

  *This tool is called **File Manager** in build view and **My Files** in student view; we should alphabetize it as **My Files.**

Don't Add

- **Media Library, Syllabus.** These tools should always be unavailable to students.
- Any tools that aren't used in the course (e.g., **Assessments**).

CHANGE *Assignments Tool

We are now strongly recommending that instructors use the **Assignments** tool for all submitted assignments (but see note below). Since most of the courses that we are revising don't use this tool, the course developer should explain this change to the instructor. Once the instructor agrees to it, the course developer needs to rewrite the submission instructions and add the **Assignments** tool as one of the first four priority links. (If a course doesn't use this tool, then omit it completely from the toolbar.)

Note: It appears that we can't use decimals for the point values in the **Assignments** tool (e.g., 12.5 points). We are checking into this, but in the meantime you can wait to implement the **Assignments** tool in a course if the assignments have decimal point values. We hope to have a solution soon.

Course Home Page

Below are the standard elements of the Vista home page with brief comments. For more information about these elements, see the next section or the **editors model** folder. If there are other major course elements, you can add additional links to the home page (in learning modules), as indicated below.

Syllabus

This link is a learning module that includes the following pages:

- **Meet Your Instructor:** This page starts with the instructor's welcome message. The other required elements are the instructor's bio, photo/video, contact info, and frequency of course visits (or how quickly the instructor will respond to queries). If the instructor hasn't included this last information, ask for it; it's important that we include this to manage student expectations of instructor feedback.
- **Course at a Glance:** The format and contents of this page are standardized. Follow the format and standard text used in the editors model.
- **Course Introduction:** Includes the course overview, objectives, and introduction.
- **Course Schedule** (term-based)/**Course Outline** (extended-term): Includes topics and submissions due for each week or lesson. Term-based includes lesson module dates. This page does not normally include readings.
- **Course Materials:** Includes all course materials information, including how to access materials and a link to the bookstore.
- **Assignments & Grading:** The format and contents of this page are standardized. Follow the format and standard text used in the editors model. Includes detailed breakdown of course requirements, grading criteria, grading scale, all generic assignment information and instructions that aren't lesson specific (replaces any **About the Assignments** pages in the CE course). This page may be longer than the norm.
- **Academic Integrity Policy:** The standard text on this shared page has been revised; don't edit it. (If you find a typo, let Rose know.) To ensure that all your courses have the latest version of this page, you should refresh the **shared** folder from the latest version in the editors model every semester.*
- **Other:** Any other course-specific information that doesn't belong in a lesson module or on any of the other **Syllabus** pages. (Don't title it "Other.") This may include:

- Course glossary (i.e., key terms with definitions). Key terms without definitions should go in lessons or on the **Assignments & Grading** page.
- Links to program information, such as proctored exam info and forms.

PROCESS REMINDER **Refresh the Shared Folder Every Semester*

Since the shared pages are subject to frequent changes and edits, we need to copy the latest **shared** folder into all our revised courses every semester. Only the pages in the **editors model-shared** folder are guaranteed to be the latest version.

Lessons/Modules

This link is an organizer page that contains links to learning modules (one for each lesson).

- The course learning modules are called **Lessons** in X program courses and **Modules** in X program courses. (The shared pages refer to "lesson modules" to accommodate both programs.)

Assignment Resources

NOTE: This name is now standard for all program courses. This link is a learning module that includes the following pages

- **Research Guidelines** (shared page)
- **Writing Help** (shared page)
- **Bibliography** (if applicable)
- **References** (if applicable)
- **Useful Links** (if applicable)
- **External Links:** course library page*, program library page (if applicable), plus any useful or supplemental links for the course.

PROCESS REMINDER **Course Library Pages*

All program courses should have a course library page; the course developer initiates it by filling out the form at link to form on university library site. Provide the instructor's contact info and ask to be notified when the page is ready. If you don't hear back in a few weeks, the form probably got lost. In that case, consult the list at link to form on university library site and e-mail a librarian in a related field, asking for an update.

Help & FAQs

This link is a shared Web page (not editable) that will be updated when you refresh your **shared** folder.

Other

These are links to any other major components of the course (i.e., **Audio, Videos, Flashcards, Downloads**, etc.) that don't go in the other sections. As a rule, put these components in the relevant learning module(s); put them on the home page only when necessary.

