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A Case Study of the Effects of a Web Interface Redesign Based on Usability Guidelines

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A thesis

presented to

the faculty of the Department of Computer & Information Sciences

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Master of Science in Computer Science

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by

Paromita Bhattacharya

August 2011

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Keyword: Usability Study, User Interface Design, Usability Guidelines, Usability Engineering

## ABSTRACT

A Case Study of the Effects of a Web Interface Redesign Based on Usability Guidelines

by

Paromita Bhattacharya

Usability guidelines for user interface (UI) design formulated by Nielsen and other authorities were used to redesign the web interface for a web based distance education course. The website's original UI, as judged by a group of web design professionals, violated standard guidelines for usability, readability, learnability, consistency, efficiency of use and flexibility. The original and redesigned UIs were tested using thinking aloud testing, a user satisfaction survey, and usability inspection. The results of user testing and heuristic evaluation suggest that the use of these guidelines in website redesign had a positive impact on user performance. A more conclusive result would have required a larger sample size and a redesigned testing protocol that varied the order in which participants worked with the old and redesigned interfaces.

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## CHAPTER 1

### INTRODUCTION

This thesis is a case study on the effectiveness of applying usability guidelines to redesign the web interface of a web based course offered by East Tennessee State University's Departments of Nursing, Family Medicine, and Pharmacy. The rise in popularity of web-based learning, according to Neal and Miller (2005), is attributable to two factors. The increased popularity of computers has allowed distance education course material be distributed via web or by CD ROMs containing web based course materials. The web, in turn, has made content more accessible to students in diverse locations, with diverse skills and support. This accessibility is due, in part, to the web's ability to deliver content in ways that are independent of any specific time and location – a practice that Neal and Miller alternatively refer to as distance education, distance learning, web based learning, e-learning and online learning (Neal & Miller, 2005).

Neal and Miller (2005) argue that usability is important for the effective assimilation of web based content. The authors stress the need for “learnability, remember ability, efficiency in use, reliability in use, and user satisfaction” for making these materials more accessible to students. Various strategies have been suggested for improving a UI's usability. Nielsen and Mack (1994), for example, suggest usability inspection techniques such as heuristic evaluation, guideline review, pluralistic walkthroughs, cognitive walkthrough, and feature inspection. Ebling and John (2000), Lewis et al. (1999), Ramey et al. (2006) and Ssemugabi and Villers (2007) suggest user testing techniques such as thinking aloud, empirical evaluation and questionnaires to detect usability problems in an interface.

This thesis represents a case study on the application of usability guidelines by Burton and Walther (2001), Ivory and Megraw (2005), Nielsen (1999), Paay and Kjeldskov (2007), Shneiderman and Plaisant (2005), Burrell and Sodan (2006), and Rumpradit and Donnell (1999) to the redesign of the interface for a web based course. This course, Communication Skills for Health Professionals (CSHP: 1321), is offered by East Tennessee State University's (ETSU) Departments of Nursing, Family

Medicine, and Pharmacy and is made available to the students through a CD-ROM. This study was conducted at the behest of the course’s directors who had requested the help of the Department of Computer and Information Science of East Tennessee State University to address problems being faced by students while trying to access the course’s CD-ROM modules. CSHP 1321 students had complained about the background color, the font color and the difficulty in finding information using the web-enhanced version of the course.

An initial inspection of the course’s original web interface, by the author of this thesis (cf. Figure 1), indicated that the interface suffered from a lack of readability, learnability, consistency, and flexibility, and was also inefficient for accessing course content. The yellow colored font on the green background suggested readability problems. The dotted lines after the text on the left hand side of the interface could not be identified as hyperlinks and suggested problems with consistency and efficiency of use. The text on the image in the center of the old web interface could not be read clearly. The blinking images on the top of the interface were mistaken as hyperlinks to external sites. Each of these findings indicated that the web interface was a strong candidate for improvement through effective redesign.

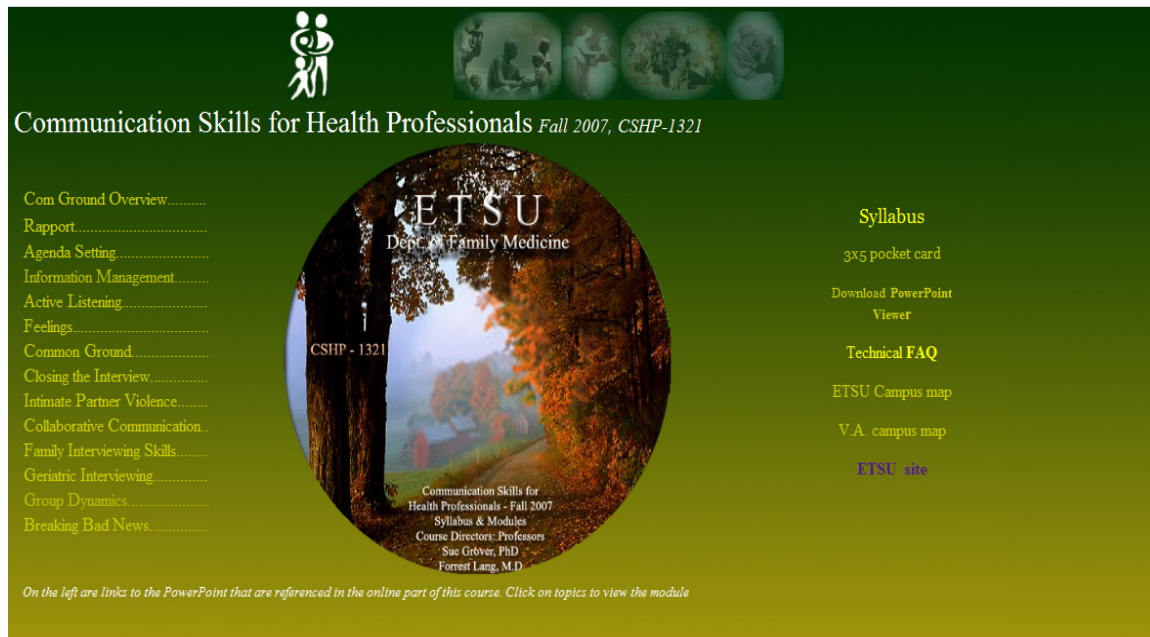


Figure 1. Screen Shot of the Original Interface of the Course: Communication Skills for Health Professionals (CSHP: 1321)

Various guidelines were used as a basis for redesigning this website. The starting points for the redesign were Burton and Walther's (2001) guidelines for identifying the requirements of the page's prospective users: a mix of students of Pharmacy, Family Medicine, and Nursing. It was assumed that these students were semi-skilled computer and internet users who would benefit from an interface that minimized the work of finding relevant information in the web based interface. This goal would be achieved in part by allowing them to use a limited set of web-browsing skills to access course content. Nielsen's (1999) checklists and Ivory and Megraw's (2005) Web Tango Methodology were used to redesign the website's text, images, links and logos. The images for the home page's flash plug-in were chosen based on Paay and Kjeldskov's (2007) Laws of Gestalt on focal point and symmetry. Paay and Kjeldskov's Laws of Gestalt on proximity, similarity and simplicity were used to design the menu and group menu items. Shneiderman and Plaisant's (2005) guidelines were used to limit the number of different colors and to select the redesigned UI's font color, text style, and foreground and background colors. Other issues considered included the design of the navigation menu, the use of appropriate context relevant to the course subject and strategies for providing users with flexibility and control while navigating the web interface to search for course related information.

After the redesign was complete, the new UI was subjected to a usability evaluation to determine the extent to which the interface's usability had improved. Usability evaluation is that part of the usability engineering process that is concerned with assessing a UI's quality (Scholtz, 2004). This is done by comparing the results from testing a UI's usability with objectives established during the requirement phase of UI development.

In this study, usability evaluations were performed using the original and redesigned interfaces to determine whether the redesign aided user performance. Testing consisted of a set of thinking aloud studies involving 16 participants, followed by a user satisfaction survey. Users were asked to think aloud while performing a series of six assigned tasks using the original and redesigned interface (cf. Appendix A). The thinking aloud technique is the only usability testing technique that obtains user feedback while a

user is interacting with an interface. According to Lewis et al. (1990), thinking aloud technique “is assumed to give access to the cognitive processes during users’ engagement with computers”.

The six tasks in this study sought to determine whether incorporating the usability principles of visibility, site navigation, flexibility and consistency, user freedom, error recovery, and help and documentation (Nielsen, 2003) into the new design would improve user performance and satisfaction. Data from the think aloud technique was used to infer how well the users’ sense of how to perform tasks matched that of the designer: the better the match, the faster it should be for users to complete these tasks. The results of the think aloud experiments were then augmented with a survey (cf. Appendix A) that identified participants’ satisfaction with the original and redesigned UI’s fonts, styles, use of color and images, presentation of course content and other subjective attributes. The users’ ratings of the original and redesigned UIs were used to determine their subjective satisfaction with the interfaces.

As a check on these results, a heuristic evaluation of the original and redesigned interfaces was conducted using five experts. Heuristic evaluation is a usability inspection technique that uses usability experts or evaluators to judge whether a web interface conforms to the principles or heuristics of usability. According to Ssemugabi and Villiers (2007), heuristic evaluation can detect weaknesses in an interface that users fail to identify, because heuristic evaluators are more aware of an interface’s goals than its users. Here, one of the goals of this evaluation was to identify usability problems that might have remained unnoticed during the user testing process. The heuristic evaluation employed here used Nielsen’s (Nielsen & Mack, 1994) ten heuristics to evaluate the original and the redesigned interface.

## CHAPTER 2

### LITERATURE REVIEW

This chapter discusses the concepts and methodologies upon which this research is based. Topics covered include guidelines for developing web interfaces; methodologies for organizing content in a web interface; navigation styles for web interfaces; and interface evaluation techniques, including heuristic evaluation, evaluations using surveys and thinking aloud.

#### Definition of User Interface and Usability

A user interface (UI) is a component of a system that supports interactions between people and that system's information devices. These modes of interaction may include display screens, keyboards, mice, light pens, help messages and illuminated characters.

Author Nielsen (2003) gives the following definition of usability: "Usability is a quality attribute that assesses the ease of use of UIs. The word usability also refers to methods for improving ease-of-use during the design process."

Nielsen (2003) discusses five important components of usability:

- "Learnability": The ease with which users complete tasks during their first interaction with the interface.
- "Efficiency": The time taken to complete tasks after users has learnt to use the interface.
- "Memorability": The degree to which users remember and recollect the skills they acquired after they return to the interface after some time.
- "Errors": The number of errors committed by a user while performing tasks using the interface, the severity of the errors and the ease with which users can "recover from the errors".
- "Satisfaction": The level of satisfaction of the users after interacting with the interface.

#### Guidelines for Developing a Web Interface

Researchers Ivory and Megraw (2005) developed the Web Tango Methodology to provide a set of design guidelines for user interface designers. The methodology consists of five steps:

- “Identifying an exhaustive set of quantitative interface measures”.
- “Computing measures for a large sample of rated interfaces”.
- Preparing statistical models based on the quantitative measures and ratings of the sampled interfaces.
- Rating new interfaces using the statistical models.
- Validating the predictions made by the models.

The Web Tango Methodology (Ivory & Megraw, 2005) is applied in two distinct phases. In the first phase, a baseline is established for interface quality. In the second phase, the interface’s quality is assessed. Ivory and Megraw identified eight features that affect the quality of a web interface:

- “Text elements”: The total amount of text in the web site and the simplicity and the quality of the presentation of the text elements.
- “Link elements”: The total number of links.
- “Text formatting”: The arrangement of text, the use of colors and font size for highlighting text.
- “Link formatting”: The use of colors to display links.
- “Graphic formatting”: The area covered by images.
- “Page formatting”: The combination of colors and other elements used to interact with users.
- “Page performance”: The download speed of the interface.
- “Site architecture”: The site’s size, page arrangement and consistency of design on each page.

Burton and Walther (2001) describe a different approach for web interface design: one that focuses on identifying the needs of an interface’s prospective users. This study shows that the requirements of the prospective users can be understood by studying user reactions to various aspects of the websites.

While Ivory and Megraw (2005) and Burton and Walther (2001) focus on the requirements phase of UI design, Nielsen’s (1999) guidelines apply to UI design. The guidelines are as follows:

- Every page in a web interface must have a logo. Except for the home page logo, the logo on every page should be linked to the home page.

- The web site should have a search option if there are more than 100 pages in the site.
- Each page in a site must have a simple heading or title that provides a brief idea of the page's content.
- The web interface content must "facilitate scanning" so that readers can view large portions of the contents at a glance. This can be done by grouping related information.
- The designer must try to adhere to popular design practice, since users often expect this.
- In order to make more efficient use of images, designers should use "relevance-enhanced image reduction", which involves a closer display of an image's important parts instead of reducing the image to its thumbnail.

Burton and Walther's (2001) study argues for focusing on the requirements of an interface's prospective users. Ivory and Megraw's (2005) guidelines provide a foundation for organizing a web interface's contents. Nielsen's (1999) guidelines are checklists for making interfaces more usable. Nielsen's (1999) guidelines, however, are applicable only after an interface's design is complete.

#### Applications of Gestalt Laws in Design of Web Interfaces

The laws of Gestalt Theory are concerned with the effective presentation of graphics or images in an interface. Authors Paay and Kjeldskov (2007) discuss the following Laws of Gestalt Theory:

- Law of Balance/Symmetry: Lack of symmetry or imbalance of a visual object will make it appear incomplete. Balance can be achieved by placing a visual "weight" (Paay & Kjeldskov, 2007) with equal area on each side of the object's axis.
- Law of continuation: The eye follows the direction that is shown in a visual image
- Law of closure: The use of open shapes distracts the users, in that they tend to think that the pattern is incomplete. The human mind tends to close any gaps that may exist in an image.
- Law of Figure-Ground: The use of two different foreground colors make the human mind see two different images within the same image.
- Law of Focal Point: It is best for graphics to have a center of interest (focal point). The focal point grabs the viewer's attention while directing the eye to follow a path through the image.



- Law of Isomorphic Correspondence: The meaning of images varies with a user's experiences.
- Law of proximity: Items that are placed near each other will be assumed to belong to the same group.
- Law of similarity: Similar objects must be grouped together.
- Law of simplicity: Viewers attempt to simplify a visual into a simple and uncluttered image.
- Law of Unity/Harmony: The user will often try to relate similar objects in a design. Putting related objects in different forms will create confusion, since the viewer will treat them as unrelated.

These laws help UI designers to determine a page's focal point. The Laws of Gestalt can be used in positioning navigational menus, images and text matter in a web interface.

### Design of Navigation Styles in Web Interfaces

Burrell and Sodan (2006) examined six common navigation styles and their positioning in a web interface, measuring user satisfaction.

