Full-Page Versus Partial-Page Screen Designs in Web-Based Training:

Their Effects on Learner Satisfaction and Performance

by

Phillip Eulon Grace

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Doctor of Philosophy
Department of Secondary Education
College of Education
University of South Florida

Major Professor: James White, Ph.D.
Ann Barron, Ed.D.
Darrel Bostow, Ph.D.
Robert Dedrick, Ph.D.

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Dedication

First, to my mother and step-father, Doris and Don Smith: two finer, more loving and supportive people cannot be found on this planet. They have my eternal love and gratitude. I am forever in their debt.

And to my father, James E., who passed from this phase of the world before I was capable of truly communicating with him. I think he would have been pleased with this accomplishment.

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ABSTRACT

This is a report on research regarding the screen layout of Web-based training 
(WBT) programs, conducted with an eye toward providing evidence-based guidance for 
the design and development of WBT interfaces. Specifically, the study investigated the 
relative instructional benefits of two general types of WBT screen design, full-page and 
partial-page, in terms of both learner performance and learner satisfaction. The main 
hypotheses of the study were that the full-page design option would yield significantly 
better outcomes in both categories of interest.

The study employed a mixed-method design, generating both quantitative and 
qualitative data. The main phase of the study was experimental, following a factorial 
design to explore the relationships between a single treatment variable (WBT screen 
design) in two treatment conditions (partial-page WBT design and full-page WBT 
design) and two dependent variables (learner performance and learner satisfaction). Both 
a full-page and a partial-page version of the same Web-based tutorial were created, and 
129 self-selected undergraduate students who reported having little or no experience with 
the tutorial subject matter were randomly assigned into the two treatment groups. 
Performance data were collected as scores on the tutorial’s 18-item, multiple choice final 
exam, and satisfaction data were collected via a 10-item satisfaction survey. In addition,
59 of the study participants were randomly selected to participate in post-study session interviews.

The results of the study yielded no significant difference between the two treatment groups for either learner performance or learner satisfaction; thus, making it impossible to reject the null hypothesis for either of the two primary research questions. The conclusion of this study was that the presence or absence of scrolling alone is not a significant factor either in how well a person performs in a WBT program or how satisfied they are with the learning experience. However, while analysis of the post-study session interview data supported this conclusion, the fact that a large majority of the interviewees stated a preference for the full-page, non-scrolling WBT interface design suggests that some elements inherent in the full-page design might warrant further consideration and/or study.
Chapter One – Introduction and Background

Introduction

Although Web-based training (WBT) has been around in some form almost as long as the World Wide Web itself, it has become a serious instructional alternative only since around 1996 (Alessi & Trollip, 2001; Horton, 2000; Kruse & Keil, 2000). Like any medium of instruction, the Web offers advantages and disadvantages to both instructional designers and potential learners alike. It is, of course, the task of the instructional designer of WBT programs to maximize these advantages, while attempting to minimize the disadvantages in order to provide the learner with the optimal learning experience (Horton, 2000).

A problem arises, however, when we attempt to delineate just exactly what an “optimal” WBT learning experience would entail. Inasmuch as a learning experience is the nexus of learner, instructional, and environmental elements, the effectiveness and quality of that learning experience reflect the confluence of such things as learner attributes and interface design. Practitioners and researchers from many fields have long been investigating how learners are impacted (both positively and negatively) by the design of instructional media interfaces (Shneiderman, 1998).

Screen design is a critical element in Web page and computer-based instructional design, in general, and in WBT design, in particular (Alessi & Trollip, 2001; Geraci, 2002; Grabinger & Osman-Jouchoux, 1996; Nielsen, 2000; Shneiderman, 1998; Smith &
Ragan, 1993). It is an integral component of a program’s interface, which is “the door between the student and the instruction” (Kruse & Keil, 2000, p.120). Screen designs that are consistent, functional, and pleasing can improve the utility and appeal of an instructional program (Smith & Ragan, 1993). Since the screen is “the central point of the interaction between student and program” (Grabinger & Osman-Jouchoux, 1996, p.181) and because “[interface] design choices determine the success or failure of instruction” (Grabinger & Osman-Jouchoux, 1996, p.206), screen design is a major focus of the overarching process of interface design. It follows, then, that WBT designers, as well as other computer-based instructional designers, need to follow “best practices” in Web page design and human factors design.

However, because WBT has become a viable instructional option only over the last several years, no firm consensus has yet developed regarding the most effective and/or desirable characteristics of WBT (Alessi & Trollip, 2001). This is an unfortunate situation, given that WBT is currently proliferating at an incredible rate (Alessi & Trollip, 2001; Ellis, Wagner, & Longmire, 1999; Geraci, 2002; Horton, 2000; Kruse & Keil, 2000; Lim, 2003; Mwaura, 2003). Indeed, Horton (2000) alludes to the dearth of research-based WBT design principles in his recent book, *Designing Web-Based Training*, when he writes:

My sisters and brothers in the academic community are welcome to read this book, but no one should expect a scholarly work crammed with footnotes and hesitant generalizations. This book is for practitioners who cannot wait for all the research to be done and need advice now. (p. vi)
It is, therefore, within the context of this milieu, where technology is out-pacing research, that this study was undertaken as an effort to address a controversial WBT design issue: scrolling. While scrolling is a ubiquitous characteristic of the vast majority of pages currently populating the Web, it is problematic for WBT designers (Alden, 1998; Alessi & Trollip, 2001). Although scrolling can provide several advantages (Alden, 1998; Alessi & Trollip, 2001; Nielsen, 2000), it also presents several disadvantages that can interfere with the learning process (Alessi & Trollip, 2001; Dyson & Kipping, 1998; Levi, 1998; Merrill, 1994). Recognizing the necessity and/or desirability of scrolling Web pages in certain circumstances, Alessi and Trollip (2001) nevertheless recommend designing alternatives to scrolling whenever possible. Others suggest that if scrolling is going to be present, it should be limited to no more than two to three screens long (Koyani, Bailey & Nall, 2003; Nielsen, 2000).