"e-mail WebAssist"

This is a hidden e-mail link that includes the course ID and semester, for example:

> mailto:webassist@university.edu?subject=Course Designator and Number Summer 2010

PROCESS REMINDER *Standard Filenames*

Please use the same filenames for the standard syllabus pages that are used in the editor's model (01instructor.htm, 02ataglance.htm, etc.).

Web Page Changes

Here's a guide to the changes required to convert the Web pages in your courses to IA R2. If you have any questions, you can refer to the R2 folder in the editors model or the Vista site **Course Development - Model - R2.**

Course-Wide Changes

Remove College Logo Links

- Use **Find and Replace** to remove the links from the College logos at the bottom of all course Web pages except the **shared** pages. The **shared** pages have been corrected in the editors model, so these pages will be updated when you refresh the **shared** folder* in your course.
- Check the code and remove any image modifiers such as height, width, border, etc.
- Add the alt tag "College logo" to the image.
- The final html code for the logo should be:

    <img src="../shared/graphics/collegelogovista.gif" alt="College logo">

Syllabus Changes

In the **Syllabus,** two pages have been moved, and the formats and contents of two other pages have been standardized. It's important to follow the new standard formats, since this was a major issue in our negotiations with the BUPs.

Meet Your Instructor

This page is now located at the beginning of the **Syllabus** rather than on the home page.

Academic Integrity

This shared page is now located at the end of the **Syllabus** rather than on the home page.

Course at a Glance

The headers and contents of this page have been standardized as follows:

Headers

In IA R2 there are five H3 headers on the **Course at a Glance** page:

- Course Title
- Educational Purpose
- Prerequisites
- Course Requirements

•University Policies & Resources

Don’t change these standard headers or add any other H2 or H3 headers. If there are any other headers on the original page, either fold the text into an existing header (if it belongs there) or move it to another page.

Content

Several sections have been removed from the **Course at a Glance** page, and some information has been added. These changes are listed below in the order that they appear on the final page, except for the deletions, which are given first.

- Delete the “Course Materials” and “Course Schedule” sections.
- Remove the “Academic Integrity” statement from the “Grading Policy” section.
- Remove the “Grading Options” section or statement. (This is no longer included in **Course at a Glance.** If a course is A–F only, just delete this statement. If a course has an S/N option, then put a statement and an explanation of both grading options on **Assignments & Grading**, as described below, but not on **Course at a Glance.**)
- Move whatever is left of the “Grading Policy” section to **Assignments & Grading** (as described in the instructions for that page below).
- Make sure that the course title/credit statement is in the standard format (see the editors model or the “Formatting Titles” section of the *Style Guide*).
- The “Course Requirements” section should begin with “For more information, see **Assignments & Grading.**

The list of course requirements should be a simple bulleted list, as in the editor’s model, not an html table. A table makes it impossible to use the tight line formatting that is preferred for bulleted lists with very short entries (see “Formatting Lists” in the *Style Guide*).

For each course requirement, list the official name of the assignment (as shown on **Grading & Assignments**) and the item’s percentage of the course grade in parentheses (unless not applicable). Avoid adding more information to this list; brief explanatory comments are okay if really needed to clarify the nature of the assignment.

- Add this note after the list of course requirements (this exact wording is required in all courses):

> Note: The syllabus for this course is subject to change at the instructor’s discretion as needed to support the learning objectives of this course.

- Remove any course requirements text that has survived from the old “Online Participation” section, such as “You are required to participate in online group work, submit your assignments electronically, and communicate with your instructors online." The list of course requirements should include only the graded or required assignments.

- Change the name of the last header on the page from "University Policies" to "University Policies & Resources."

Assignments & Grading

The headers and contents of this page have been standardized as follows:

Headers

In IA R2 the **Assignments & Grading** page has three to five H2 headers, in this order:

- Grading Summary
- Grading Policies (opt.)
- Assignments
- Grading Criteria (opt.)
- Grading Scale

Don't change these standard headers or add any other H2 headers. The optional headers can be omitted if they aren't necessary; the other three headers are required. If there are any other H2 headers on the original page, either fold the text into an existing header (if it belongs there) or move it to another page. If the instructor's submission uses other headers, convert the contents to this format (per program request).