- The "Tabbed" style uses "Tab" styled images on a page's topmost area for browsing and navigation. The tab represents folders used to store files inside cabinets. The style was first used by Amazon and is now used by the Firefox and IE browsers, which allow each new page to be opened in a new tab.
- The "Left Navigation Bar" displays links on an interface's left hand side, in keeping with the practice in English and other languages of arranging text from left to right.
- The "Top Navigation Bar" uses a single row or multiple rows of links on the top of a web interface. These rows of links act as navigational cues for the whole site. Often they may also be used as links for "sign-in" or "logout" or "contact us". Their use makes it easier to read information on the top, especially with pages having vertical scroll bars.
- The "Combination of Top and Bottom Bar" provides the main navigational links along the top of the webpage and secondary links at the bottom. Often the two sets of links are used by different groups of users. The secondary links usually consist of links to disclaimers, contact information, feedback forms or other information of lesser importance to the site's primary users. This style is used by large corporate or educational institutions that have two separate kinds of users for their websites.

- The “Combination of Top and Left Bar” style groups web interface links into two primary groups. One navigation bar, which runs on top of the page, has navigation links to the home page and other important internal links. The other, which runs on the left side of the interface, provides links to category-specific contents. The style is used in sites with large number of main links.
- The “Combination of Top and Right Bar” is the same as the top bar and left navigational menu, except that the second bar is on the interface’s right side.

According to Shneiderman and Plaisant (2005), titles of single menus must be simple. Ideally, single word titles should be used to describe a menu item’s functionality. The ordering of the items in a navigation menu must follow the sequence in which a website’s pages are arranged. Some users prefer centered titles; others, like the authors, prefer left justification. Titles must have a consistent grammatical style with phrases that explain the page’s operation. The terminology of the titles must be known to the user community and each item should be distinct from one other. Screen width and length influences the graphic layout of menus. A menu that displays 50 states would require a lengthy screen with scroll bars. Lacking this, the menu must be broken into sub categories. Sometimes with linear menu sequences a (+) sign or a (-) sign indicates a user’s history of browsing that menu.

### Use of Colors in Web Interfaces

Shneiderman and Plaisant (2005) give three guidelines for using color in interface design.

- Use color conservatively: While the use of multiple colors may brighten a display screen, this may also confuse users. The authors cite the example of a UI that displayed the seven letters of a company’s name in seven different colors; the name was visible from a distance but not visible up close. A second example involved the use of four different colors for a menu’s twelve items, which incorrectly suggested that items with the same colors belong to the same category.
- Limit the number of colors: Designers should limit the number of colors in any one display to four and the number of colors in an overall web interface to seven.

- Be alert to common expectations about color code: Designers need to consult users before selecting colors. To chemical engineers, for example, the color blue denotes cold, while to map makers blue denotes water. To avoid confusion, the meaning of color codes should be included in a readily available help file.

Color coding has its advantages and disadvantages (Shneiderman & Plaisant, 2005). For some task color speeds the recognition process. For example the use of red to display overdue items in accounting software makes those items readily visible. However the use of a second color in the same accounting software to display overdue items might confuse users.

Red and blue should not be used side by side, since blue and red are on opposite ends of the visual spectrum. Attempting to focus simultaneously on red and blue objects strains eye muscles; “The blue color will appear to recede and the red color will appear to come forward” (Shneiderman & Plaisant, 2005). Other combinations like magenta on green and yellow on purple pose the same problem. Too little contrast, on the other hand, for example yellow text on white background, is difficult to read. Black on light blue and blue on white have low error rates; magenta on green and green on white have high error rates. Designers must also account for the effect of graphic cards on how colors display.

#### User Satisfaction Studies on Navigation Styles and Content of Web Interfaces

Burrell and Sodan’s (2006) survey indicated a clear liking for tabbed menus. Tabbed menus ranked highest in terms of learnability and understandability. Respondents felt that the tabbed bar offered easier access to pages than other parts of a web interface. Although the top and the left bar style was the second most preferred style by the users, users found it difficult to learn. The top bar was more preferred than the left bar as users felt it provided more screen space. The combinations of top and bottom bars and top and right navigation menus were the least preferred, as users found these navigation styles “awkward” and “backward” (Burrell and Sodan, 2006). Another interesting finding made by Burrell and Sodan (2006), was that tabbed style was more preferred by females than males.

A study conducted at Eyetools Inc indicated that top navigation bars captured more attention than left or right navigation bars because of “visual bleed” (Outing & Roel, 2008) . Another interesting

finding was that users spent more time focusing on right menus than left navigational links in a web interface. Outing and Roel (2008) consider novelty as a reason for the right navigation bar being more seen by users than the left navigation bar. This study also found that users tend to spend more time on compact pages and less time on extended pages with lots of content, and that navigational links get more used on compact pages than extended ones. Forty percent of the viewers clicked on navigational links on a compact web page and only 7% clicked on navigational links on the extended version of the same page.

Rumpradit and Donnell (1999) studied the effects of various interface elements on users' experience. Five patterns of UI design were used for the study:

- Traditional plain hypertext;
- Plain hypertext with only one index;
- Plain hypertext with an image map;
- Plain hypertext with a context path, a list of text buttons that act as navigational cues, added to an index; and
- Plain hypertext with a context path added to an image map

Context paths provide a hierarchical structure for the interface and enable backtracking if a user is lost.

In the study conducted by Rumpradit and Donnell (1999), participants were asked to use the five modes of interface design while they were surfing the internet. The total number of correct answers, time for task completion, level of user confidence while searching the web interface and users' overall satisfaction were recorded. The study revealed no significant effect on the learning curve among the five different kinds of interfaces. The presence of navigational cues (context paths) increased the level of confidence, user learning rate and user success rate. The navigational cues often matched the users' mental model of a browser. Navigational menus also helped to avoid user disorientation and discouragement during the exploration of the user interface.

The studies on navigation styles by Outing and Roel (2008) and Burrell and Sodan (2006) indicate a clear preference for the tabbed style, followed by the top and then left navigation styles. Burrell and

Sodan's (2006) study also reveals the importance of ease of usage; learnability and visibility while choosing the appropriate style for navigation menus. The results of the Rumpradit and Donnell's (1999) study indicate the importance of the layout of contents along with the navigation style within a web interface.

### Usability Evaluation Techniques

Nielsen and Mack (1994) define a usability inspection as a procedure in which evaluators inspect a UI to determine its usability. The objective of any usability inspection is to find and fix a system's usability problems. The authors suggest that usability inspection can be done only in that stage of the usability engineering cycle when a UI has already been generated.

Nielsen and Mack (1994) suggest three probable tasks after the identification of usability problems:

- Identifying those fixes that may require redesigning the interface,
- Prioritizing problems with respect to their severity,
- Calculating of the cost of the software associated with implementing the redesign.

According to Nielsen and Mack (1994) the cost of programming can be estimated with the help of various software engineering metrics. The authors (Nielsen & Mack, 1994) stated that severe usability problems will be fixed irrespective of their cost. Most usability problems can be fixed without major changes in the code. These should not affect the usability inspection as the inspector must identify even those usability problems that are expensive to fix. The fixing of an interface's usability problems may result in a new UI that is much better than the original.

Nielsen and Mack (1994) describe eight usability inspection techniques: heuristic evaluation, guideline review, pluralistic walkthroughs, consistency inspections, standard inspections, cognitive walkthrough, formal usability inspections, and feature inspection.

### Heuristic Evaluation Technique

In heuristic evaluation, a UI is assessed for compliance with a set of heuristics. Nielsen and Molich (1990) identified nine heuristics as a basis for practical heuristic evaluation: "simple and natural

language, speak the user's language, minimize user memory load, be consistent, provide a view of the working of the system, provide clearly marked exits, provide shortcuts, generate relevant error messages and prevent user errors". Nielsen and Molich (1990) view these heuristics as obvious but very difficult to implement in practice. They tested the practical applicability of heuristic evaluation with four case studies.

- In the first case study, 37 computer science students evaluated the UI of a Danish Video-tex system called Teledata that had 52 usability problems.
- In the second study, readers of Danish Computer World Magazine evaluated the UI for a Danish telephone that had 30 usability problems. A paper prototype of the system was used for the study.
- In the third and the fourth studies, a single group of people evaluated voice response systems for a bank and a public transportation company. In both cases customers interacted with the systems using a 12-key keypad. The first system provided account information to a bank's account holders. The second provided commuters with information on bus routes. The two interfaces had 34 and 48 usability problems, respectively.

The subjects for these studies were shown paper prototypes of the four interfaces. The subjects (evaluators) had to report usability problems to the researcher. Evaluators' reports were scored according to how well their findings matched with those of the authors, Nielsen and Molich (1990). A regression analysis on evaluator performance in the experiments revealed very little consistency amongst evaluators in finding usability problems. Nielsen and Molich also found that an evaluator's ability to detect problems is independent of evaluator quality. Often a "poor" evaluator can detect hard usability problems that a good evaluator might overlook. To overcome the problem of difference in usability problems evaluators may engage in collective evaluation after the evaluators have evaluated the interface independently. The assumption is that a group of evaluators is better than one single "best" evaluator.

Another objective of this experiment as indicated by Nielsen and Molich (1990) was to determine an optimum number of evaluators. The problem is compounded by the possible inability of evaluators to serve as equally good judges for different UIs. The graph of the total number of usability problems

detected by the evaluators in the four experiments revealed a sharp increase in the beginning but flattened in the interval between five to ten evaluators. Even for the hardest interface, i.e. the interface for the transportation company, five evaluators found more than half of the usability problems.

From the above study conducted by Nielsen and Molich (1990) it can be concluded that heuristic evaluation is inexpensive and can be done without prior planning. It can be used in any phase of the development cycle. It is also easy to motivate people to participate in heuristic evaluation. One disadvantage of heuristic evaluation is that it does not suggest solutions for problems and can be biased by evaluators' mindsets. Sometimes it may not yield any major improvements in a UI design.

### Thinking Aloud Technique

Think aloud testing, which is often referred to as the usability method, is the only usability testing technique that obtains feedback while a user is interacting with an interface. Users' verbalizations of their thoughts during every step of a task capture what's in a user's short term memory. Initial think-aloud testing, when complete, can be combined with retrospective think aloud as a cross checking mechanism.

The thinking aloud technique has been used in laboratory settings, workshops and field settings (Lewis et al., 1990). According to Lewis et al. (1990) this technique "is assumed to give access to the cognitive processes during users' engagement with computers". They noted that the literature is divided on the value of requiring users to speak during usability testing. Users may find it more difficult to speak while doing engaging tasks or while in the presence of a facilitator. In spite of its apparent drawbacks, thinking aloud is useful as it is cost effective, can be completed with few test subjects, and can even be done with non-usability experts (Lewis et al., 1990)

In the article "Does think aloud work? How do we know?" Ramey et al. (2006) summarize observations by three groups of panelists on the validity of the thinking aloud technique. The first group of panelists observed that moderators often intervened when the user was thinking aloud, which was inconsistent with how moderators are trained to facilitate think aloud sessions. The users' feedback consisted of a series of reports of actions and statements. The moderators reported only those problems that they felt would be convincing to the developers. The first group, therefore, rejected thinking aloud as

a valid method for user testing. The second group of panelists also questioned the failure by usability professionals to adhere to concurrent think aloud protocols and retrospective think aloud protocols. The third group of panelists noted that some experimenters do not intervene during the think aloud process for fear of compromising the data while others believe that intervention, though as a rule undesirable, might be necessary in certain situations so as to collect some crucial information. The third group of panelists felt the need to explore “how to make those crucial interventions, how to identify when you are at a point that requires one, and when it is best to just keep quiet” (Ramey et al. 2006).

Researchers Buur and Bagger (1999) developed the following principles for conducting think aloud techniques:

- “Moving the test facilitator in the lab”: The traditional use of labs for usability testing creates an artificial situation that makes users nervous. The presence of a facilitator in a lab can enable the user to get help when needed.
- “Developing video documentation procedures: In Buur and Bagger’s (1999) study, video tapes of a company employee’s attempts to use a company-developed UI helped to convince the company’s management that this UI was not easy to use.
- “Turning test sessions into workshops”: Sometimes think aloud sessions can be converted to workshops where designers can actively participate in design discussions with participants. Video recording of such workshops can be later observed by the designer to recollect significant user–designer conversation that can serve as a basis for design improvement.
- “Involving users in design”: Users are often a source for new design ideas. Users should be provided with a medium through which they can communicate their ideas and create scenarios for interacting with the UI, possibly in collaboration with other participants.

From Buur and Bagger’s (1999) study it can be inferred that better results can be obtained by converting usability testing into dialogues between designers and prospective system users. Dialogues



reveal users' priorities while they are performing tasks that would have otherwise remained hidden. Dialogues between designers and users often generate new and innovative design possibilities.

### Relevance of Heuristic Evaluation, Thinking Aloud, and Survey

Ssemugabi and Villers (2007) suggest the use of heuristic evaluation and questionnaires for evaluating UIs. They used the survey method and heuristic evaluation to find usability problem in a UI. The survey, which was conducted with 61 participants, revealed 64 usability problems. Heuristic evaluation of the UI conducted with four evaluators revealed 58 problems. Most of the expert evaluators had identified the same problems with the UI as had been found by the survey. Although the survey method found more usability problems in the interface; ten of the twelve major problems were identified by heuristic experts and not the survey. This study's findings indicate that heuristic evaluation is a more efficient mode of usability study than surveys with users of a prospective interface. Often the experts are more aware of an interface's objectives than regular users.

Ebling and John's (2000) analysis of data generated after conducting thinking aloud and survey revealed that thinking aloud helped to identify more major problems in a UI than those identified by the survey method. They concluded that thinking aloud was the more important usability inspection tool as measured by its cost/benefit ratio. They (Ebling and John, 2000) observed that data generated from the surveys was useful, in that it identified the lesser usability problems and supported the findings of the thinking aloud experiments by suggesting a convergence of the usability problems.

### Usability Metrics

According to Nielsen (2001) "it is easy to specify usability metrics but hard to collect them". Usability metrics are based on the most basic usability attributes: learnability, efficiency, error-rate, satisfaction, and memorability (Nielsen, 2001). Usability metrics are the basis for determining whether a UI meets the basic usability attributes. While these metrics and their use can vary based on a UI's target audience and purpose, Nielsen (2001) has suggested five metrics as appropriate for any UI:

- "Success rate": Success rate, or the "percentage of tasks that users complete correctly, is easy to compute and the results are easy to collect.

- Time taken to complete a task.
- “Error –Rate”: The number of failed attempts made by the user to successfully complete a task.
- “Users’ subjective satisfaction”: The participants’ overall reaction to the UI.
- “Changes required”: The enhancements required in the interface so as to make it more usable.

### Summary

Ivory and Megraw’s (2005) studies of web interfaces suggest the use of “L” shaped navigation bars for web interfaces. The studies by Eyetools Inc. (Outing & Roel, 2008) however indicate that the top menu navigation bar is most liked by users after the tabbed navigation bar. The combination of top and left navigation bar was less liked than the top or the tabbed style. It can be inferred that when the number of links increases, designers resort to the top and left navigation bar, as this is the style that is used by almost all popular web interfaces.

Heuristic evaluation, thinking aloud and surveys are the most commonly used techniques for UI evaluation. These three techniques, however, must be used in combination so as to generate valid data for measuring user satisfaction. The usability metrics form an important factor while testing an interface’s usability. The results obtained from usability metrics help to formulate an overall idea about a UI’s usability.