Statement of the Problem

Alessi and Trollip do not, however, provide research findings to substantiate their WBT design recommendation. In fact, a search for research specifically comparing the instructional benefits of a non-scrolling, full-page WBT design with those of a scrolling, partial-page yielded mostly confusion. A few studies have compared the relative benefits of scrolling with those of what has been termed as paging in more general contexts, such as Web searches (Bernard, Baker, & Fernandez, 2002), online text readability (Baker, 2003; Dyson & Kipping, 1998), and finding information in text passages on a web page (Parsons, 2001). (See the Definitions and Acronyms section later in this chapter for definitions of paging and other terms used in these introductory sections.)
The literature concerning scrolling versus paging generally favors paging over scrolling (Alessi & Trollip, 2001; Bernard, et al., 2002; Harrell, 1999; Kolers, Duchnicky, & Ferguson, 1981; Dyson & Kipping, 1998; Mills & Weldon, 1987; Parsons, 2001; Piolat, Roussey, & Thunin, 1997; Schwarz, Beldie, & Pastoor, 1983). Others, however, came to the opposite conclusion, that scrolling had some advantages over paging for certain purposes (Lee & Tedder, 2004; Ryan, 2004). Koyani, Bailey & Nall (2003) in their Research-Based Web Design and Usability Guidelines suggest employing scrolling and paging according to “considerations of the primary users and the type of tasks being performed [pointing out that] some tasks that require users to remember where information is located on a page may benefit from paging, while many reading tasks [such as comprehension] benefit from scrolling” (p.66). However, they mitigate their suggestion of scrolling in reading comprehension tasks by stating, “with pages that have fast loading times, there is no reliable difference between scrolling and paging when people are reading for comprehension” (p.68). Indeed, they referred to Piolat, Roussey, and Thunin’s 1998 findings when reporting that paging may allow for “better mental representations of the text as a whole, and are better at remembering the main ideas and later locating relevant information on a page” (p. 68).

It should be noted, however, that the terminology in the literature on this issue is poorly operationalized such that is sometimes unclear as to what the term “paging” actually refers. In some cases it seems to refer to the process of moving between separate non-scrollable screens linked together by hypertext links (i.e., full-page design). In other cases paging refers to moving quickly through a single, scrollable page in large increments either by using the Page Up and Page Down keys or by clicking in the gray
areas of the scroll bar (in contrast to the much slower line-by-line scrolling accomplished by clicking on the up and down arrows of the scroll bar). In such cases, paging could be considered just another form of scrolling. And in yet other cases, it refers to a hybrid of the first two instances, with scrollable pages of relatively limited content linked together by hypertext links. Thus, to the mind of this researcher, the current literature on scrolling does not adequately address, and may even confound the question of whether or not scrolling is an effective and/or desirable design characteristic, particularly for Web-based instructional programs.

More to the point of this study, the literature to date does not clearly indicate which has greater instructional implications specifically for WBT programs: a non-scrollable full-page design or a partial-page design that requires scrolling. The vast majority of literature distinctly comparing partial-page and full-page screen designs do so in contexts other than Web-based instructional programs, such as performing Web searches, or finding information within a text passage. This researcher was unable to locate another study that specifically compared the two design alternatives in relation to a WBT program to the degree that it was done here.

There is no question that the literature pertaining to scrolling has utility in helping to delineate possible WBT design guidelines. However, the most convincing and reliable path to devising such guidelines is to actually test the conclusions of this literature specifically with full-fledged WBT programs. WBT programs, as a genre, constitute a much more complex learning environment than has been represented in most previous studies. The various instructional and support elements found in a well-designed WBT are not fully mirrored in tasks such as Web searches or finding information in text
passages on Web pages. Many of the principles of screen design suggested in the existing literature will surely apply, but until these principles are thoroughly tested in the domain of WBT programs, we cannot speak with true authority on which principles apply, under what circumstances, and with what effect. And this leads to the purpose of this study.

Purpose of This Study

This study examined the effects of the two page design options for WBT mentioned above (partial-page and full-page) on both learner performance and satisfaction. Because learners’ individual experience with computers and the Web could well confound a comparison of the two screen designs, participants’ level of computer proficiency and level of Web experience were controlled for. It was hypothesized that a non-scrolling, full-page WBT design might be superior to a partial-page design that necessitates scrolling, if not in performance, then with regard to learner satisfaction.

Rationale for This Study

Alessi and Trollip (2001, p. 65) refer to the issue of scrolling as “the most difficult design issue regarding text” in hypermedia and Web pages. But while they and other researchers and practitioners present both advantages and disadvantages of scrolling in WBT and more general Web page design, there appears to be very little research serving to guide WBT designers in specifically deciding between a partial-page or full-page design. Given that screen design can be instrumental to the success or failure of a WBT program, it is critical that the screen design process be informed, as much as
possible, by solid research. This study is an attempt to shed some guiding light on the relative instructional value of partial-page versus full-page WBT design.

The focus of this study concerns a primary aspect of page design that could have important implications for the efficiency and effectiveness of WBT programs. As will be discussed in this report, the WBT interface is an integral part of the online learning process and can impact learners’ learning satisfaction, their motivation to learn, and ultimately their learning performance. Hopefully, the results of this study will help current and future WBT designers make fundamentally sound decisions about their interface designs.

Research Questions and Hypotheses

The primary intent of this study was to investigate the following two questions:

1. Is there a significant difference in performance between learners using a scrolling, partial-page WBT and those using a non-scrolling, full-page WBT design?

2. Is there a significant difference in satisfaction between learners using a partial-page WBT and those using a full-page WBT design?