Here are some comments on the sections that you may find on this page and what to do with them:

- **Grading Criteria:** There are several alternatives to using an H2 header for "Grading Criteria." You can insert the grading criteria under a subhead in the description of each assignment, make this information a subsection of "Assignments," or put it on a separate **Syllabus** page. The BUPs prefer the first option, but this choice is at the editor's discretion. (If this text actually describes grading policies [late submissions, extra credit, etc.], put it in the "Grading Policies" section.) Also check for grading criteria under another name (e.g., "Paper Grading Standards"); rename and treat in one of the above ways.
- **How to Submit Assignments:** If this text is general information covered in **Help & FAQs** or the Vista help link, replace with a reference to **Help & FAQS.** We are now recommending that instructors use the **Assignments** tool and referring students to the Vista help link for further instructions. If the instructor has specific submission instructions for the course, put them in a subsection of "Assignments" or on another **Syllabus** page.
- **Proctored exam information:** If this text describes general proctored exam information, forms, and policies, replace with links to the Program Web site.

(Jeanne has the current links.) Include only the specific exam instructions for the course.

- **Discussion guidelines:** If this text is general information covered in **Help & FAQs** or the Vista help link, replace with a reference to **Help & FAQS.** Include only the specific discussion assignment instructions for the course, rather than general guidelines such as "post early" or "use good Netiquette."

NEW * *Two New Header Levels*

Our workgroup.css file currently only includes H1–H4 header styles. We are in the process of adding H5 and H6 header styles. You can start using those styles now, but they won't show the proper formatting yet; don't change that default format. Once the new workgroup.css file is ready (you'll get an e-mail from one of the editors), just copy the new workgroup.css file into your courses from the editor's model, and the correct formatting will show up automatically (unless you have added extra formatting).

Content

The contents of the **Assignments & Grading** page have been reorganized. The changes are listed below in the order that they appear on the final page, except for the deletions, which are given first.

- Remove the "Academic Integrity and Scholastic Dishonesty" standard text.
- Remove text "If taking this course on an S/N basis…" unless S/N is an option. If it is, put that sentence and any other S/N info right after the "Grading Scale" header (see below).
- The page header and page title should both read "Assignments & Grading." Don't rename this page or the standard headers for this page; fit the instructor's submission into this format.
- Insert a new H2 header "Grading Summary" at the top of the page.
- Move the grading chart that is currently under the H2 header "Grading" to the top of the page under the new "Grading Summary" header.
- After the grading chart, insert a new H2 header "Grading Policies" (if applicable; this header is optional).
- Insert under that header the "Grading Policy" text from the old **Course at a Glance** page (after deletions). Check this text and delete anything that is now redundant. Also move all other general course grading policies (such as the X program extra credit statement) into this section. If the course has no special grading policies, omit this header.
- The "Assignments" (H2) section has not been changed, but check the header hierarchy. Each new type of assignment or topic should start with an H3 head.

Use H4–H6 heads to organize the information. The BUPs request that this section be as succinct and clearly organized as possible.

- At the bottom of the page, change the H3 header “Grading Scale” to H2. This should remain at the bottom of the page, and nothing should follow it. The scale should be the standard University grading scale. In general, instructors aren’t supposed to create their own grading scales; if an instructor wants to use another scale or grade on a curve, ask program director about it.)

Appendix G

Verbal Report Findings and Conclusions

Findings

Assignments

Students had a number of usability problems related to the course assignments, a key feature of any instruction. They had difficulty finding the course pages containing the assignment guidelines, which resulted in several other instructional problems. First, they did not understand the assignment requirements which included how to create the assignment, what the requirements for the assignment were (including the due dates) because some of the assignment due dates in one course were from a previous semester. The course site had not been updated to reflect the current semester. Second, when students navigated to the Assignments tool in the CMS, the assignments directions were not in the same location. This forced the student to navigate to another page to see how to complete the assignment and back to the Assignments tool to submit it. Further, students reported they needed more detailed directions on how to submit the assignments, with some students requesting a tutorial.

Messaging

Most students did not have difficulty with e-mail, however, there was some confusion regarding which messaging system to use the main university mail system or an internal mail system within the CMS. Some students struggled to locate contact information for both their professors and their classmates.