## CHAPTER 3

### RESEARCH PLAN

This chapter discusses the principles that were used to develop the new interface and the techniques that were used to test the effectiveness of the original and the new interface.

#### Motivation for the Research

Neal and Miller (2005) observed that distance education has become popular and its nature has changed with the increased use of computers and the Internet. Neal and Miller found that distance education is being used to make education more accessible to students who are geographically dispersed, physically challenged, and have varied access to technology. Neal and Miller's findings (2005) are confirmed by Pope's (2006) article which showed that 80% students of online courses "are generally older and more likely to be working and have families". According to Parry (2010), colleges recorded a 17% increase in registration for online classes in fall 2008 with one in every four students taking online classes. Parry (2010) also states that the percentage increase of students registering for online classes was much higher compared to only 1.2% growth rate of overall student population in higher education.

The starting point for this thesis was a non-traditional course, Communication Skills for Health Professionals (CSHP 1321), that is offered to students of the East Tennessee State University (ETSU) Departments of Nursing, Family Medicine, and Pharmacy. The course is administered by distributing CD-ROMs that contain the web based version of the course. The students can access the course modules through the course's web based interface. A student evaluation of CSHP 1321 in spring 2008 had revealed that students had problems with the interface's font size, color and graphic elements. In spring 2008, a course director for CSHP 1321 contacted the ETSU's Department of Computer and Information Sciences to discuss strategies for improving the course's interface.

The goal of this thesis was to determine the extent to which the original interface for CSHP 1321, hereafter referred as the Control User Interface or Control UI, could be improved by redesigning it in accordance with the usability guidelines discussed in Chapter 2. The effectiveness of the new interface, hereafter referred as the Test User Interface or Test UI, was tested using the thinking aloud technique, a

user survey, and heuristic evaluation. The results obtained from conducting usability evaluation with the Control UI provided a basis for evaluating the Test UI.

### Governing Principles for the Research

Nielsen and Molich (1990) observe that “any system designed for people to use should be easy to learn and remember, effective and pleasant to use”. In accordance with findings by Burton and Walther (2001) and Ivory and Megraw (2005), attempts were made during the redesign to identify elements that would best suit the prospective users, in this case, students of Nursing, Family Medicine and Pharmacy. The usability principles that have been applied to redesign the original interface are listed below:

- Content of the web interface: A web interface’s images, font size and color, background and foreground color, and other graphic elements must relate to the course’s subject matter and user’s task domain (Shneiderman & Plaisant, 2005). Shneiderman and Plaisant (2005) suggest that appropriate color and graphic elements, adequate indentation and spacing between words and less dense displays improve task performance and overall user satisfaction. Rumpradit and Donnell (1999) found that navigation menus make it easier to find information in an interface. Navigational menus also help to avoid user disorientation and discouragement while exploring the user interface. According to the Gestalt Laws of Proximity and Similarity (Paay & Kjeldskov, 2007) navigation menus should be grouped in the order of their usage to improve learnability and ease of use.
- “Visibility of systems status” (Nielsen & Mack, 1994): A web interface should always alert users to a system’s present behavior. Navigational cues in the form of bread crumb trails on a web page’s left hand corner prevent a user from getting lost while searching for relevant information. Maintaining a clear distinction between downloadable files and external links informs users of a system’s present state.
- “Recognition rather than recall” (Nielsen & Mack, 1994): Users should not have to remember methods and options to search information and complete tasks. Steps or options that the UI provides for completing tasks should be visible or readily available. For example, a web site for buying flight

tickets should calculate ticket prices and take users immediately to a credit card information page after they have chosen their ticket and logged in, without forcing users to recall any process.

- “User control and freedom” (Nielsen & Mack, 1994): A UI should allow users to undo their mistakes and provide an “emergency exit” to users who choose a wrong task. For example, download controls should provide users with a “cancel” (Nielsen & Mack) option for aborting unnecessary downloads.
- “Help and documentation” (Nielsen & Mack, 1994): A web interface must document procedures for recovering from any technical problems that users might experience. Heroku’s “Dev Center” and Google Apps’ “Developer’s Guide” are examples of web pages that provide help and documentation for their novice and semi-skilled users.
- “Consistency and standards” (Nielsen & Mack, 1994): An interface’s design should be consistent with other interfaces used previously by the user. For example, web interfaces typically highlight hyperlinks with an underline below the word when a user mouse hovers on the hyperlink. Using a different convention for displaying hyperlinks might confuse users.
- “Flexibility and efficiency of use” (Nielsen & Mack, 1994): A UI should cater to its skilled, semi-skilled, and novice users. This includes providing icons and menu items for novice and semi-skilled users and shortcuts for skilled users, like Microsoft Word 2007’s “Ctrl + O” option for opening a new word document.

#### Starting Point for the Research

The initial web interface for CSHP 1321 consisted of one web page (cf. Figure 2) with hyperlinks on either side of an image in the page’s center. The top right hand corner logo links to ETSU’s Department of Family Medicine. The blinking images on the top of the web page relate to course objectives. A list of course directors appears on the image on the center of the web interface.

The hyperlinks on the page’s left side link to PowerPoint slides for the course’s topics. The page’s right hand side consists of links to external web sites, including ETSU’s home page, and links to

course-related word documents, like the course’s syllabus. The “Technical FAQ” hyperlink on the page’s right hand side links to a Word document (cf. Appendix C) that provides help and documentation for students who might face difficulties while accessing the web interface.



Figure 2. Screen Shot of the Original Interface of the Course: Communication Skills for Health Professionals

### Methodology

#### Identification of Design Flaws in the Control User Interface

An initial examination of the Control UI uncovered the following design flaws.

- Content of the web interface: Although the Control UI is simple and makes all information available on a single page, it violates guidelines given by Shneiderman and Plaisant (2005) and Paay and Kjeldskov (2007). The page’s central image has no relationship to the course’s task domain or content. Its background color, green, is not commonly associated with the healthcare industry. The combination of yellow font and green background fails to conform to Shneiderman and Plaisant’s (2005) guidelines for color and images. The list of hyperlinks on the right hand combines links to

external web sites and internal documents. There was no logical grouping of similar information in the Control UI: it fails to conform to Gestalt laws of proximity and similarity.

- “Visibility of systems status” (Nielsen & Mack, 1994): The web page fails to inform users as to whether its links lead to documents or to external sites (cf. Figures 2 and 3). The blinking images on the top of the Control UI suggest, but fail to correspond to, clickable hyperlinks.
- “User control and freedom” (Nielsen & Mack, 1994): The Control UI fails to provide users with adequate freedom of navigability. Although access to the course modules was easily available, the page fails to state that the links on the Control UI’s left hand side reference PowerPoint slides for the course modules. The message below the image that provides additional information about the list on the left hand side of the Control UI (cf. Figure 3) is not easily readable or visible.

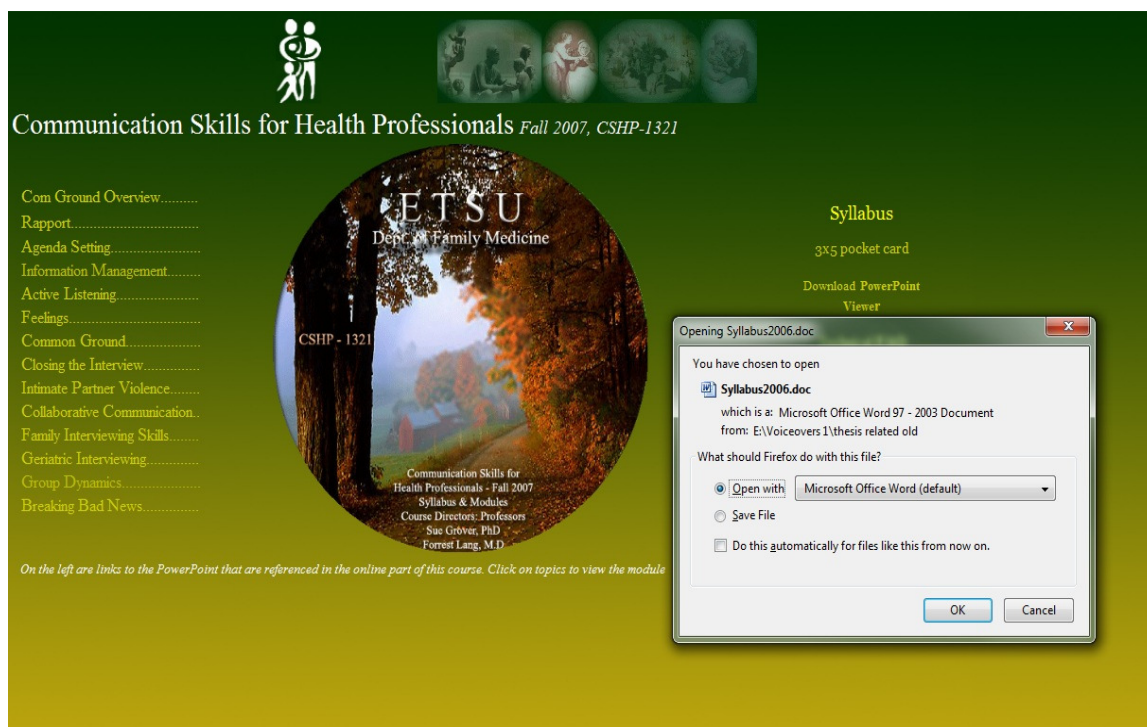


Figure 3. Screen Shot of the Control UI for the Course: Communication Skills for Health Professionals

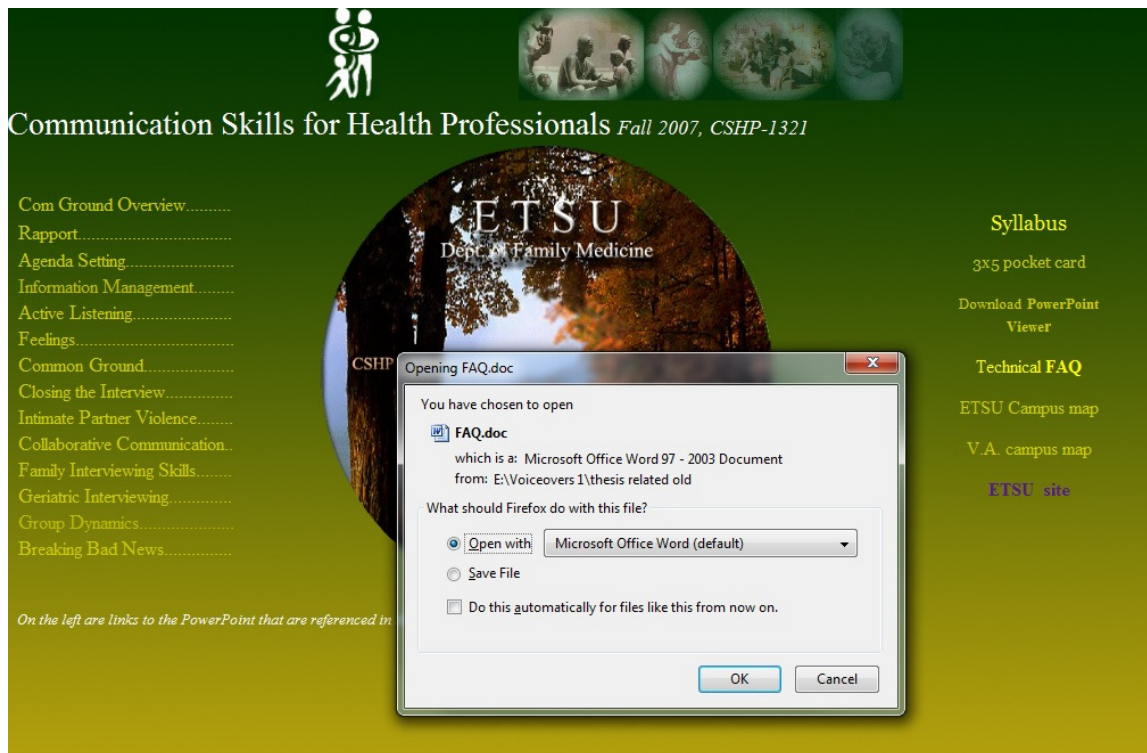


Figure 4. Screen Shot of the Control UI While Opening the “FAQ” Document in the Web Interface for the Course: Communication Skills for Health Professionals

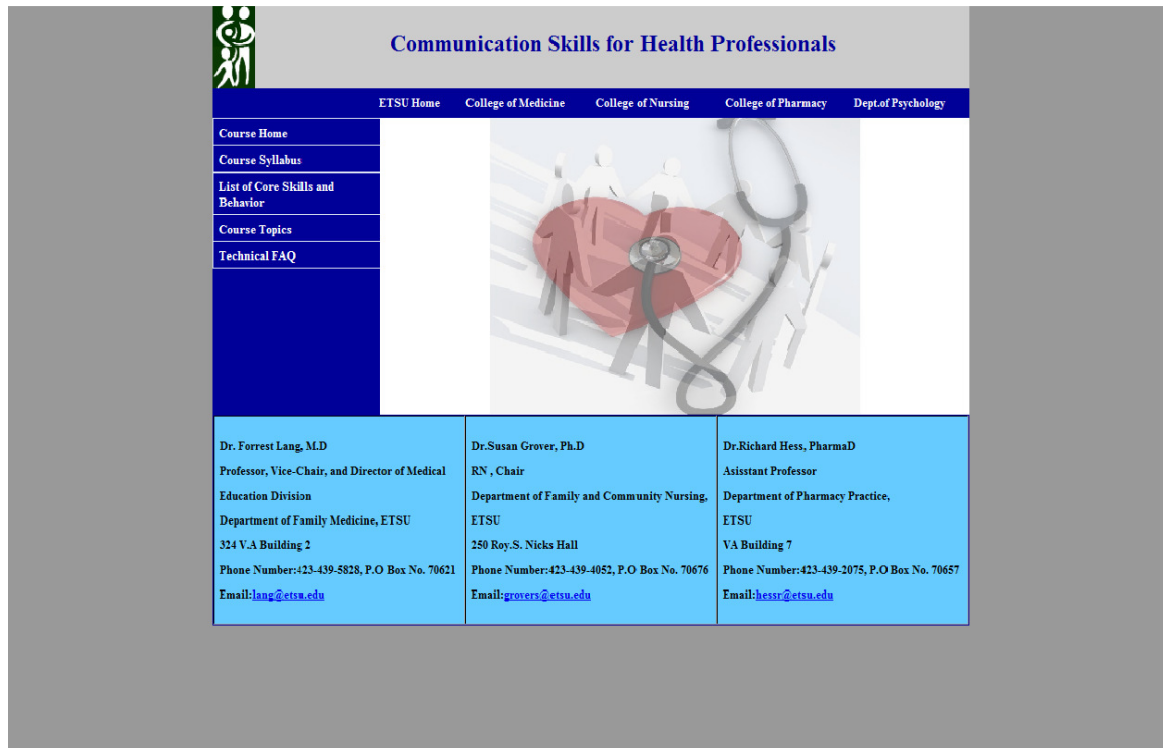
- “Help and documentation” (Nielsen & Mack, 1994): The word “FAQ” in the “Technical FAQ” element on the Control UI’s right hand side (cf. Figure 4), when clicked, opens a Word document (cf. Appendix C) that addresses technical problems users might face while accessing the Control UI. The word “Technical”, however, is not clickable.
- “Consistency and standards” (Nielsen & Mack, 1994): No design flaws were found in the Control UI, which, as seen in Figure 4, follows Windows platform conventions for tasks like opening PowerPoint slides and Word documents. The options for exiting from the interface also follow the consistency and standard found in all web interfaces.
- “Flexibility and efficiency of use” (Nielsen & Mack, 1994): A novice user might be confused by the list on the Control UI left-hand side, which is tough to read and cannot be distinguished as hyperlinks to PowerPoint slides for various modules of the course.