Given what the literature pertaining to CBI and WBT screen design indicates, one might expect that learners using a full-page design would have a higher level of performance than those using a partial-page design. This performance gain would probably be attributable not only to aspects of the full-page design that facilitates learning (e.g., retention, low error rates, efficiency), but also to higher levels of satisfaction that such a design would probably evoke in users. At the very least, it might be expected that full-page designs would prove to be as effective as partial-page designs.
Even in the absence of a significant difference in performance between the two designs, the higher levels of satisfaction expected for a full-page design would seem to make for a qualitatively better experience for the user and possibly result in a user preference for the full-page design. The literature makes a connection between learner satisfaction, motivation, and learning. In a 2002 study, Hsu, Wang & Wang found a strong correlation between learner motivation, learning satisfaction, and learning effectiveness. Keller’s ARCS model of motivation design includes learner satisfaction as an integral component in creating motivating instruction, suggesting that satisfied learners are motivated to continue learning because they see value in what they are doing (Keller & Suzuki, 1988). Kruse (2004) also points to the ARCS model when he states, “Even the most elegantly designed training program will fail if the students are not motivated to learn. Without a desire to learn on the part of the student, retention is unlikely” (1st paragraph). And, even though Horton (2000) suggests that learning satisfaction is not a reliable measure of learning, he states that “it certainly beats learning dissatisfaction” (p. 27). Finally, Nielsen (1993, 2003) and Shneiderman (1998) both consider learner satisfaction a hallmark of good usability design.

Limitations

Discussion throughout this report might well give the reader the impression that there is a simple dichotomy of WBT screen designs: full-page and partial-page. This is not the case at all. There are a number of alternative designs, employing different principles and navigational elements (e.g., frames, embedded hypertext links, etc.) that were not included in this study. The fact that distinct partial-page and full-page designs
were compared, however, was to isolate the variable of scrolling as much as possible. Use of other navigational methods within and between content pages could have confounded the study results, making it much more difficult to center the results specifically on variable of scrolling.

While the design of the study as it was conducted was a reasonable path of investigation (especially considering the number of practical considerations that defined its parameters), the fact that all study participants were exposed to only one treatment might be considered a limitation in that they had no opportunity for a direct comparison of the two screen designs. Therefore, the possibility of future studies where participants are afforded the chance to experience both screen designs is discussed in Chapter Five.

Finally, it should be noted that the partial-page design in this study could be considered something of a hybrid of the full- and partial-page designs. While each of its content pages required the user to scroll, each of its content sections consisted of several contiguous pages hyperlinked to each other in the same manner as those of the full-page interface. Each page in the partial-page design contained at least three screenfuls of content, but none contained an entire section worth of content. It cannot be known if modifying the partial-page design such that each content section consisted of a single page would have altered the results in this study, but it is offered as one way to improve the study in Chapter Five.

*Definitions and Acronyms*

In order to facilitate clarity and precision during the discussion of this study, it is wise to first define and discuss some terms that are used in this report. It is important to
operationalize terms because some terms can have a variety of connotations, which can obscure the intent of their use and lead to confusion. Sometimes, however, mere definitions of certain terms are inadequate in and of themselves to contextualize the relevance to and importance of those terms to the purpose of this study. Therefore, supplemental background and/or conceptual information are provided for some of the terms.

World Wide Web (a.k.a. the Web)

The World Wide Web (commonly referred to simply as the Web) has been defined as, “system of Internet servers that support specially formatted documents. The documents are formatted in a markup language called HTML (HyperText Markup Language) that supports links to other documents, as well as graphics, audio, and video files” (Webopedia Computer Dictionary, 2005c).

HTML

HTML is the acronym for HyperText Markup Language, which can be defined simply as the “authoring language used to create documents on the World Wide Web” (Webopedia Computer Dictionary, 2005a). The online encyclopedia, Wikipedia (2006), adds that it is “used to structure information – denoting certain text as headings, paragraphs, lists and so on – and can be used to describe, to some degree, the appearance and semantics of a document.”
Computer-Based Instruction (CBI)

The terminology for types of instruction delivered in some way through a computer varies widely according to those who develop, utilize, theorize and/or write about such technologies, the context in which these instruction/learning technologies are used, and the purposes to which these technologies are put. According to Kruse and Keil (2000), many of the terms, such as computer-based learning (CBL), computer-based training (CBT), and computer-based education (CBE), have come to be considered more or less interchangeable, while some terms, such as Web-based training (WBT), are more distinctly defined. The variety of actual terms and acronyms referring to the permutations of computer-based learning, including those that utilize the Web, has been covered elsewhere (Barron, 1998; Bixler & Bergman, 2001; Eberts, 1997; Kruse & Keil, 2000; Horton, 2000).

In this study, CBI was used as an overarching term that refers to any instruction that is delivered via a computer, either locally or from a distance. This was taken to include sub-genres such as Web-based training. It does bear noting, however, that the term “traditional CBI” is sometimes used in this report to refer to a non-Web-based CBI that is designed and programmed specifically as a “stand-alone” application. Thus, “traditional CBI” stands in contrast to Web-based instructional programs that require other applications (e.g., a Web browser and one or more plug-ins) in order to display and otherwise function. Traditional CBI affords the instructional designer a high level of control over the look, feel, and function of the program, while most Web-based programs are subject to a greater degree of change by the user (e.g., font typeface, font size, and graphics displaying or not). The exceptions to this level of user control over Web-based
programs are CBI programs that have been created as traditional, stand-alone applications but which are transmitted over the Web via the use of browser plug-ins (e.g., Shockwave for Authorware) (Barron, 1998).

Web-Based Training (WBT)

For the purpose of this study, the term Web-based training (WBT) was used to refer to “any purposeful, considered application of Web technologies to the task of educating a fellow human being” (Horton, 2000, p. 2). Bixler and Bergman (2001), call WBT “a new, creative method for delivering computer-based training to widespread, limitless audiences.” They also see WBT as representing “a shift from the current paradigm of [traditional] CBT, where the information presented is usually stored on the local machine, a local server, or a local CD-ROM, to a system where information is distributed via [the Web] and most likely is stored at a distant location” (1st paragraph).