Content

In some course sites tested, students had difficulty locating the content they needed to complete tasks. These usability difficulties resulted from the amount of text on a course page, including too much text, content that was not broken down by headings or content that disappeared below the bottom of the screen. One student commented that the CMS features took up too much screen real estate and did not leave enough space for instructional content. When content was not organized to match student expectations or did not contain internal links within the content that allowed navigation to other course pages, students had usability problems with accessing course materials. A problem with one course was that the content was organized by lesson number and numbered sections rather than by content topic. To access content to complete tasks, students had to open every link until they located the content needed to complete the task. Printing content was a usability problem if students did not notice the printer icon at the top of a portable document file (.pdf). Students requested that all content needed to complete a task be organized together in close proximity to promote usability. Multiple testers requested all multimedia content files organized within one folder in the course site to facilitate the downloading and printing of files.

Language

The usability problems related to language occurred when the language labeling links pointing to the same types of files was inconsistent; language did not match between the syllabus and content files, and did not match student expectations. Several student testers objected to the use of the word "modules." They did not understand what the term meant and they expected the course to be organized by "weeks." Another problematic term was the use of "units" rather than lessons or weeks to organize course content.

Exams

The usability problems surrounding the use of exams included the inability to locate the exam within the course and a lack of clear instructions on how the exam was to be submitted. Other usability problems occurred with exams to be taken face-to-face rather than online in the course site. Students did not understand the term "proctored" exams. They also had difficulty locating the form necessary to schedule a proctored exam, locating the information related to finding a suitable proctor, and locating information related to finding the location on campus where proctored exams are administered.

Grades

Checking grades was an easy task for students. Students did not like the “Grades” tab in the CMS to be hidden under the “More Tools” tab. Students wanted the “Grades” tab visible on the home page. Students reported that they liked the ability to monitor their progress in the course by viewing their grades online.

Navigation

Navigation causes many usability problems in course sites. The various modes of navigation available to students need to be obvious to them. The majority of testers reported favorable comments concerning the left navigation bar and table of contents when it was available in the course. They found it convenient to use, they liked all the content needed for a lesson or week to be visible in a menu, and the comments were favorable. Students looked to the left navigation bar first to find content. Clear labeling and the use of topics rather than lesson numbers and section numbers were important to allow students to locate the content they needed to complete tasks.

Students did not like to navigate by scrolling up and down course pages through long sections of content to find what they needed to complete tasks. This negative response to long pages of content to navigate via scrolling persisted even when the content was broken down by headings. Students commented on too much text, the fact that they don’t read content, but instead skim content and look for headings as cues to locate the correct content.

Some students reported that they needed a site map as an overview of the organization of course content, while others requested a tutorial in site use. Most students like the left navigation bar table of contents. However, a few students were thrown by it. They did not understand the collapsible and expandable features of this menu and struggled with using them.

Tools

As previously noted students reported that tools needed for the course should be visible on the home page with all course tools organized within a single, visible toolbar. They did not want to look for tools they needed to complete a task under the "More Tools" tab.

Several students mentioned that the inclusion of a calendar tool which listed all the assignments and their corresponding due dates for the course would be helpful so they could keep track of course activities and assignments. One student mentioned they would find a master online calendar with the activities and assignments for all the online courses they were enrolled in a semester useful.

Prior Experience

Students who reported having prior experience with an online course found it beneficial to them in completing the course tasks. They made a point of relating how many previous courses they had experience with and naming the institutions administering the other courses.

Syllabus

The course syllabus is the course page(s) that students use to find the course information they need to complete course tasks. When the syllabus is difficult to use, it causes students problems in locating the information they need to complete course tasks. Some students reported positive feelings concerning the syllabus and its organization. For example, several students said that they always go back to the syllabus because it has everything you need. Other students found the syllabus difficult to use if the lesson topics were not specifically listed on that course page, if the syllabus was too bulky, or if the syllabus content was not obvious on the course home page.

Easiest Task

Clearly, students are concerned with assignments, grades, and communicating with their professor and classmates. The majority of participants had no difficulties completing any of these tasks.

Most Difficult Task

The most difficult tasks for students involved locating particular content for the reasons previously reported. A few students reported that nothing was difficult.

Conclusions

Assignments

As the primary way that students are evaluated in a course, the source of student grades, and, ultimately, the credits required for student credentials or graduation, assignments are a key component of any online course. For a course site to be usable, students need clear assignment guidelines, current due dates, clear assignment directions within the Assignments tool, and clear instructions on how to submit assignments. When entering a course site, a student's goal is to accomplish their course-related tasks. They do not want to waste time opening and looking in extra content links to find all the content they need to complete their assignments.