## Design of the Test User Interface

The Test UI was developed based on the usability principles discussed in Section 3.2. The usability principles that were applied to design the Test UI are listed below:

- Web interface content: The interface's content is relevant to the course's content (cf. Figure 5). The interface's images carry relevance to the interface content. Every page has a logo in its upper left-hand corner (cf. Figures 5 and 6). All non-home-page logos link to the home page. The site's overall organization is simple. The navigational menus are hierarchical in nature "moving from general to the specific" (Sseguambi & Villers, 2007).



*Figure 5.* Screen Shot of the Test UI's Home Page Showing Use of Images Relevant to the Course Content

The site uses a single font face (Times New Roman, Times serif text), with 12 pt. footer text and 16-18 pt. body text. Footer text is rendered in a different color to distinguish it from body text. Test UI menus use terms that users should understand. Items in menus are listed in order of use and arranged so that items do not overlap. Navigation menus use simple titles that characterize the content of the pages

they reference. Contrasting colors have been used as background and foreground colors to make text easier to read. The total numbers of colors used in the Test UI excepting the images have not exceeded seven.

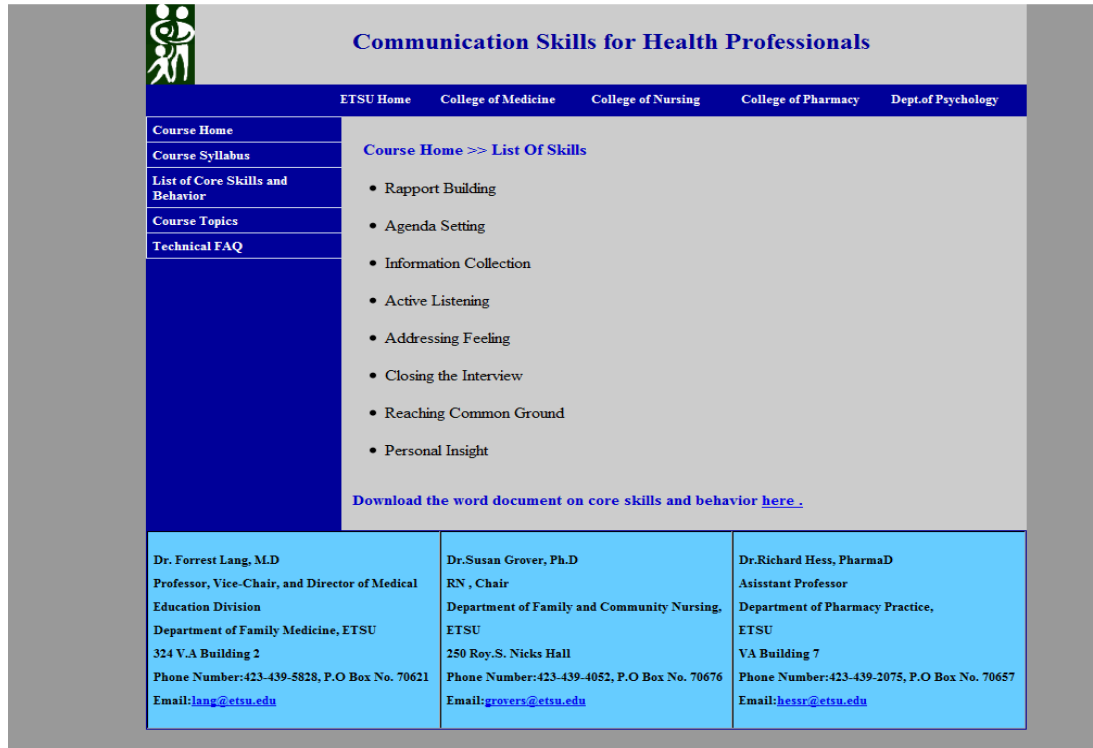


Figure 6. Screen Shot of the Test UI’s “skills.html” Page

- “Visibility of systems status” (Nielsen & Mack, 1994): The Test UI keeps users informed about the interface’s status with the help of navigation menus and navigation cues (cf. Figure 7). Users can use the top and left navigation menus to navigate to external sites and internal web pages respectively. Every web page provides navigation cues in the form of a breadcrumb trail on its upper left hand corner; this trail informs users about the page’s location within the Test UI.
- “Recognition rather than recall” (Nielsen & Mack, 1994): The Test UI consists of five web pages. The user can navigate to any of these pages from any location within the web site using the left navigation menu on each web page. The Test UI’s columnar design and navigation menu placement are compatible with web interfaces that the user might have used in day to day interaction with the Internet. The ordering of items on the left hand side of the navigation menu follows standard patterns

of site usage. For example, in Figure 7 it can be seen that the “Course Syllabus” is listed above the “Course Topics” as students will read the syllabus before moving on to the “Course Topics”.



Figure 7. Screen Shot of the Test UI Showing the Top and Left Navigation Menus and Navigation Cues

- “User control and freedom” (Nielsen & Mack, 1994): The UI helps users to recover from choosing the wrong task. The list of course modules in the “topics.html” page (cf. Figure 8) allows users to switch back to a separate PowerPoint in case of a wrong selection.

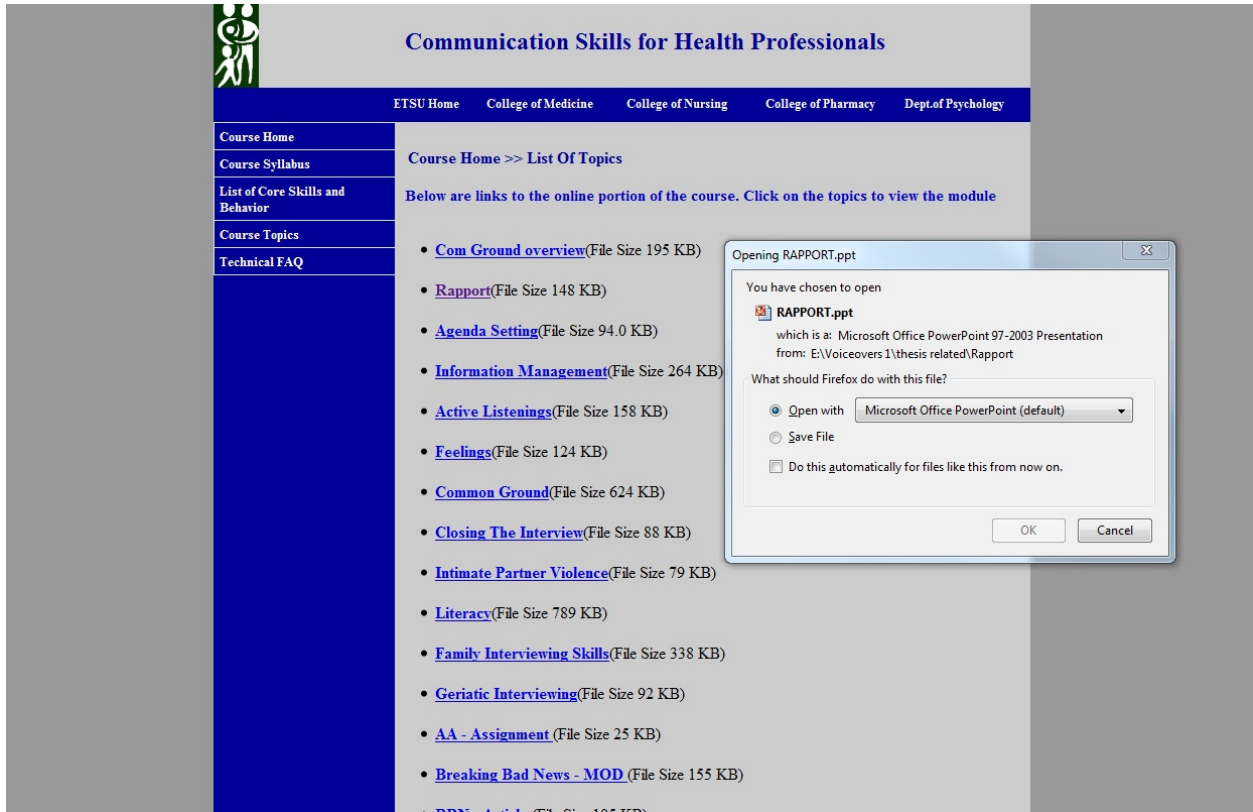


Figure 8. Screen Shot of the Test UI Suggesting “User control and freedom” (Nielsen & Mack, 1994)

- “Help and documentation” (Nielsen & Mack, 1994): The Test UI’s Technical FAQ (cf. Figure 9) acts as the help and documentation page for intended users. The page enlists possible problems that users might face while using the web interface, along with their solutions.



Figure 9. Screen Shot of the “faq.html” Page Which Acts as the Test UI’s Help and Documentation Page

- “Consistency and standards” (Nielsen & Mack, 1994): The Test UI follows Windows platform conventions for tasks like opening PowerPoint slides and exiting the interface, as can be seen in Figure 10 The hyperlinks do not open in a separate web page but provide users with the options of saving a file or opening it for temporary viewing.

- “Flexibility and efficiency of use” (Nielsen & Mack, 1994): The Test UI allows intended users to distinguish between external links and downloadable files. All file links provide information on files’ sizes (cf. Figure 10). The information can prevent users from being confused when they click on hyperlinks that link to course modules or to external links. Because the Test UI consists of five web pages that are easily navigable, it provided no shortcuts for experienced users.

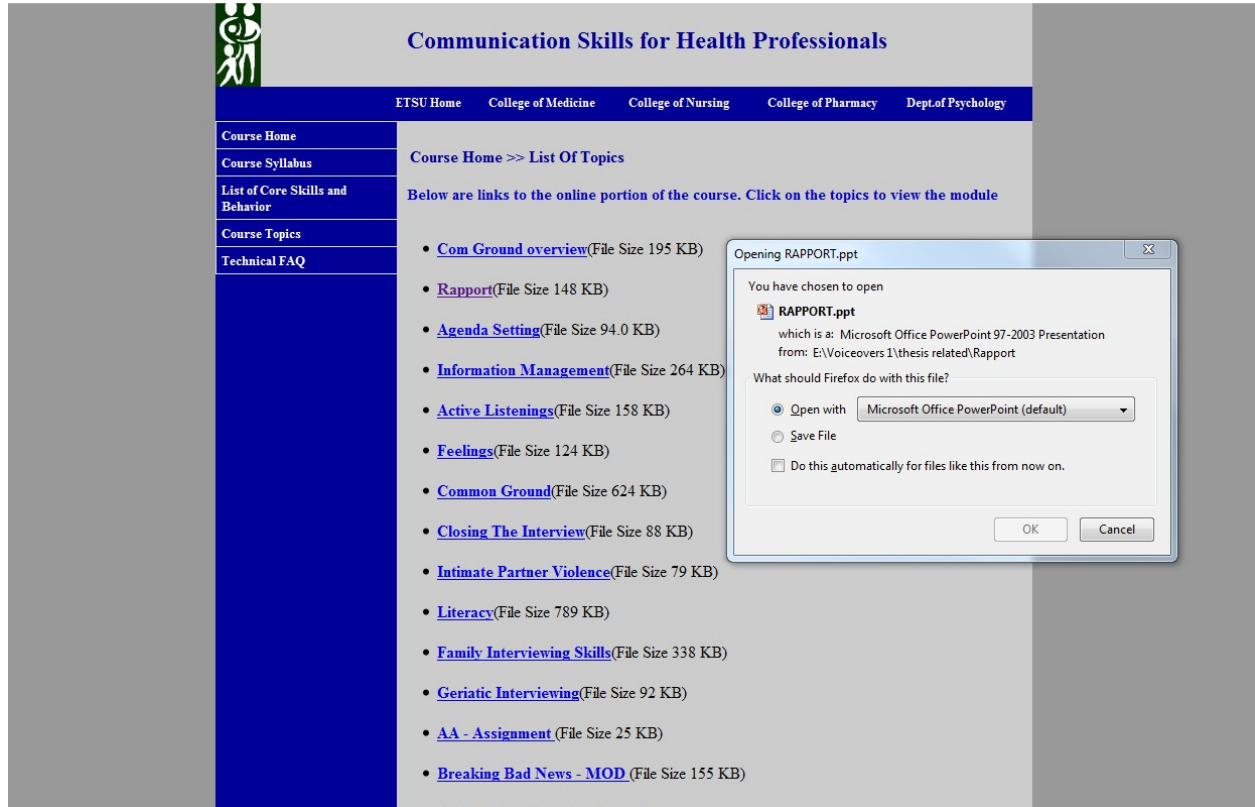


Figure 10. Screen Shot of PowerPoint File Being Opened Using the Test UI

### Description of User Testing

The thinking aloud experiments and survey of participants was conducted in March, 2009 in a span of two weeks. The experiments were conducted in separate conference rooms on ETSU’s VA Campus and in ETSU’s Department of Computer and Information Sciences. The study’s location varied according to the availability of test participants. The participants for the usability testing were a mix of students of ETSU’s College of Nursing, Department of Family Medicine, and Department of Pharmacy. All participants had used the Control UI in fall 2008. Participants were recruited via email campaigns.

Each participant was rewarded with gift cards worth ten dollars after completing the thinking aloud tests and the survey using the Control and the Test UI. Sixteen participants from a total demographic size of 300 students participated in the study.

Users were provided with six representative tasks to perform with the Control UI and then the Test UI. Each task was designed to test whether certain usability principles had been successfully implemented in the UI. Tasks were arranged in order of increasing difficulty in order to enhance the confidence of the users as they navigated the UIs. As users were directed to think aloud while completing the tasks, usability testing was conducted with one user at a time. The designer acted as the principal investigator for the study. IRB regulations required all test facilitators to complete the ETSU Human Subject Training Program. The principal investigator was the only person to successfully complete the training program. The principal investigator was present in the room to assist test participants with any queries during thinking aloud or the survey. While users completed the tasks, they were asked to think aloud and their responses were recorded via audio recorder.

The description of and objectives for each of the six tasks are given below:

1. *Who are the course directors of the course?*

Objectives: Readability, use of fonts, and use of colors in the interface.

For the Control UI, the names of the course directors are available on the main page but are written on an image. In the Test UI, the information is available in the interface's footer.