Barron (1998) delineates three basic types (or “design options,” as she refers to them) of WBT screen designs: page-based (i.e., partial-page), screen-based (i.e., full-page), and frame-based\(^1\), of which only the first two are of concern for this study. Each describes a different approach to Web-based instructional design and reflects a particular strategy for dealing with the various features and operating parameters of the Web, in particular those that have significant instructional design implications.

Usability (a.k.a. Web Usability)

AgelessLearner.com (2005), an online educational website and advisory services firm, defines usability as:
Capable of being used. In web design, this refers to the capability of a web site to be used by everyone. Usability issues include interface and navigation design (can the user easily understand how to find their way around the site), content layout (small blocks of text that are not too wide are easier for reading on the web), and accessibility and compatibility issues (1st paragraph).

“Web usability” is an umbrella term that spans everything from page design to content design to an entire site design (Nielsen, 2000). Nielsen (1993) considers usability in terms of five attributes:

1. **Learnability**: the system should be easy to learn so that the user can rapidly start getting some work done with it.
2. **Efficiency**: the system should be efficient to use, so that once the user has learned the system, a high level of productivity is possible.
3. **Memorability**: the system should be easy to remember, so that the casual user is able to return to the system after some period of not having used it, without having to learn everything all over again.
4. **Low Rate of Errors**: the system should have a low error rate, so that users make few errors during the use of the system, and so that if they do make errors they can easily recover from them. Further, catastrophic errors must not occur.
5. **Satisfaction**: the system should be pleasant to use, so that users are subjectively satisfied when using it; this means that they like it.
Screen Design (a.k.a. Interface Design)

In this report, screen design refers to the layout of what a user sees on their monitor when they view a CBI or WBT program. In CBI, the program interface may take up the entire monitor screen, while WBT program interfaces are usually more restricted due to the screen space (or screen real estate) reserved for the Web browser. It is through the screen design elements that the user interfaces (i.e., interacts) with the program; thus, screen design also encompasses the functionality and usability facets of the program. Throughout this report the terms screen design and interface design are used interchangeably, as are the terms screen and interface.

Scrolling

Scrolling refers to both a feature (or characteristic) of screen design and an action. Merriam-Webster Online (2005) defines scrolling in two senses. The first is as an intransitive verb meaning, “to move text or graphics up or down or across a display screen as if by unrolling a scroll.” The second, transitive sense is “to cause (text or graphics on a display screen) to move in scrolling.” Both senses are relevant to the discussion of screen design in this study. A bit more detailed definition of scrolling was found online at Webopedia Computer Dictionary (2005b):

To view consecutive lines of data on the display screen. The term scroll means that once the screen is full, each new line appears at the edge of the screen and all other lines move over one position. For example, when you scroll down, each new line appears at the bottom of the screen and all the other lines move up one row,
so that the top line disappears. The term *vertical scrolling* refers to the ability to scroll up or down. *Horizontal scrolling* means that the image moves sideways.

Scrolling becomes necessary “when all the information cannot fit on the content portion of the screen at one time [so that in order to] view all the information, the user has to scroll up or down to see it, causing other information to disappear from the screen” (Alessi and Trollip, 2001, p. 65). The most common scrolling controls are vertical and/or horizontal “scroll bars” that are usually located, respectively, along the right and bottom edges of the content portion of a screen. These scroll bars allow the user to manually control the process of scrolling up, down or sideways by clicking on the arrowheads that reside at either end of a scroll bar. (Some computer mouse models come with a “scroll wheel” that allows the user to scroll line by line by rolling the wheel forward and backward with a finger.) However, Web pages can also be programmed to scroll automatically, without the need for the user to control the process.

For the purposes of this report, scrolling should be taken to mean manually scrolling through the content of a Web page line by line (although the discussion of this phenomenon generally applies to automatic scrolling as well). It is also to be taken as the defining characteristic of the partial-page screen design, serving to distinguish it from the full-page design, where no scrolling is required.

*Partial-Page WBT Screen Design*

A partial-page WBT screen design is, essentially, the “classic” Web page (based on simple HTML) that has constituted most Web pages since the Web’s inception. Due to
the amount of page material and features, the user will probably have to scroll (see scrolling below) – at least vertically – to gain access to all available content and program features. The instructional content is embedded in a simple (i.e., no frames) Web page such that if the entire page content cannot be displayed all at once on the screen, users must scroll to view the rest of the page content (see Appendix A for a graphic example of a partial-page screen design). If the entire page content cannot be viewed, or if the WBT program window is resized smaller, a single scroll bar appears along the right-hand side of the WBT program window for vertical scrolling and/or along the bottom for scrolling horizontally.

Paging

Paging is a confusing term, as it has been used to mean two different concepts and/or activities depending on which source one consults. In earlier literature, paging refers to an alternate form of vertical scrolling on a single page. Instead of line-by-line scrolling, paging “shift[s] the text [vertically] by a span of lines equal to the [computer] screen size” (Piolat, Roussey, & Thunin, 1997, p. 568). In other words, an entire screen of content is replaced by another with the press of a single keystroke (using the Page-Up and Page-Down keys) or a single mouse click in the (usually) gray area above (to page up) or below (to page down) the scroll control box in the scroll bar. Essentially, the user is scrolling through a Web page by blocks of text instead of line by line.

More recently, however, the term has been used to refer to the process of moving linearly between multiple contiguous Web pages by clicking on hypertext links (usually dichotomously labeled something similar to “Previous” and “Next”). It is analogous to
turning pages in a book. Paging, in this context, traditionally limits content on each of these hyperlinked pages, either greatly reducing or completely eliminating the necessity of vertical scrolling. When vertical scrolling is completely eliminated, paging can be viewed as the primary navigational method employed in full-page screen design.