All content relating to assignment submission needs to be located in the same area of the course site. Students need clear assignment guidelines, current due dates, assignment directions within the Assignments tool, and clear instructions on assignment submission so they are not forced to navigate to another page to see how to complete an assignment and back to the Assignments tool to submit it. In a usable course, the tools students need to submit assignments are ready-at-hand. This need reflects how tasks are accomplished effectively and efficiently in the real world; the instructions and tools necessary for task completion are gathered together prior to beginning a task. Constantine (2000) calls this the visibility principle. He states "Keep all needed options and materials for a given task visible without distracting the user with extraneous or redundant information" (p.4). He abbreviates this concept with the acronym WYSIWYN—what you see is what you need. For example, students should not be forced to exit the Assignments tool to find various components (assignment instructions, document forms, information related to the using the Assignments tool) they need to complete an assignment.

Messaging

As the only means of communication in an online course site, contact information for the instructor needs to be prominent and easy to find in the course site. If there is an instructor or program preference for course communication such as receiving messages via a specific messaging system, in a particular mail box, or with a particular subject line, this information needs to be adjacent to the instructor's contact information. In several of the courses studied, a majority of students in the usability testing sessions were unable to locate the instructor's contact information.

Content

As the heart of an online course, content organization is a key factor for course site usability. Content that is used together needs to be located together in the course site (i.e., organized in a way that facilitates rather than hinders) the use of the web site for the accomplishment of the student's tasks. Content labels and links need to clearly indicate what content is accessible by clicking on each link rather than the link being labeled by a lesson number rather than the content name. Students dislike being forced to navigate around various locations in a site to open multiple links to locate the content they need as a result of unclear content labeling and organization. It wastes student time and causes frustration. It is neither efficient nor effective.

In this study, most students found the left navigation table of contents that contained “everything they needed” for the week usable. Students who did not understand the computing convention of expandable and collapsible menus found the left navigation bar table of contents difficult to use because the content of all menus was not visible. Content present within collapsed menus was invisible to the student until the “plus” icon was depressed to open the menu and reveal the “hidden” links.

Students disliked long passages of text, particularly in the syllabus. Student testers stated they don’t read long passages of text. They look at content headings and skim (instead of reading) to find the information they need. This finding validates guidelines (Nielsen, 2009; Redish, 2007) for writing for the web which suggest writing in a pyramid style with the most important content presented first, organized with clear headings, and short passages of text. This writing style is particularly important for the type of information content found in the syllabus. For longer instructional content such as passages used to present or develop complex arguments, linking to separate documents or resources is recommended.

Another important aspect of content organization is to make site elements visible through screen layout—the use of visual cues, white space, grouping, and sequencing to distinguish content types. This type of organization facilitates recognition of content rather than forcing students to remember where content is located. Since the Web is global, it is also about following cultural conventions for providing content as they differ between locales (i.e., text is read horizontally in some countries, vertically in others). Again, this is about providing content in a clear, concise manner, sequencing and grouping content to match students' tasks and providing instructions where they are used.

Language

Language needs to be consistent for students to find content and to understand what they are required to do in an online course. Consistent language not only means using language that is consistent on each page, but also consistent between links on pages, between pages, in the course management tools, exams, and any downloadable documents. This conclusion is consistent with previous research (Crystal, 2001, Engelbart, 1962; Flores et al., 1988; Winograd, 1996) who note that the language used to label and describe links and actions shapes users' understanding of the interface, what they think they are able to do, and determines their capacity to make use of the course tools and functions. If the language used in the course site is unclear, users may not understand the options available to them on the screen. This causes a breakdown

(Flores et al., 1988; Winograd & Flores, 1987). This breakdown renders students helpless to perform the desired action and causes them to waste time as they fumble through multiple options to find the correct one (Kukulaska-Hulme, 1999). This type of breakdown results in a frustrating experience in the online classroom which interferes with learning. Again, inconsistency in language results in a course site that is neither efficient nor effective.

Exams

Exams are key features of a course. They are another primary way students are evaluated and able to earn grades and credits. In this study, four of the six courses required students to take exams. In these four courses, 9 of the 19 student testers had difficulty locating exam information. For a course to be usable, information concerning exams needs to be clear. The exam type, any prerequisites required for students to sit for an exam, information related to the exam dates, location, scheduling, and how to submit the exam are all key characteristics of a usable course.