2. *List at least two objectives of the course.*

Objectives: Visibility of system status and ease of use.

For the Control UI, the course objectives are listed in the "syllabus.doc". In the Test UI, the syllabus was available by clicking on the left navigation menu item "Course Syllabus". The "syllabus.html" page provides a brief overview of the course syllabus. The list suggests that the objectives will be available in the "syllabus.doc" file available for download on the same page.

3. *Find the date and week of the final exams for nursing students.*

Objectives: Recognition and recall and flexibility and efficiency of use.

In the Control UI the user had to find the link to the course syllabus and open the Word document for “syllabus2006.doc”. The information is available on the Control UI’s main page. In the Test UI the course objectives and examination schedule are available in the course syllabus page. The user had to navigate to the “syllabus.html” page and open the course syllabus document. Users had already opened the syllabus to complete Task 2. It was assumed that users would use the steps learnt in Task 2 to complete Task 3. It was assumed that users would therefore take less time to complete Task 3 than they did with Task 2.

4. *List the behaviors associated with rapport building skills.*

Objectives: Content organization of the interface, conformance to standards and the extent of user freedom provided by the interface.

To complete the task in the Control UI, the user had to navigate to the link “3 X 5 pocket cards” and open the Word document “3 X 5.doc”. In the Test UI, the user had to click on the left hand menu item to the “skills.html” page and open the Word document that lists associated skills and behavior. The process of opening the Word document follows the Windows platform convention. The user is also given the choice of saving the document as the document is opened. At any point in time the user can cancel reading the document. By successfully completing this task, a user demonstrates the ability to apply previously learnt computer skills to open and read the Word document.

5. *Find the objectives on Breaking Bad News.*

Objectives: Content organization of the interface, conformance to standards and the extent of user control and freedom provided by the interface.

In the Control UI, the user had to click on the link “Breaking Bad News” in order to open the PowerPoint on Breaking Bad News and then find the relevant objectives. In the Test UI, there were two ways users could complete this task. In the first method, the user could navigate to the



“topics.html” page and then open the PowerPoint on “Breaking Bad News”. The second method was to mouse-hover on “Course Topics” on the left hand side of the navigational menu. This action displayed the list of course topics to the user. The user had to click on the correct link to open the PowerPoint slide on Breaking Bad News. The objectives of Breaking Bad News are enlisted in the PowerPoint slide.

6. *What are the specifications to run the CD containing the course materials?*

Objectives: Help and documentation provided by the interface.

In the Control UI, the user had to click on the link “FAQ” and open the document “FAQ.doc” to obtain the specifications for running the CD. In the Test UI, the user had to navigate to the page “faq.html” and then scroll down the page to obtain the desired information. The task required two keystrokes for the Control and Test UI alike. This task helped to judge the readability and organization of the “Technical FAQ” page.

Users were asked to indicate their level of satisfaction with each interface’s qualities after completing the thinking aloud exercises for that interface (cf. Appendix A). This survey consists of seven questions that ask participants to rate a UI’s color and font size; its readability; the ease with which information can be located in the interface; the interface’s resemblance to online courses; and the relevance of the contents and images in the interface to the course material. This survey asked users to rate these properties using a Likert scale which ranged from zero to four, a rating of ‘0’ represented unsatisfactory, ‘1’ represented somewhat unsatisfactory, ‘2’ represented neutral, ‘3’ represented somewhat satisfactory and ‘4’ represented satisfactory rating. Before participating in the survey the users were explained the value of each rating by the principal investigator.

The satisfaction survey for the Test UI included a final question that asked participants to indicate their preferred UI. The feedback from this eighth question was used to help validate user feedback, under the assumption that ratings for the first seven questions would correlate with these overall preferences.

### Description of Heuristic Evaluation

Heuristic evaluation was used to find problems in the test and the control UI that users might have overlooked or failed to report. Five evaluators were chosen to conduct heuristic evaluation. The first heuristic expert held an M.S in Computer Science and had taken courses on Human Computer Interaction (HCI). The second was an M.S. student in Computer Science who had successfully completed a course in HCI. The third had dual M.S. degrees in Communication Studies and Technology in Education and had successfully completed course work in HCI. The fourth was a doctoral candidate in Instructional Technology who had extensive experience in conducting online classes. The fifth holds a M.S. in Technology and has over ten years of experience as a web developer and designer.

The experts were asked to evaluate the interface on the basis of Nielsen's (Nielsen & Mack, 1994) ten heuristics, using ten questions which can be read in Appendix B of this thesis. Evaluators were provided with two CD-ROMs labeled "User Interface 1" and "User Interface 2" and two heuristic evaluation sheets (cf. Appendix B) for each interface. The Control UI was accessible through the CD-ROM labeled "User-Interface 1" and the Test UI was accessible through the CD-ROM labeled "User-Interface2". Evaluators were requested to complete their evaluation within two weeks.

### Summary

The objective of usability testing was to find the effectiveness of the redesigned Control Interface. The tasks for thinking aloud aimed to find the ease with which users could find information using the two interfaces. The survey recorded the users' subjective satisfaction after interacting with the two interfaces. The major reason for using heuristic evaluation was to find problems in the test and the control UI that the users might have overlooked or missed or failed to report.

## CHAPTER 4

### EXPERIMENTAL RESULTS AND ANALYSIS

#### Results and Analysis of Usability Testing with Participants

The thinking aloud experiments and survey of participants was conducted in March, 2009 in conference rooms in ETSU's VA Campus and Department of Computer and Information Sciences. Sixteen participants from a total demographic size of 300 students participated in the study.

**Usability testing:** Usability tests were conducted using a mix of 16 students from ETSU's Quillen College of Medicine, Gatton College of Pharmacy, and College of Nursing. Twelve participants (75%) considered themselves skilled in the use of computers and the Internet. Four (25%) considered themselves semi-skilled in the use of computers and the internet. Each participant had to use the Control UI and then the Test UI to complete six tests, using the think aloud technique. After completing the tasks each participant completed a satisfaction survey, as described in Chapter 3.

#### Results and Analysis of Thinking Aloud Technique

##### ***Task 1: Who are the course directors of the course?***

Users' times to complete Task 1 improved by an average of 97% with the Test UI (cf. Appendix D, Table 11). In both UIs the course directors' contact information was on the home page. The use of green as the foreground color and yellow as the font color on the Control UI's home page might have reduced the UI's readability. Most participants tried to find the information by opening, then browsing, the syllabus. All users completed the task on the first attempt with both UIs.

##### ***Task 2: List at least two objectives of the course***

Users' times to complete Task 2 improved by an average of 26% with the Test UI (cf. Appendix D, Table 12). In both interfaces users had to open the relevant PowerPoint presentation or the syllabus in order to search for course objectives. The only changes in the Test UI were to the web interface's layout: the content and layout of the syllabus and the PowerPoint slides were unchanged. Because the Control UI

was shown before the Test UI, the learning effect from the Control UI might have contributed to the improvement in the time for the Test UI.

***Task 3: Find the date and week of the final exams for nursing students***

Users' times to complete Task 3 improved by an average of 16% with the Test UI (cf. Appendix D, Table 13). The final exam's date and week were included in the syllabus. The syllabus's content and layout were the same for both UIs. The Test UI's left menu might have helped users to locate the syllabus faster. One user took more time to locate the information with the Test UI. The user found the left menu intimidating. The Control UI's homepage seemed more usable to the participant as all information was available on one page.

***Task 4: List the behaviors associated with rapport building skills***

Users' times to complete Task 4 improved by an average of 32% with the Test UI (cf. Appendix D, Table 14). The Test UI allowed the user to quickly navigate to the course listings page. The "Course Topics" page listed all course materials (PowerPoint slides). The list of behaviors also formed a separate section on the left-side menu of the Test UI. Participants who could understand the question located the information using a link on the left menu.

***Task 5: Find the objectives in breaking bad news***

Users' times to complete Task 5 improved by an average of 18% with the Test UI (cf. Appendix D, Table 15). The change of the layout and content of the Test UI could have been the reason for improvement in time. The content and the layout of the PowerPoint slides that formed a part of the course materials for the online course remained unchanged. Participants might have found it easier to locate the PowerPoint slides with the Test UI. In order to complete the task participants had to locate information in the PowerPoint files which took up some time.

***Task 6: What are the specifications to run the CD containing the course material?***

Users' times to complete Task 6 improved by an average of 85% with the Test UI (cf. Appendix D, Table 16). The three participants who failed to complete the task with the Control UI completed the

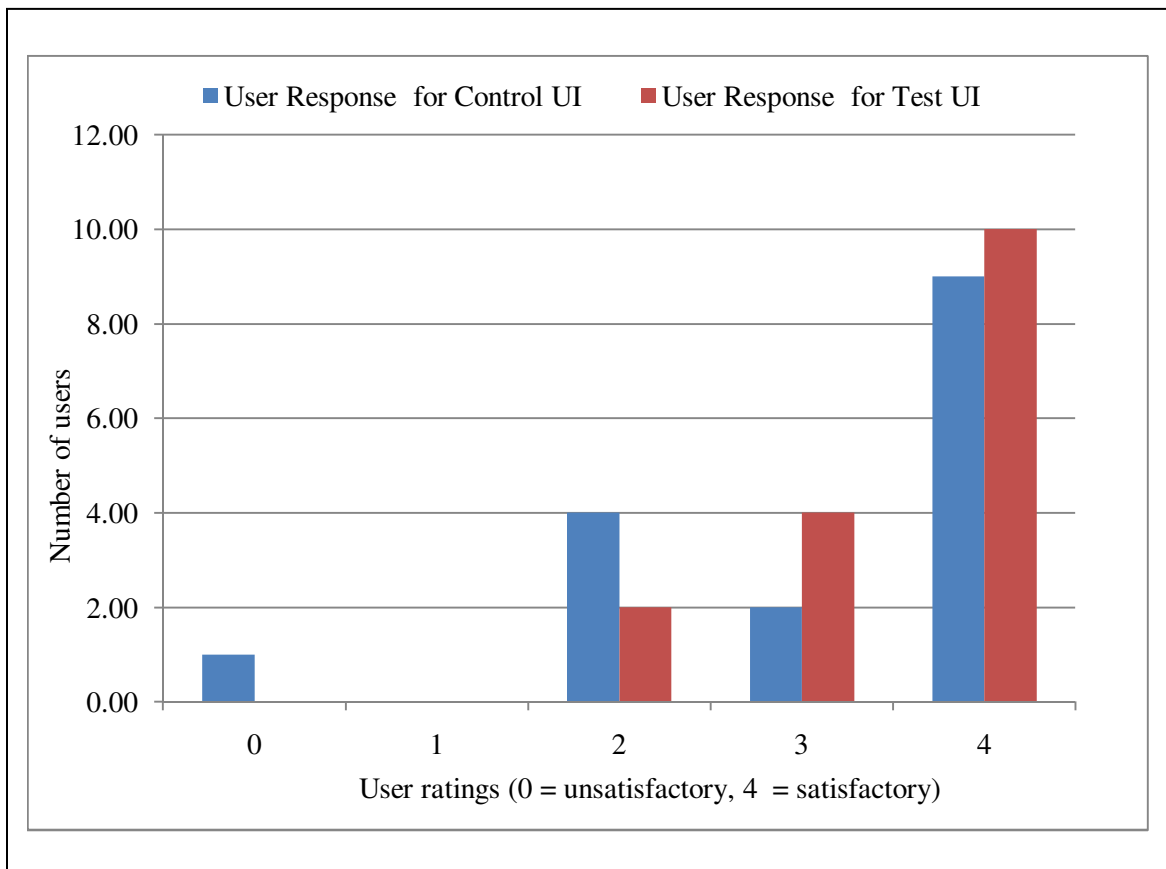
task with minimum time with the Test UI. The Control UI was shown before the Test UI, therefore a transfer of knowledge could also have accounted for this improvement in time.

### Results of User Responses to Survey Conducted after Thinking Aloud

The thinking aloud technique was followed by a survey which required users to rate various aspects of the two interfaces. The users had to rate the two UIs using a five point Likert Scale which ranged from '0' to '4'. The value of the ratings in the survey has been described in Chapter 3, Description of User Testing, of this thesis.

#### ***Rate the use of color***

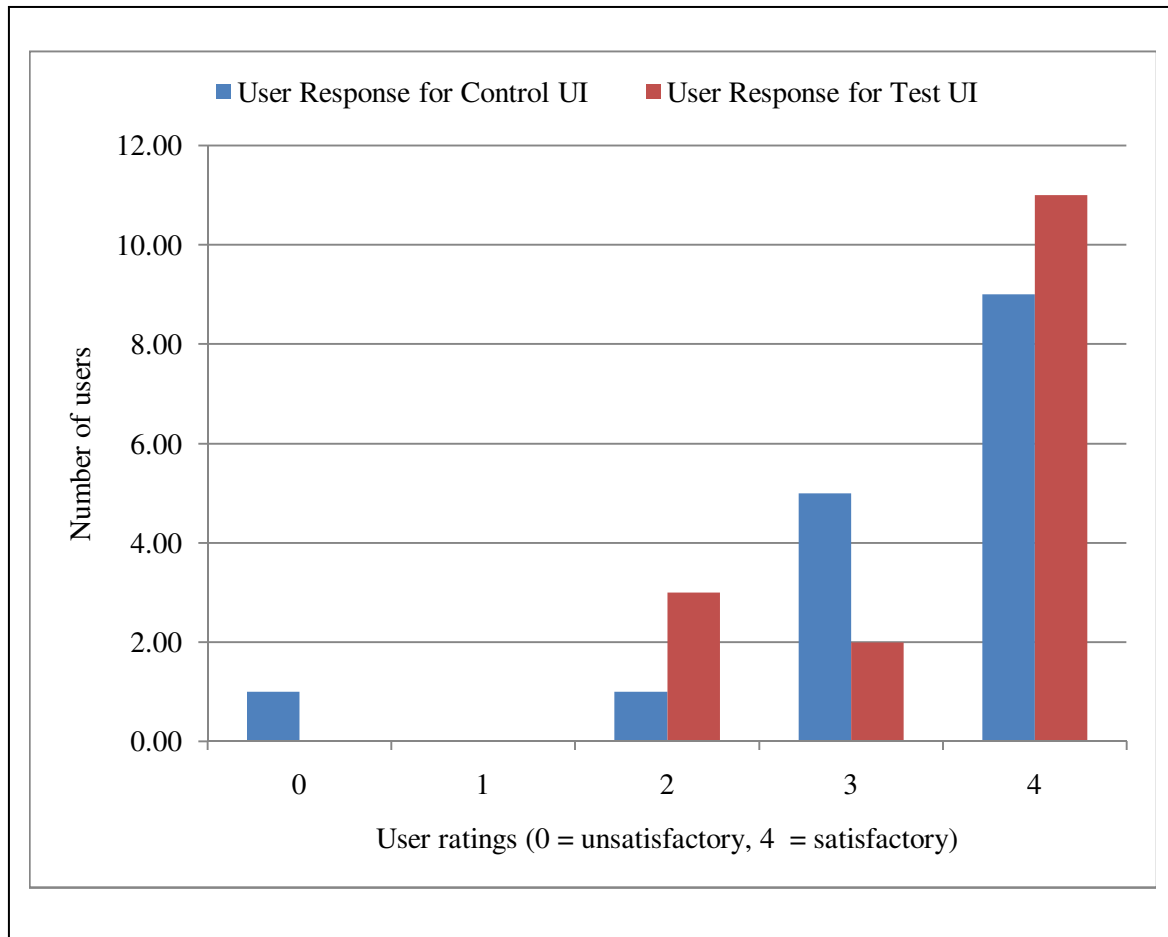
There was little difference in users' assessment of the use of color in the two UIs (cf. Figure 11).