**Full-Page WBT Screen Design**

The full-page design, while also constructed of simple HTML code, is a “fixed” screen display in the sense that the user does not have to scroll, either horizontally or vertically, to see the entire content of the page. In other words, all features and navigation options offered by the program are always visible and accessible from within the screen area, such that only the instructional content changes as the user moves through an instructional program (see Appendix A for a graphic example of a full-page WBT screen design).

Barron (1998) notes that full-page WBT design can appear almost exactly the same as “traditional CBT.” CBT stands for computer-based training, which, in the traditional sense, refers to computer instruction whose design features are “hard-wired” and can not be altered by the user unless customization of the program is included as one of the design features. This is in contrast to the actual level of design control a WBT designer has in insuring a WBT program will display and operate as intended. (Note: This, of course, does not include courseware that is produced in an authoring system, such as Authorware, and only delivered through the Web via browser plug-ins.)
**Chunking**

In instructional design, chunking refers to the general process of breaking larger pieces of information into smaller, more “digestible” pieces (Fleming & Levie, 1993; Kruse & Keil, 2000; Nielsen, 2000; Brehover, 2000; Shneiderman, 1998). The notion derives from psychologist George Miller’s work in the 1950s on short-term memory. Miller (1956) first posited the principle that, on average, people have the capacity to remember seven items of information at a time, give or take two items. Chunking can be performed at various levels. For instance, one can chunk an entire book up into chapters, units, parts, and/or sections (Brehover, 2000). On the other hand, as in the case of this study, one could chunk a single Web page containing a large block of continuous text into a several separate, sequenced, screen-sized pages, each containing smaller, more concise “chunks” of the information.

**Basic Web Page Programming Tutorial (BWPP)**

The *Basic Web Page Programming* tutorial is a Web-based instructional program on how to create very basic Web pages using only the HTML Web authoring language. It was based on a more extensive CBI program, entitled *Internet Programming*, and was developed solely for this study. Its final exam was the instrument for measuring learner performance (one of the study’s dependent variables of interest). This tutorial is described in greater detail in the Chapter Three. The BWPP tutorial is also referred to alternately as the *BWPP program* and as the *BWPP courseware*. 
Chapter Two – Literature Review

Introduction

The great majority of discussion about WBT screen design is derived from the literature on the overarching area of CBI interface design, as well as that concerning general Web page design. This is reasonable because (1) WBT, being a genre of CBI, shares many of the same characteristics and, thus, design concerns with other types of CBI, and (2) WBT programs are constructed as Web pages for delivery over the Web. WBT, however, unlike more traditional CBI, presents some singular design concerns that revolve around the use of the Web as a delivery medium. Screen real estate, bandwidth limitations, computer processing resources, non-standardized operating environment parameters, high levels of user-control over the Web browser environment and disparities in end-user equipment capabilities are just some of the problems that designers of WBT must confront.

The necessity of using Web browsers, such as Microsoft Internet Explorer and Netscape Navigator, to access and display WBT programs creates severe design problems. Of particular relevance to this study are the difficulties surrounding the issue of screen real estate. In addition to the display restrictions inherent to computer monitors (Nielsen, 2000; Shneiderman, 1998, 1998; Tullis, 1997), the framework that Web browsers provide for the display of Web pages further restricts the content and operational areas of WBT programs. Thus, while computer screen display issues have
always presented difficulties for designers of more traditional CBI, these problems are even more critical to WBT designers.

Barron (1998) delineates three main types of WBT screen designs: page-based (referred to here as partial-page), screen-based (referred to here as full-page), and frame-based (again, only the first two are of concern for this study). While her consideration of each design’s apparent advantages and disadvantages can be helpful to WBT designers, they do not constitute definitive research as to which design might provide an instructional advantage over the others. Indeed, the literature specifically pertaining to WBT screen design rarely speaks directly to decisions about full-page versus partial-page designs. This seems to because there is an assumption, by and large, that scrolling was a given characteristic of Web-based instructional programs.

It is the purpose of this chapter, therefore, to review the literature on CBI screen design in order to inform a more specific discussion of the central issue for this study: the relative instructional benefits of a full-page WBT screen design as compared to a partial-page screen design.

To begin a review of the literature specifically related to CBI and WBT screen design, however, it seems appropriate to first consider the matter of CBI design and development in the broader context of instructional effectiveness. The effectiveness of CBI has been a perennial topic of debate ever since computers were first used to deliver instruction several decades ago. Thus, as WBT becomes both more widely available and more extensively relied upon to fulfill the educational and training needs and/or goals of both academic and commercial communities, long-debated questions concerning the instructional benefits of computers become ever more important. Since an underlying
premise of this study is that WBT can provide effective instruction, a cursory
examination of the concept of “effective CBI” is presented in order to provide context to
this assumption.

Effective Computer-Based Instruction (CBI)

The goal of developing effective CBI programs, which includes the genre of
WBT, is rather lofty. What makes this pursuit so difficult is the adjective “effective.”
Educational theorists, researchers and practitioners have yet to agree upon a satisfactory
definition of what “learning” is, let alone agree upon what constitutes “effective”
instruction and how effectiveness should be gauged. The literature on the effectiveness of
CBI reflects, at best, a mixed bag of research findings (Cuban & Kirkpatrick, 1998;
Kerlin, 1992). While there are those who tout the educational benefits of computer-based
instructional technologies (Barth, 1990; Crosby & Stelovsky, 1995; Fletcher-Flinn &
Gravatt, 1995; Friend & Cole, 1990; Greenfield, 1984; Johnston, 1995; Liu & Reed,
1994; Sloan, 1997; Vockell & Brown, 1992), there are others who reject this proposition
Oppenheimer, 1997; Pepi & Scheurman, 1996; Russell, 1999). In addition, there has been
much criticism regarding the quality of many of the studies that have indicated an
advantage of CBI over traditional forms of instruction (Becker, 1992; Berson, 1996;
Clark, 1983, 1994; Cuban & Kirkpatrick, 1998; Lookatch, 1995, 1996; Reeves, 1993,
1998). Thus, it seems that the net result of the last thirty or so years of educational
theorizing and research in the areas of educational and instructional technology is a bit
disappointing for those seeking definitive answers to questions pertaining to effective CBI.