Grades

Grades are important to students. This importance was driven home in this study by the speed students were able to check their grades in their courses. All 29 students in the usability testing sessions with a functioning time/error log measurement completed this task quickly and successfully. Students reported they liked to be able to monitor their progress in a course by viewing their grades. A usable course allows them to check grades quickly and easily by making the tool used to check grades clearly visible to students.

Navigation

Usable course sites have multiple ways to navigate through the course. Navigation schemes should be clear. This is related to the visibility of options, how to achieve goals, how to accomplish desired tasks (Barnum, 2002; Brown, 1986; Cooper, 1999; Cooper & Reinmann, 2003; Garrett, 2003; Hackos & Redish, 1998; Hackos & Stevens, 1997; Horton, 2001; Johnson, 1998; Laurillard, 2002; Norman, 1988, 1993; Shneiderman, 1998, 2002; Tufte, 1997, 2006; Wood, 1998) and the ability to make a mental model of the site (Amadieu, van Gog, Paas, Tricot, & Mariné, 2009; Berge, Collins, & Dougherty, 2000; Brown, 1986; Dillon & Greene, 2003; Garrett, 2003; Hackos & Redish, 1998; Johnson-Laird & Byrne, 2000; Laurel, 1993; Norman, 1988, 2002; Otter & Johnson, 2000). Navigation facilitated between course pages via internal links is perceived by students as usable. In contrast, students dislike being forced by the lack of internal links to leave one content page, navigate back to a main page, and click on a link to access new content pages, a type of navigation scheme that may leave users disoriented and lost and does not meet their needs.

Tools

All tools students must use in the course need to be visible on the course site. They should be organized together and clearly labeled. All students in the usability testing sessions commented that all tools should be visible and organized together.

Prior experience

Students with prior experience taking an online course expressed confidence in using their course sites during the testing sessions. This observation appears to be related to the students' perceptions of their self-efficacy (Bandura, 1997) of using their new course site based on their prior experience.

Syllabus

The course syllabus is a key component to any online course because traditionally students in a face-to-face class look at the syllabus as the primary document distributed by the instructor to find information on course materials, assignments, and contact information. Students find the syllabus a "go to" document to find important course information. Although student expectations differ regarding specific syllabus content, several key components were found. A usable syllabus organizes the course content by topics and weeks, provides clear due dates for assignments, includes links to complete assignment and exam instructions, and furnishes complete information for students to contact their instructor and classmates. Complete contact information includes the e-mail address of the instructor, how to contact other course participants, the preferred messaging system, and any special instructions for subject line information. The Assignment tool has different purposes and functions from the syllabus. The purpose of the Assignment tool is to provide a means for students to submit their assignments to one location in the CMS and allows the assignment to be recorded as “submitted.” This facilitates the following record-keeping functions. The assignment is marked “submitted” in the course site, so the student is assured that the assignment has been received. A due date and time is set up in the Assignments tool for each assignment. An assignment submitted after the due date and time is marked “late.” The Assignments tool is linked to the grade book. This facilitates recording of grades and allows students easy access to the status of their assignment (e.g., submitted, not submitted, graded, ungraded).

Easiest Task

The easiest tasks for students were checking grades and sending messages via e-mail. Both of these tasks were straightforward. For five of the six course sites studied the tool students use to check grades was clearly visible on the course home page. These tasks were cited as the easiest tasks due to the importance of grades, and students are familiar using e-mail in other contexts (i.e., social or work-related) to send messages.

Most Difficult Task

The most difficult task was locating specific content within the course site. This conclusion reflects the need for site design that matches students' tasks (Barnum, 2002; Brown, 1986; Constantine, 2000; Cooper, 1999, 2002; Garrett, 2003; Hackos & Redish, 1998; Hackos & Stevens, 1997; Horton, 2001; Johnson, 1998; Laurillard, 2002; Norman, 1988, 1993; Shneiderman, 1998, 2002; Tufte, 1997, 2003; Wood, 1998), mental maps (Amadieu, van Gog, Paas, Tricot, & Mariné, 2009; Berge, Collins & Dougherty, 2000; Brown, 1986; Dillon & Greene, 2003; Garrett, 2003; Hackos & Redish, 1998; Johnson-Laird & Byrne, 2000; Laurel, 1993; Norman, 1988, 2002; Otter & Johnson, 2000), and uses clear, consistent language to label course content, links, and site tools (Crystal, 2001; Kukulaska-Hulme, 1999). Since content and language is unique to each course and varies widely between subjects, the language and labels used need to reflect the language and knowledge structure of the discipline.