*Figure 11.* Users' Assessments on Use of Color in Control UI and Test UI. (0 = Unsatisfactory, 4 = Satisfactory)

***Rate the use of fonts in the web interface***

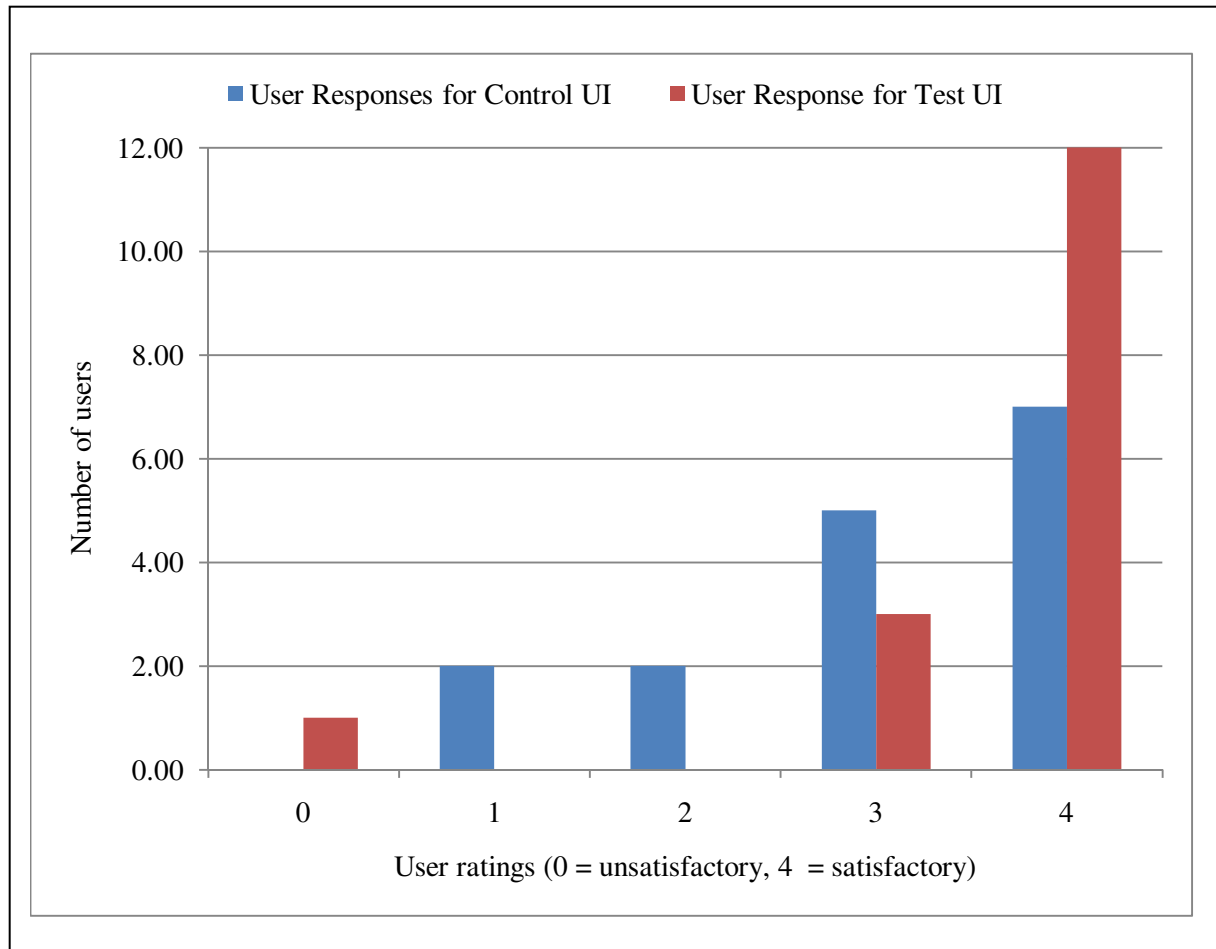
There was little difference in users' assessment of font styles in the two UIs (cf. Figure 12).



*Figure 12.* User's Assessments on Use of Fonts in the Control and Test UIs. (0 = Unsatisfactory, 4 = Satisfactory)

*The interface looks like online course materials*

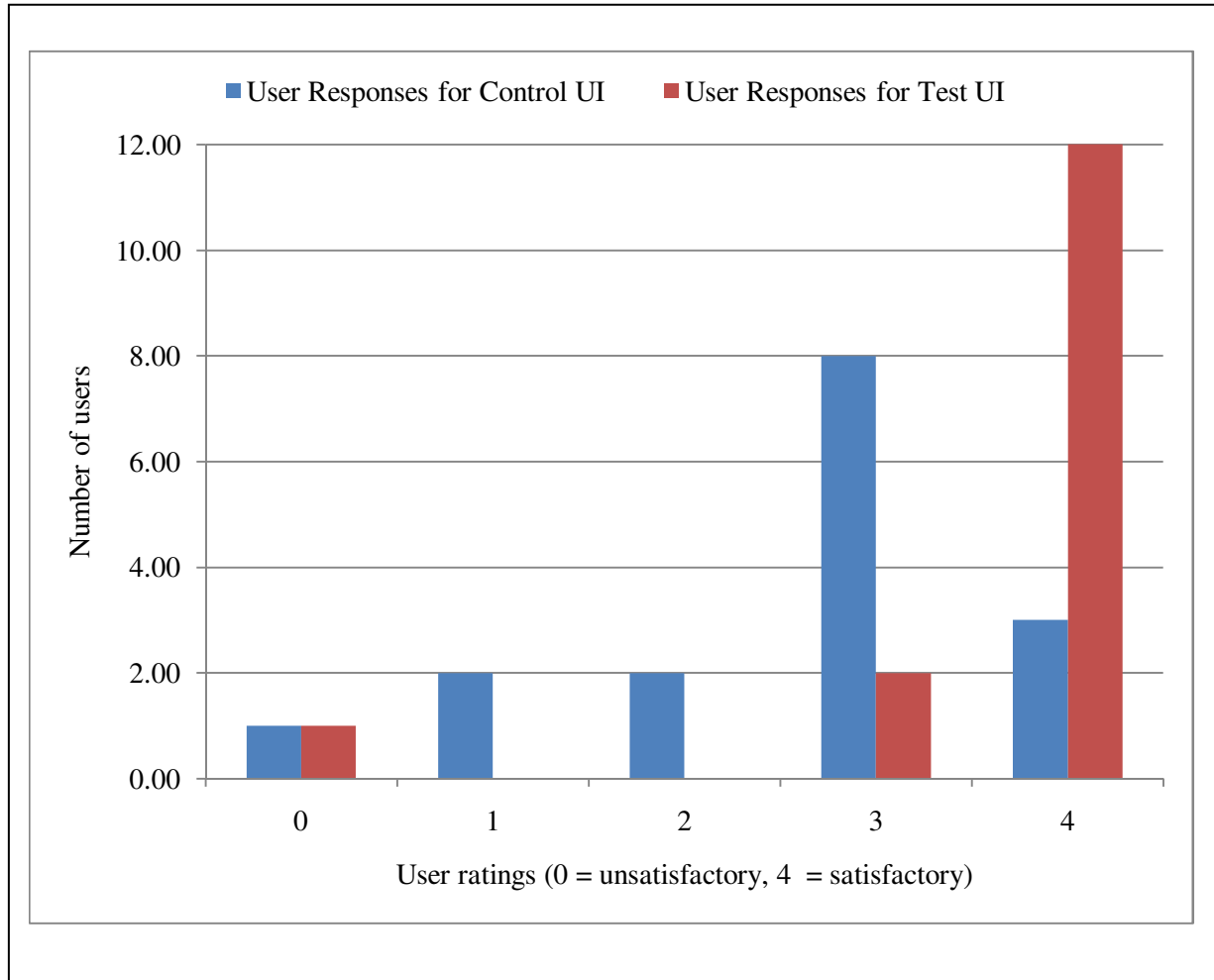
Users felt that the Test UI more closely resembles online course materials (cf. Figure 13).



*Figure 13.* Users' Assessments on the Resemblance of Control UI and Test UIs to Online Course Materials. (0 = Unsatisfactory, 4 = Satisfactory)

***The ease with which you could find desired information on the interface***

Users found it easier to locate information in the Test UI (cf. Figure 14).

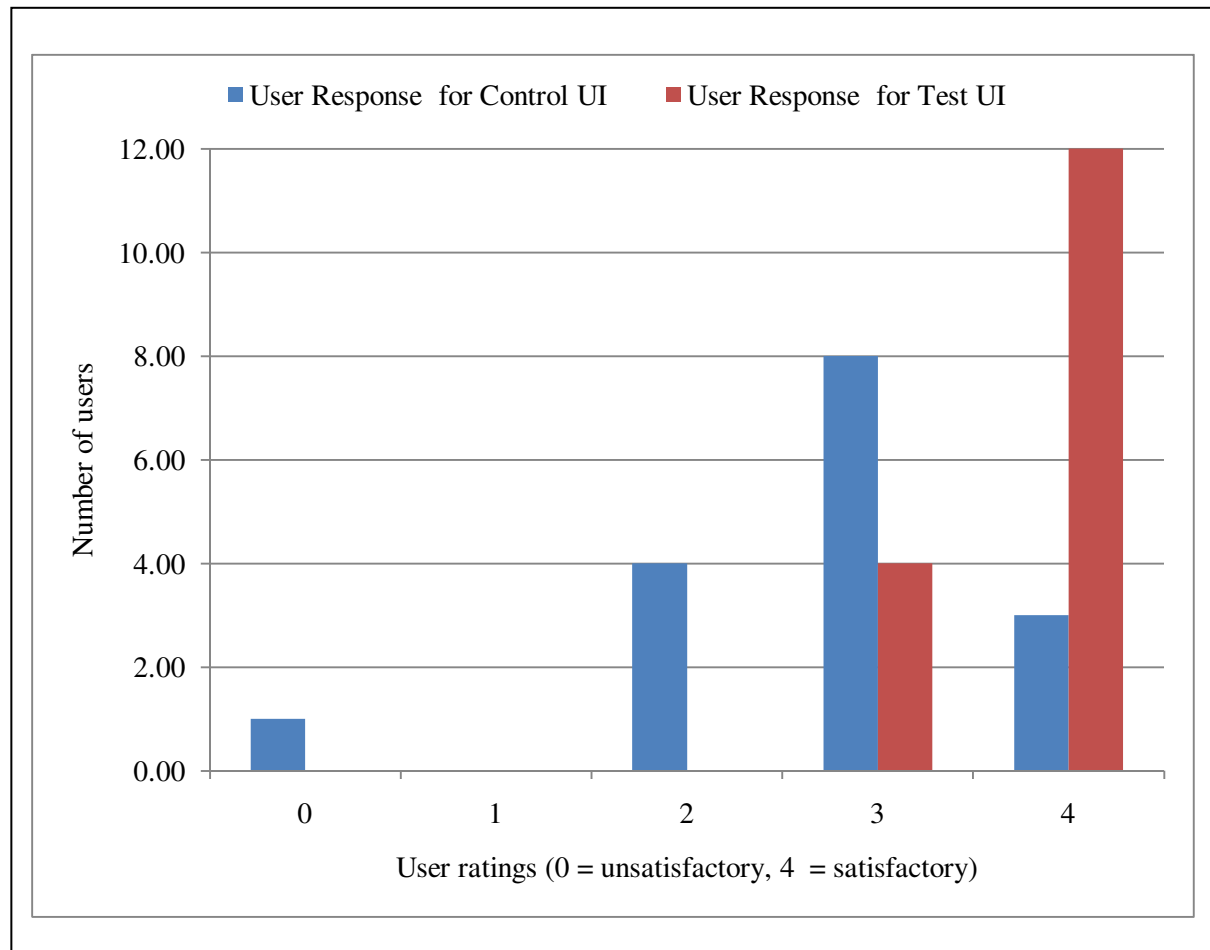


*Figure 14.* Users' Assessments on the Ease with Which Desired Information Can Be Found in Control UI and Test UI. (0 = Unsatisfactory, 4 = Satisfactory)



***Use of images on the interface and their relation with the course material:***

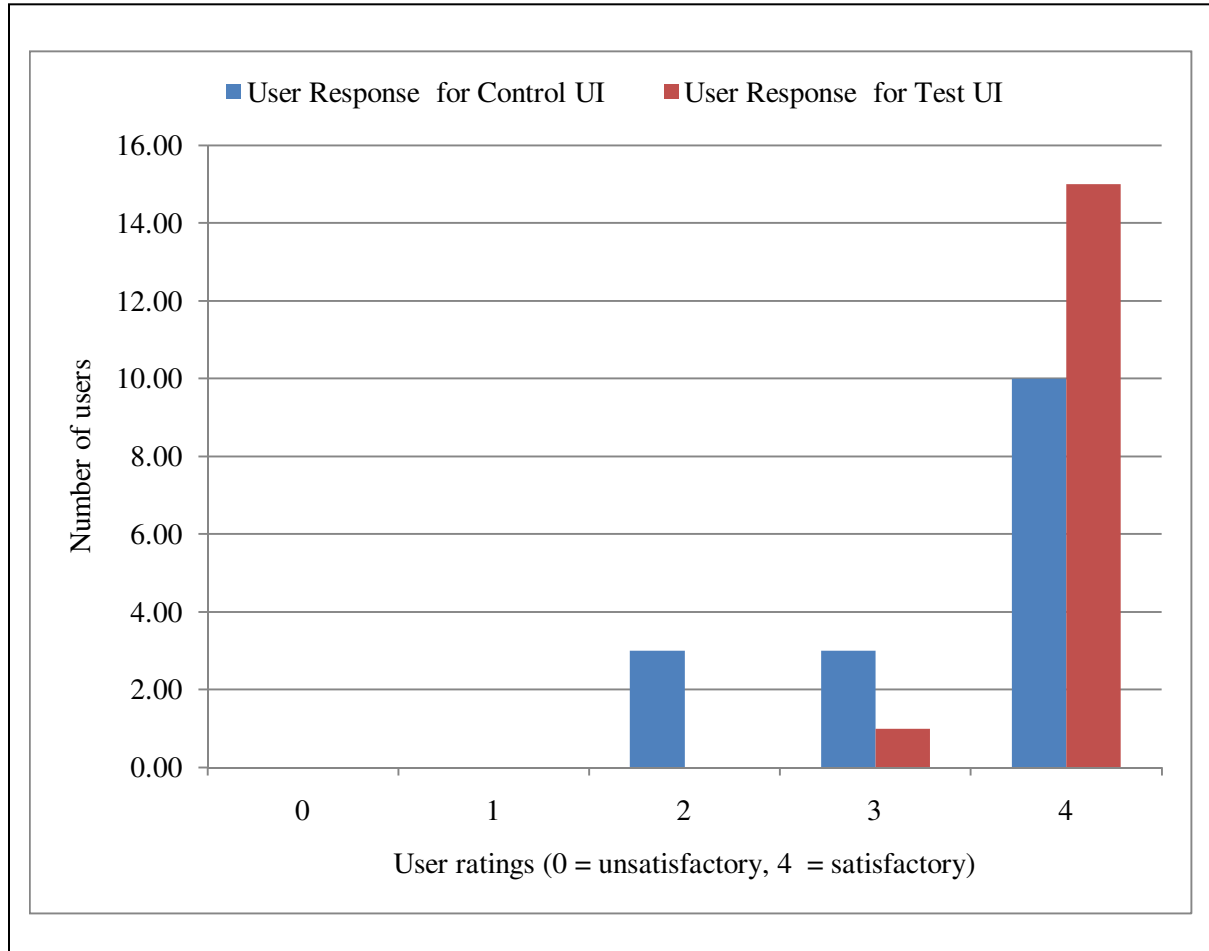
Twelve users felt that the Test UI's images were relevant to the course material (cf. Figure 15).