Discussions about CBI effectiveness are necessarily multidimensional, reflecting the complex nature of human learning. Even though we have not fully deciphered how humans do, in fact, learn, we assume that the process of learning involves many factors. Precisely what these factors are and to what degree they influence, facilitate or dictate how humans learn, however, remain sources of contention among scholars and researchers from a variety of educational disciplines (Brown, 1997a, 1997b, 1997c; Hiemstra & Brockett, 1994; Merrill 1994; Steinberg, 1989).

“Effective CBI” is a tenuous concept. The notion of effective CBI begs the question of what exactly is meant by “effective”. Much discussion of CBI efficacy in the literature revolves around levels of student achievement (Fletcher-Flinn & Gravatt, 1995). However, Cuban and Kirkpatrick (1998) lament the lack of clear focus in educational research regarding the efficacy of technology in education, and they cite a variety of measures of effectiveness found in the literature. They note that some researchers measure effectiveness in terms of student scores, some focus on how quickly students learn, while others look at student motivation levels. These different measures of effectiveness in educational research, they contend, make it difficult to assess CBI efficacy.

It may also be that the effectiveness of a CBI program can be measured, not only in terms of significant gains in student achievement over more traditional forms of instruction, but also in terms of it being just as effective as traditional methods. Ayersman (1996), for example, found hypermedia programs to be at least as effective as lecture,
especially for remedial and learning disabled students. Under these circumstances, the
decisions regarding the use of CBI programs would probably hinge on other factors (such
as cost-effectiveness) that may or may not give CBI an advantage over more traditional
instructional media.

While noting the difficulty of documenting gains in learning through computer
instruction, Alessi and Trollip (2001) outline some of CBI’s perceived benefits:

… it is widely accepted that computer-based instruction at least reduces the time
spent learning. Even if the learning itself is not better, reducing time is a benefit.
Properly used, computers can improve learning effectiveness and efficiency
(Christmann, Badgett & Lucking, 1997; Kulik & Kulik, 1991). In addition, using
technology for learning has logistical benefits. Materials can be distributed more
cheaply and easily; it is easier to ensure all users have the most recent version of
the materials; learners can access the materials at their convenience; accessibility
is facilitated for people with disabilities; and dangerous, expensive, or unique
environments can be simulated to improve access. (p. 5)

They go on to concede, however, that none of these situations guarantees that computers
were beneficial to the learning process. Recognizing that the benefit of computers in
educational endeavors remains debatable, they are hopeful that, as more educational and
training applications are proliferated on the Web, people will take CBI more seriously.
In this way, they predict, more instructionally sound material will be developed. Even so,
they never directly try to delineate how effective or quality CBI might be defined.

The fact that the literature yields no clear definition of effective CBI might be
attributable to at least two prerequisite issues: how learning is defined and the influence
of media on learning. In the first case, it is reasonable to expect that one’s definition of learning will determine how the effectiveness of any instructional program is conceived and measured. While a discussion of learning as a concept is beyond the scope of this study, the proposition that instructional media has an impact on learning needs to be briefly explored as it has direct implications for the design and development of any type of technology-based instruction, including WBT.

**The Learning and Media Debate**

It may be that CBI, as an effective instructional medium, may not warrant consideration separate from other types of instructional media. The very notion of “effective instructional media” (from books to overhead projectors to videotape to laser discs to CBI) is predicated upon the assumption that the media, itself, impacts learning. This assumption, however, is not universally accepted. Indeed, Richard Clark proffered a compelling argument for focusing discussions of instructional effectiveness on instructional method rather than the particular medium used to relay the instruction to the learner (Clark, 1983, 1991, 1994). The case he made against media having influence on learning has direct implications for framing the definition and measurement of “effective CBI” or any other instructional media.

The impact of instructional media (or their attributes) on learning, motivation and efficiency gains from instruction has been a long-standing debate. Though not the first to say so, Clark precipitated this rather heated quarrel with his contention in his 1983 article that instructional media, in and of themselves, offer no learning benefits. In his opinion, media are “mere vehicles that deliver instruction but do not influence student
achievement any more than the truck that delivers our groceries causes changes in our nutrition” (1983, p.445). Offering several studies to substantiate this assertion, he hypothesized that achievement gains being attributed to instructional media (or their attributes) are due to a confusion of the media with instructional methods. Thus, Clark’s claim was that the potential for educational achievement exists only in the instructional method employed, not in the particular media used to delivery it.

Over the years, other instructional technology and media researchers have taken Clark to task on this matter (Cunningham, 1986; Kozma, 1991, 1994; Petkovitch & Tennyson, 1985; Salomon, Perkins, & Gloverson, 1991; Ullmer 1994). Clark (1994), however, remains unmoved by their arguments, claiming that every media researcher who had engaged him in dialogue eventually agreed that the available evidence does not yet support the claims that either media or their attributes affect learning. This issue has yet to be definitively resolved.

*Instructional Design: Virtues and Flaws*

Every instructional method has an upside and a downside, as does every system for delivering instruction to the learner. While there is certainly debate among instructional theorists, designers and practitioners about the relative effectiveness of this particular method or that particular delivery system, most would probably concede that all methods and delivery systems have both virtues and flaws. Virtues would be features, characteristics or aspects that facilitate the learning process, while those that inhibit or otherwise interfere with the learning process can be viewed as flaws. Determining which is which is not always a simple or easy matter because a variety of factors (e.g., subject
matter, learning styles of learners, available instructional resources, etc.) can differentially impact the effectiveness of an instructional program. In other words, what might be a virtue in one learning environment (or with one type of learner) might prove to be a flaw in another (Merrill, 1994; Shneiderman, 1998). There is simply no single instructional method or delivery system that is best across the board and in all circumstances.