*Figure 15.* Users' Assessments on the Use of Images and Their Correlation with the Course Material in Control UI and Test UI. (0 = Unsatisfactory, 4 = Satisfactory)

***The ease with which users could read the contents of the web interface:***

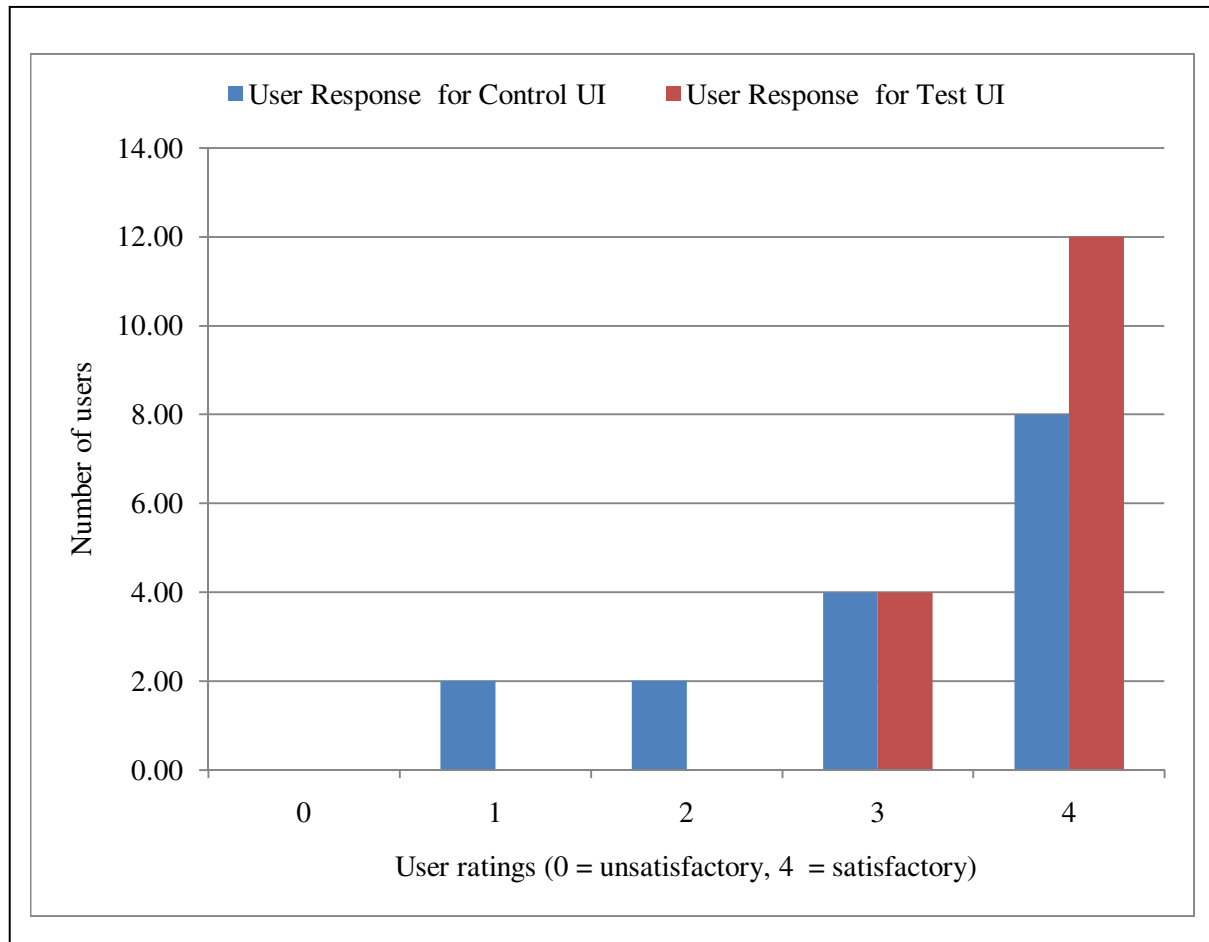
Fifteen participants felt that it was easier to read the contents using the Test UI (cf. Figure 16).



*Figure 16.* Users' Assessments on the Ease with Which Course Material Could Be Read in Control UI and Test UI. (0 = Unsatisfactory, 4 = Satisfactory)

***Your overall reaction to the interface:***

Twelve participants had a more satisfactory reaction to the Test UI (cf. Figure 17)



*Figure 17. Users' Overall Assessment of the Control and Test UI. (0 = Unsatisfactory, 4 = Satisfactory)*

## Results and Analysis of Heuristic Evaluation

Heuristic evaluation was conducted with five evaluators in April, 2009 in a time span of two weeks. The heuristic experts were asked to evaluate the interface using ten questions which were based on Nielsen's (Nielsen & Mack, 1994.) ten heuristics (cf. Appendix C). Heuristic evaluation was used to find problems in the test and the control UI that users might have overlooked or failed to report. The evaluators' credentials were described in Section 3.4.4, along with the procedures for conducting the evaluation. Evaluators were given two weeks to complete their evaluation.

### *Visibility of system status*

All five experts agreed that the Test UI conforms to Nielsen's first heuristic (cf. Table 1). Three experts stated that the Control UI also conformed to Nielsen's first heuristic

*Table 1.* Comparison of Opinions on "Visibility of system status" (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	No	When I first looked at the interface it was not at all clear that this was a course	Yes	It would be helpful if the interface did not require a flash plug-in. What if user does not have flash
2	Yes		Yes	
3	Yes	Very clear	Yes	In a very organized and systematic way
4	No	No differentiation between links to websites and links to PowerPoint slides. Users should know that they are opening an attachment. Notice at bottom of site not obvious.	Yes	Breadcrumb Trail
5	Yes	There is no system status. So the default is yes	Yes	It has a breadcrumb trail to show where you are and highlights the "nav" item.

***Match between system and the real world***

All five experts were of the opinion that the Test UI conforms to Nielsen’s (Nielsen & Mack, 1994) first heuristic (cf. Table 2). Four experts agreed that the Control UI also conforms to Nielsen’s second heuristic, but with reservations.

*Table 2.* Expert Opinions on “Match between system and the real world” (Nielsen & Mack, 1994) for

**Control and Test UI**

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	Yes	Forced to say yes but course titles are abbreviated to the point they are not always meaningful.	Yes	
2	No	The list of topics on left do not appear to follow the order of the syllabus	Yes	Follows the content of the syllabus and the list of topics is easy to use
3	Yes		Yes	Quite relevant
4	Yes		Yes	
5	Yes	I assume	Yes	

***User control and freedom***

All five experts agreed that both UIs follow Nielsen’s (Nielsen & Mack, 1994) third heuristic (cf. Table 3).

*Table 3.* Expert Opinions on “User control and freedom” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	Yes		Yes	
2	Yes		Yes	
3	Yes	After clicking on a particular topic user can open, save or cancel	Yes	
4	Yes	Can open document multiple times	Yes	Can click on link multiple times
5	Yes	It’s a simple list	Yes	Everything is always accessible. User can click on “Course Topics” as well as the menu.

### *Consistency and standards*

All five experts stated that the Test UI maintains “consistency and standards” (Nielsen & Mack, 1994) across all pages (cf. Table 4). However, four experts stated that the heuristic applies to the Control UI, one of these with reservations.

*Table 4.* Expert Opinions on “Consistency and standards” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	Yes	There is only one page so there is no question of consistency	Yes	
2	Yes	By closing the file we return to the original structure.	Yes	
3	Yes		Yes	Very clear to find & use them
4	N/A	Navigation appears only on one page. No other pages to judge consistency	Yes	Navigation stays in left pane, same order top horizontal menu on each page; same division of frames on each page; pop out menu appears only for one link-distracting.
5	Yes	The jagged edges of the dots are annoying and unnecessary. They should be removed or more of them added. The width of the table should be set with overflow attribute hidden	Yes	

### ***Error prevention***

Most experts recommended that error prevention was not required for the two UIs (cf. Table 5).

*Table 5.* Expert Opinions on “Error prevention” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	N/A	There were no error messages. So the question do not apply	No	No error messages used
2	No	The FAQ will not be sufficient if these were posted online. There is no warning that .wmv files will not run on macs without additional plugins	Yes	But extra tips should be added for MAC users.
3	Yes		Yes	
4	N/A	No room for error only links to click on	N/A	No room for error only links to click on
5	No	Not needed	Yes	

### ***Recognition rather than recall***

All five experts agreed that both UIs conformed to the heuristic. One expert however stated that the issues of “recall” do not apply to the one-page-long Control UI. (cf. Table 6)

*Table 6.* Expert Opinions on “Recognition rather than recall” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	Yes	Only one page available So recall is not a issue	Yes	
2	Yes		Yes	
3	Yes	Just by looking at it one can tell that it is to be clicked. The logo of family doesn’t appear that it is a hotspot or button	Yes	
4	Yes		Yes	
5	Yes	It is hard to tell that the yellow words are links. So it is recall.	Yes	Everything is where it should be. But course topic being a menu should have a marker.

### *Flexibility and efficiency of use*

All five experts agreed that the Test UI is more flexible, efficient and more suited to a novice user's needs. The yellow links on the Control UI might confuse users between HTML links or download links for files. The Test UI is straight forward and provides easy navigation. (cf. Table 7)

*Table 7.* Expert Opinions on “Flexibility and efficiency of use” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	No	A novice user will be confused by links leading only to documents(download) rather than HTML pages	Yes	Novice user will be helped if there was disclosure of file type. On the topics page the file type should be given in addition to the file size.
2	Yes	Although you may want to link to a PowerPoint viewer if Office 2003 is not a requirement for the course	Yes	
3	Yes	Easy to move around	Yes	No explanation is needed, easy to use.
4	No	Novice users might not know that yellows text affords' clicking”.	Yes	
5	Yes	It is very straight forward.	Yes	



*Aesthetic and minimalist design*

All five experts agreed that the Test UI's images and color matched course content. (cf. Table 8)

Table 8. Expert Opinions on “Aesthetic and minimalist design” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	No	The bright yellow for text is very difficult to read on the radiant background; the font size is too small and the instructions at the bottom of the page are way too small and get lost. They should be in a prominent place!	Yes	But the font choice should be sans-serif. The background color is dull while the foreground color harsh. For a communication course it would be better to use a soft color.
2	No	Picture is beautiful but not relevant and the space could be used for more instructions	Yes	Images are more relevant
3	Yes-Maybe	The layout and placement of images and text is organized and appealing, but the font color (yellow) against yellowish green background can affect readability	Yes	Good use of color (light and dark contrast). Font type and font size clear. The layout appears to be very professional and organized. Images are appropriate and well placed
4	No	Sunny image irrelevant; yellow color text is also irrelevant to communication skills	Yes	Most people associate blue and white with health-text relevant to course
5	No	The yellow and the green at the top look good; at the bottom not so much.	Yes	The grey background can change.

***Help users recognize, diagnose, and recover from errors***

Because none of the interfaces require users to handle and recover from errors, this heuristic was irrelevant (cf. Table 9).

*Table 9.* Expert Opinions on “Help users recognize, diagnose, and recover from errors” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	N/A	No error messages	N/A	No room for errors
2	Yes	The FAQ is a good start but it would need additions for other systems	Yes	But additional help should be added for other systems and MAC users.
3	Yes		Yes	
4	N/A	No errors occurred	N/A	No room for errors only links
5	Yes	There can't be errors	Yes	

### ***Help and documentation***

Both UIs have a very minimal, unorganized Technical FAQ page that is not specialized for Windows and Mac users. (cf. Table 10)

*Table 10.* Expert Opinions on “Help and documentation” (Nielsen & Mack, 1994) for Control and Test UI

Heuristic Expert	Rating for Control UI	Comments	Rating for Test UI	Comments
1	No	Minimal at best	No	Minimal at best
2	Yes	The “FAQ” is a good start but it would need additions for other systems	Yes	More information should be added to the FAQ
3	Yes	It is very helpful. But can include more information	Yes	
4	No	No organization of questions. Questions are just listed and can be difficult to search. Some questions are irrelevant	N/A	No organization or division of questions into categories for easy search.
5	No	It’s a Word document. The PowerPoint slides and the Word documents can be exported for the web so that they won’t be needed	Yes	The windows centric nature is still there; but as a page it is better.

### Analysis

The Control UI was redesigned based on the six principles discussed in Chapter 3, of this thesis. Data from the experiments with the two UIs provide a basis for assessing the value of the redesign.

- **Content of the web interface:** The results of Task 1 (cf. Appendix D, Table 11) suggests that test participants took less time to complete the task using the Test UI in spite of using the Control UI three months before the commencement of the experiments. The result suggests that the Control UI had issues of learnability. The ratings on the use of color (cf. Figure 11) show that nine users were satisfied by the use of color in the Control UI while ten users were satisfied were satisfied with Test UI. The ratings on the use of fonts (cf. Figure 12) show ten users being satisfied by the Control UI and eleven users with the test UI. The results of the survey on the use of fonts (cf. Figure 11) and

colors (cf. Figure 12) is not suggestive enough to conclude that users disliked the use of color and font size in the Control or the Test UI. All five expert evaluators (cf. Table 8) agreed that use of color, font size and images in the Test UI synced with the course objective and the task domain. Four experts agreed that the Control UI did not conform to Nielsen's (Nielsen & Mack, 1994) heuristic "aesthetics and minimalist design". The heuristic evaluation of the two UIs therefore suggests that the Test UI's content conforms to the requirements of its participants and relates to the task domain of the participants.

- "Visibility of system status" (Nielsen & Mack, 1994): The results of Task 2 (cf. Appendix D, Table 12) show that participants took more time to complete the task with the Control UI than the Test UI, although all participants had already taken CSHP 1321 and accessed the course's syllabus. The users' ratings of the two UI's resemblance to online courses suggest that more users considered Test UI closely resembled an online course. The ratings of the ease (cf. Figure 13) with which information can be found in the two interfaces suggested that more participants found it was easier to find information in the Test UI than in the Control UI. All five expert evaluators (cf. Appendix D, Table 1) agreed that the Test UI conformed to the heuristic "visibility of system status". Evaluators, however, failed to reach a consensus on the Control UI's conformance to the same heuristic (cf. Table 1).
- "Recognition rather than recall" (Nielsen & Mack, 1994): The results for Task 2 (cf. Appendix D, Table 12) and Task 3 (cf. Appendix D, Table 13) showed that 15 of the 16 participants could complete Task 3 in less time with the Test UI than with the Control UI. Transfer of knowledge could be the one reason for this improvement, although all participants had used the Control UI as part of their coursework in fall 2008, and should have taken less time to complete the tasks. The results of the thinking aloud loosely suggest that both the UIs conformed to this principle. The results of heuristic evaluation (cf. Table 7) also suggest that both the UIs conformed to the principle.
- "User control and freedom" (Nielsen & Mack, 1994): The results of Task 4 (cf. Appendix D, Table 14) showed that users took more time to complete Task 4 using the Control UI than the Test UI. Two concerns, however, limit any conclusions that can be drawn about this result. Participants had already

used the Control UI as part of their coursework, which might have biased the results in favor of the Control UI. Participants, however, were also shown the Control UI before the Test UI, which might account for participants taking less time to complete the task with the Test UI. The high rating of the Test UI by the test participants on the ease with which information can be found in the two UIs (cf. Figure 14) suggest that Test UI provided more user control and freedom than the Control UI. Results of heuristic evaluation (cf. Table 4) however suggest that both the UIs conformed to the principle.

- “Help and documentation” (Nielsen & Mack, 1994): The results of Task 6 (cf. Appendix D, Table 16) suggest that the Control UI failed to conform to this principle. The expert evaluators (cf. Table 10) failed to reach a consensus on the Control UI’s conformance to the standard. In the case of the Test UI one evaluator stated that the principle did not apply to the UI as there was no organization of problems into specific categories. Only three evaluators agreed that the Test UI conformed to the principle.
- “Consistency and standards” (Nielsen & Mack, 1994): The results of Task 5 (cf. Appendix D, Table 15) showed that 10 test participants took more time to complete the task with the Control UI than with the Test UI. However, the difference in time for the two UIs was very low. The results suggest that users of UIs found it easy to open the correct PowerPoint slides required to complete the task. In the Control UI the PowerPoint slides were more easily accessible than the Test UI. The expert evaluators (cf. Table 4) stated that both UIs conformed to this principle. In the case of the Control UI, the fourth expert agreed to the Control UI’s conformance to the principle with reservations (cf. Table 4).
- “Flexibility and efficiency of use” (Nielsen & Mack, 1994): The lack of menus in the Control UI created navigation issues as suggested by the increase in time required by users to complete Tasks 2 through 5 (cf. Appendix D, Tables 12 – 15). These tasks required users to navigate the links and open the specific PowerPoint slides for the courses. The Test UI solved the problem of navigation with the help of top and left menus. The expert evaluators (cf. Table 7) stated that the Test UI conformed to this principle. Only three evaluators, however, recommended that the Control UI conformed to the

principle. One of the evaluator's reservations about this point is suggested by the comment "Although you may want to link to a PowerPoint viewer if Office 2003 is not a requirement for the course" (cf. Table 7)

This study sought to determine whether the use of usability principles to redesign a web interface would reduce its usability problems. The Control UI's issues with usability are suggested by user comments "I like the picture of the mountain, but am not sure how relevant it was" and "reading was fine, but navigating it was hard". The Control UI was redesigned using the usability principles of navigability, readability, user flexibility and user control, consistency, relevance of content to the course and "help and documentation" for the users. The Test UI's "FAQ" page should also be enhanced to support Mac users and to divide hardware, software and other problems into relevant categories.

The users' opinions on the use of fonts (Figure 11), ease with which information can be found (cf. Figure 12), and ease with which contents can be read (cf. Figure 14) suggest that the Control UI had readability, visibility, and navigational issues. The survey results about the Test UI suggest that it satisfied its users with regard to the pages' readability, visibility, and ease of navigation. User comments like "This first interface is generally easier to use. However, the second user interface deep down menus and the course co-coordinators names and contact info are on the first page" (cf. Appendix E, E.1) and "The color on the interface are more professional and the list menus are more user-friendly and mimic the programs that we are used to using. Having the sites listed in categories makes the site look cleaner" (cf. Appendix E, E.5) suggest user satisfaction with the Test UI.

It can be suggested that redesigning the Control UI to the Test UI did improve user satisfaction, since twelve out of sixteen users were highly satisfied by using the Test UI ( cf. Figure 17). The results from heuristic evaluation suggest that the Control UI has problems with readability, correlation of interface with course content, minor flexibility and visibility problems.

## CHAPTER 5

### CONCLUSION AND FUTURE WORK

#### Conclusion

While the experiments conducted in this research suggest that the use of the various usability guidelines yielded improved user performance and increased satisfaction, the results are conditional for several reasons.

- The small number of participants does not make the results obtained from the experiments statistically viable.
- The presence of knowledge transfer between the Control-UI-based and Test-UI-based trials might have been responsible for the improvement in time for the task sets. A more trustworthy result could have been obtained by reversing the order of UI testing for half of the participants: i.e., by asking half the participants to evaluate the Test UI before the Control UI, rather than vice-versa.
- Similarly, differences in when the two user satisfaction surveys were conducted could have influenced users' assessments of the UIs. The trustworthiness of the user satisfaction survey could have been improved by reversing the order of UI testing for half the participants.
- At least 40% of the participants of the thinking aloud technique got confused and made more errors while completing their tasks. Some participants would not think aloud while they were completing their task but did so after they had successfully completed their tasks. In such cases the error rate and the time required for the successful completion of tasks may be flawed.
- The thinking aloud experiment and the follow-on survey were done in a laboratory setting. The laboratory setting can sometimes prove to be inhibitive to the participants. It makes the participants more conscious about their performance in the task sets. Most participants often took the completion of the tasks as a challenge and failed to realize the goal of the usability testing.

- To reduce evaluator bias, the CD-ROMs labeled “User-Interface-1” and “User-Interface-2” could have been alternated during heuristic evaluation. Also, evaluations of the two UIs could have been conducted by different experts.

### Future Work

The changes for the Test UI that had been proposed by heuristic evaluators could be implemented in the redesigning of the Test UI. The PowerPoint slides and the Word documents that form an integral part of the course material could be improved and changed according to some of the recommendations made by the test participants during the survey and the heuristic evaluators during the evaluation process. The methodology for testing the redesigned Test UI and Control UI would again consist of thinking aloud technique followed by a survey as part of the user testing techniques, and heuristic evaluation as part of the usability evaluation technique. However, transfer of knowledge for test participants will be prevented by displaying the Control and the Test UI in alternating order. In order to make participants more comfortable in a laboratory setting, the experimental protocol would consist of using tools such as Camtasia to record mouse movements of the user in combination of audio recording of think aloud responses of test participants as they completed their tasks. Camtasia will run in the background as a hidden task while participants completed their task sets. Therefore, even if users fail to think aloud, the mouse movements would provide added insight into the user’s actions during the think aloud process. The principal investigator will not stay in the room while the test participants complete their tasks. The removal of the principal investigator from the room would make participants less inhibited by the laboratory settings. The protocol for heuristic evaluation will also be changed in order to prevent bias towards the redesigned UI by the experts. In addition to selecting six new heuristic experts, the CDs containing the two UIs will be alternatively named as UI-1 and UI-2. It is believed that the results obtained by changing the experimental protocol would provide more conclusive feedback about the effectiveness of the usability guidelines by Nielsen and other authors. The next step can be to establish a correlation between usability problems and the techniques best suited to detect different categories of usability problems in a user interface.



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APPENDICES

APPENDIX A: List of Tasks and Questionnaire for User Testing

**Please read the following tasks out loud and then perform the task. As you are working, please tell us what you are thinking and feel free to express your concerns. Then write down the outputs of the tasks in the space below the tasks. This survey intends to evaluate the interface and is not intended to test you or your computer skills.**

Before beginning with the tasks answer the following questions:

How would you rate your skills and experience with using computers?

Novice

Semi-Skilled

Skilled

**TASK 1**

Who are the Course Directors of the Course?

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**TASK 2**

List at Least Two Objectives of the Course

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**TASK 3**

Find the Date and Week of the Final Exams for Nursing Students

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**TASK 4**

List the Behaviors Associated with Rapport Building Skills

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**TASK 5**

Find the Objectives of Breaking Bad News

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**TASK 6**

What are the Specifications to Run the CD Containing the Course Materials?

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Unsatisfactory

Satisfactory

0            1            2            3            4

7) Your overall reaction to the web interface

Unsatisfactory

Satisfactory

0            1            2            3            4

This question is to be asked only after the users have finished evaluating both the interfaces

8) Which interface did you like the most?

a) The first interface

b) The second interface

**THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY**

APPENDIX B: Heuristic Evaluation Checklists

**Below are the checklists on the basis of which you have to evaluate the two interfaces. Please circle the appropriate ratings below each criterion. You may also write some comment after each rating. Please note some of the guidelines may not apply to both the interfaces. If you feel the interface has failed to comply with the guidelines more than once please mention it in the comment portion.**

1. “Visibility of system status”: Does the interface keep the user informed about the work of the interface?

No

Yes

Comments

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2. “Match between system and the real world”: Are the content and its organization relevant to the course?

No

Yes

Comments



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3. “User control and freedom”: Are the users given sufficient control to do and redo their tasks with the interface?

No

Yes

Comments

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4. “Consistency and standards”: Is the content organization in the interface and the use of navigational tools consistent?

No

Yes

Comments

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5. "Error Prevention": Does the interface provide good error messages which prevent users from making errors?

No

Yes

Comments

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6. "Recognition rather than recall": Is the use of menus and other options in the interface visible to the user?

No

Yes

Comments

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7. Flexibility and efficiency of use: Is the interface flexible enough for both novice and experienced computer users?

No

Yes

Comments

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- 8.** “Aesthetic and minimalist design”: Is the use of images , color , fonts and text relevant to the course content of the interface?

No

Yes

Comments

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9. “Help users recognize, diagnose and recover from errors”: Does the information provided on the interface helps users to diagnose and recover from errors?

No

Yes

Comments

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10. “Help and documentation”: Is the TECHNICAL FAQ page provided with the interface easy to search and focus on the problems users’ might face while using the interface?

No

Yes

Comments

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~ Important Information ~

- Q: Why my sound and video is choppy (off sink and comes & goes)?
- A: you need to turn off & restart the computer. Also when running this program, possibly close all other programs.
- Q: what are the specifications to run this CD?
- A: at least 128mb of RAM & 550 MHz of processor & windows 2000 or higher.
- Q: when I click on the buttons, the PowerPoint won't open.
- A: click to download the PowerPoint viewer on the CD, it's located on the right side of the center picture.
- Q: I can't see the videos, what format are they?
- A: they are in Window's Media Player format. Update your computer <http://www.update.microsoft.com/microsoftupdate/v6/default.aspx?ln=en-us>

If your question is NOT in one of the above, E-mail me at my address bellow and I will answer your question immediately. Sincerely, Sam Astaneh

[astaneh@etsu.edu](mailto:astaneh@etsu.edu)

APPENDIX D: Results for Thinking Aloud Technique

*Table 11.* Time Taken to Complete Task 1 in Control and Test UI (Who are the Course Directors of the Course?)

Participant	Time in Control UI (secs)	Time in Test UI (secs)
1	60	1
2	30	2
3	40	1
4	55	1
5	58	1
6	60	1
7	120	2
8	124	1
9	70	1
10	55	2
11	56	1
12	70	1
13	40	1
14	52	1
15	48	1
16	52	1

Table 12. Time Taken to Complete Task 2 in Control and Test UI. (List at Least Two Objectives of the Course)

Participants	Time in Control UI (secs)	Time in Test UI (secs)
1	40	24
2	40	22
3	39	20
4	25	25
5	58	40
6	58	45
7	70	50
8	68	60
9	75	65
10	55	45
11	120	70
12	128	88
13	40	30
14	42	30
15	48	38
16	56	46

*Table 13.* Time Taken to Complete Task 3 in Control and Test UI (Find the Date and Week of the Final Exams for Nursing Students)

Participants	Time in Control UI (secs)	Time in Test UI (secs)
1	35	25
2	30	24
3	12	5
4	50	40
5	58	30
6	58	70
7	70	40
8	68	65
9	89	75
10	87	77
11	52	50
12	12	10
13	35	30
14	55	50
15	65	60
16	20	20



Table 14. Time Taken to Complete Task 4 in Control UI and Test UI (List the Behaviors Associated with Rapport Building Skills)

Participants	Time in Control UI (secs)	Time in Test UI (secs)
1	50	16
2	40	9
3	30	7
4	50	23
5	50	30
6	50	70
7	70	40
8	60	50
9	50	30
10	50	30
11	45	35
12	43	40
13	35	30
14	55	40
15	60	40
16	45	20

Table 15. Time Taken to Complete Task 5 in Control UI and Test UI (Find the Objectives of Breaking Bad News)

Participants	Time in Control UI (secs)	Time in Test UI (secs)
1	50	40
2	16	8
3	15	18
4	20	10
5	30	25
6	50	30
7	50	35
8	40	45
9	25	20
10	22	20
11	25	22
12	32	30
13	30	25
14	32	25
15	36	30
16	35	33

*Table 16.* Time Taken to Complete Task 6 in Control UI and Test UI (What are the Specifications to Run the CD Containing the Course Material? )

Participants	Time taken in Control UI(sec)	Time taken in Test UI(sec)
1	28	6
2	100	2
3	not finished	9
4	52	2
5	not finished	5
6	not finished	8
7	5	5
8	90	10
9	60	8
10	50	8
11	55	5
12	56	5
13	56	6
14	68	9
15	78	8
16	46	8

## APPENDIX E: User Comments During User Satisfaction Survey

E.1

“This first interface is generally easier to use. However the second user interface deep down menus and the course co-coordinators names and contact info are on the first page.”

E.2

On Test UI “should be web based”

E.3

On Test UI “This interface is easier to use + find the information. Liked the menu + the organization”.

E.4

On Control UI “I like the picture of the mountain, but am not sure how relevant it was” and “reading was fine, but navigating it was hard”.

E.5

On Test UI “The color on the interface are more professional and the list menus are more user-friendly and mimic the programs that we are used to using. Having the sites listed in categories makes the site look cleaner”.

VITA

PAROMITA BHATTACHARYA

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Education: B.Sc. in Advertising, Sales Promotion and Sales Management,  
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June, 2006 – July, 2006.

PHP Developer, IDLCenter.com, Mumbai, India, February, 2007 –  
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Enterprises), Norfolk, Virginia, June, 2009 - Present