The development of effective instructional programming is, at best, an exercise in informed compromise (Alessi & Trollip, 2001; Shneiderman, 1998). To tweak the greatest learning gain from a particular instructional program, instructional designers must assess that program’s subject matter and the learning environment(s) within which it was implemented in order to determine the most appropriate instructional method and delivery system for implementing the program. This means evaluating what aspects of an instructional method or delivery system would be virtues and which would be flaws within what set of circumstances. Pointing out that computer-based instructional programs are frequently developed by teams that include media and graphic designers who rarely have had training in usability design or learning theory, Gordon (1994) insists that it is the job of instructional designers to make sure that principles of good design are followed. Ideally, the various instructional design choices made throughout the design process are informed by research that delineates “best practices” in instructional design. Unfortunately, the ideal is not always easy to adhere to for a number of reasons. This is true for computer-based instruction and especially so for designing and developing WBT.

The eternal debate among proponents of the various paradigms for learning and instruction, particularly between adherents of constructivism, which currently dominates
educational theory, and advocates of behaviorism, clouds the issue of best design practices for WBT (Alessi & Trollip, 2001; Horton, 2000). This is understandable since these paradigm debates have yet to result in a consensus on the nature of learning, much less on the most effective instructional methodologies for facilitating it (Catania, 1992; H ergenhahn, 1988; Mazur, 1990). While useful in some respects, these debates have yet to result in solid, universally accepted WBT design and development guidelines and practices WBT (Alessi & Trollip, 2001; Horton, 2000). As Alessi and Trollip (2001, p.5) note, computer-based instruction, and especially WBT, are “still young and evolving [and] much remains to be learned regarding the best ways to harness the power of computers.”

As mentioned earlier, Horton (2000), contends that because the WBT genie has already been released form its bottle, so to speak, WBT designers cannot wait until research delivers guidelines for best practices in WBT design. He also warns WBT designers against becoming dogmatic adherents to particular theories, and/or design/development systems:

Many designers treat educational theories and development methodologies like strict religion. And only their religion is the true religion. An exogenous constructivist considers Designer’s Edge a tool of the seven-horned devil. Devotees of Information Mapping guffaw at the foo-foo-puffery of the Microworldians… I have seen effective WBT courses developed based on almost every popular theory, even “I just did what seemed right.” I do not mean to imply that educational theory and development methodology are not important, just that success does not depend on any particular one. (p. 14)
This does not mean, however, that WBT design has to be a Wild West-like frontier. Despite having no extensive research history upon which to draw firm conclusions, the design of WBT can be guided by past experiences with related technologies and techniques design (Alessi & Trollip, 2001; Gordon, 1994; Grabinger & Osman-Jouchoux, 1996). According to Gordon (1994), “an instructional program is a product or system just as much as any physical system such as a chair, automobile, or software program” (p. 10). He asserts that instructional programs can, therefore, be developed using design principles similar to those used in engineering design. With regard to screen design, WBT designers can be guided by principles derived from fields with more extensive research histories, such as usability engineering, human factors design and human-computer interface design (Alessi & Trollip, 2001; Gordon, 1994; Grabinger and Osman-Jouchoux, 1996). Grabinger and Osman-Jouchoux (1996) point to this multidisciplinary design approach when they write:

Design is a series of choices that interact with each other and that reflect the theoretical underpinnings of a discipline. Designers of computer screens that present information and create interactions for learning make choices in manipulating several attributes that are common to both print and electronic media, among them, text, typography, layout, and graphics… The wealth of information on printed text gives us indications about making some of these choices. (p. 181)

Since very little research can be found in the CBI or WBT literature that directly compare the instructional advantages and disadvantages of partial-page and full-page
WBT screen designs, the literature to inform this study must come from other related issues in instructional design spanning several fields concerned with CBI screen design.

**Interface Design**

According to Kruse and Keil (2000), the computer user interface is the training program for many people. They contend that it plays a very important role in the training program because it creates “the graphical association of the training program in the mind of the user” (p. 107). Murphy (1996), noting that humans and computers are very different entities, states that “the greater the difference between the two entities, the greater the need for a well-designed interface [and that] human-computer interface design looks at how we can lessen the effects of these differences” (2nd paragraph). Laurel (1990) suggests that, in general, an interface “reflects the physical properties of the interactors, the functions to be performed, and the balance of power and control [as well as the] cognitive and emotional aspects of the user’s experience” (p. xiii). Huang, Diefes-Dux, Imbrie, Daku, & Kallimani (2004) conducted a pilot study where they evaluated a CBI program using Keller’s ARCS model of motivational design and concluded that “interface design is critical for stimulating students’ Attention” (p. 34) – one of the model’s four dimensions of learner motivation. Therefore, the design of the interface must be given considerable thought and planning. Following proven design principles in constructing the user interface facilitates the learning process (Alessi & Trollip, 2001; Koyani, Bailey, Nall, 2003; Kruse & Keil, 2000; Smith & Ragan, 1993).

Designing a good user interface means that it will have optimal usability. The definition given earlier for usability included five attributes that Nielsen (1993, 2003)
states all user-interfaces should possess: learnability, efficiency, memorability, low rate of errors, and satisfaction.

Shneiderman (1998) offers a similar list that he believes is central to evaluating the usability of user-interfaces:

1. *Time to learn* (How long it takes typical users to learn how to use the commands relevant to a set of tasks)

2. *Speed of performance* (How long does it take to carry out benchmark tasks?)

3. *Rate of errors by user* (How many and what kind of errors do users make in carrying out the benchmark tests?)

4. *Retention over time* (How well do users maintain their knowledge after an hour, a day, or a week?)

5. *Subjective satisfaction* (How much did users like using various aspects of the system?) (p. 15)

Essentially, what both Nielsen and Shneiderman have done is identify the goals of interface design. These goals represent the idea outcome of any interface under any circumstances. But as Shneiderman (1998) points out, “every designer would like to succeed in every category, but there are tradeoffs” (p. 15); thus, harking back to the earlier discussion of instructional virtues and flaws. These interface usability design goals are of great significance to this study, as one would expect that whichever design is able to incorporate the greatest number of interface design principles to the greatest degree would likely produce the greatest performance and satisfaction outcomes.
Screen Density and Instructional Text

Since much, if not the majority of the instructional content of CBI and WBT programs is conveyed through text, certain principles of instructional text bear directly on decisions about screen design. Some of these principles are treated separately later in this chapter as they also relate to other considerations in making screen design decisions, but the issue of screen density on the screen is fundamental to all of them (Alessi & Trollip, 2001; Fleming & Levie, 1993; Geraci, 2002; Grabinger & Osman-Jouchoux, 1996; Nielsen, 2000; Shneiderman, 1998). Screen density refers to “the amount of empty space in relationship to text elements on the screen” (Grabinger & Osman-Jouchoux, 1996, p. 189). According to Grabinger and Osman-Jouchoux (1996):

... screens should have moderate density, appearing neither too empty or too crowded. Empty screens are viewed as boring and uninteresting. Overly crowded or complex screens are viewed as intimidating and too difficult to study. (p. 199)

Screen density is of particular concern in WBT screen design because the screen real estate with which designers have to work is very limited in the best of situations (Alessi & Trollip, 2001; Grabinger & Osman-Jouchoux, 1996; Nielsen, 2000; Shneiderman, 1998). Fleming and Levie (1993) estimate that an 80 column by 25 row screen display (a common configuration) may present only a quarter of the information that can be printed on an 8.5 by 11-inch sheet of paper. Monitor (or display) size, screen resolution and Web browser windows all have a significant effect on the amount of screen real estate available for instructional text. While large computer monitors (i.e., 17-inch and above) provide more screen real estate in general, designers must take into
account that many end-users will probably have smaller monitors (15-inch or smaller). This is particularly true of laptop computers, where screen displays are often twelve inches or smaller (especially for the new palmtop computers). Designers can design for higher screen resolutions that generally enable more text to be displayed, but there is often a tradeoff in legibility since the text size is made smaller.

WBT screen real estate is also eaten up by the Web browser window. Like any application, Web browsers entail operational features that necessarily require screen real estate in order to display. The perimeter of a Web browser window generally consists of a title bar, one or more toolbar (e.g., menu, address, and links toolbars), a status bar, and scroll bars, all of which take up precious screen space. While users can exert some control over how much of the screen these features of a Web browser take up, screen real estate is still lost.

Along with monitor size, screen resolution and the Web browser window, a number of factors specifically related to text (e.g., vertical spacing, the number of characters per line, and line length) also impact screen density. Various text density studies have compared low-density text screens with high-density text screens in order to determine preferences for the proportion of text to white space on a screen (Bernard, Fernandez, & Hull, 2002; Morrison, Ross, & O’Dell, 1988; Ross & Morrison, 1989; Ross, Morrison, & O’Dell, 1988; Morrison, Ross, Schultz, & O’Dell, 1990; Youngman & Scharff, 1998). In general, these studies found (1) that low-density text screens are just as effective as high-density screens for expository lessons, (2) that there was a significant reduction of lesson completion time with low-density screens, and (3) that users expressed a preference for low-density over high-density screens. However, Grabinger
and Osman-Jouchoux (1996) warn against concluding that learning is affected by screen density:

...as with the other typographic variable research, screen density research focuses on perception of the screen rather than on the processes of reading and studying. The results of most of this research show little, if any, consistent effect on learning. Because learning from an instructional computer screen involves the reader and complex cognitive processes, it may be more likely that changes that help the perceptual and reading processes such as organizational factors and meaning may be more valuable research material. (p. 190)

Muter (1996) reinforces this caution when he states that “at present, we do not know how to optimize reading via electronic equipment” (p. 161).

Nevertheless, the question of how much text can be displayed on the screen while maintaining an optimal screen density for learning has important ramifications for the quantity and quality of instructional information that can appear on screen at any given time (Grabinger & Osman-Jouchoux, 1996, p. 189). For instance, according to studies of viewer preferences, “readers prefer shorter rather than longer lines of text” (Grabinger & Osman-Jouchoux, 1996, p. 195). Designing a WBT screen with this as a guiding design principle, along with the various other constraints placed on the amount of screen real estate available for instructional content, requires that the designer must be particularly judicious about what is included on that screen. So the designer must give careful thought as to how the instructional message can be conveyed both as clearly as possible and as concisely as possible.
Alessi and Trollip (2001) refer to the informative, yet parsimonious construction of instructional messages as “leaness,” which they define as “say[ing] just enough to explain what is desired, and no more” (p. 67). Calling it an important quality of instructional text, they state that it “applies not only to text descriptions, but to examples of concepts, sample applications of rules, pictures for demonstration purposes, and so on” (2001, p. 67). Reader and Anderson (1980) validated the principle of leanessness when they demonstrated that readers learn the main points of a textbook better from just a summary of the main points than from the text itself, even when the main points were highlighted in the textbook.

 Authorities in instructional design point out that lean instructional text facilitates learning (Alessi & Trollip, 2001; Merrill, 1994). That leaness of instructional text can yield learning benefits seems to make sense just on the common sense principle that eliminating all superfluous elements in the instructional message would tend to increase the visibility of the message and, thus, its instructional potency. Further substantiation of this principle can be found in considering how humans perceive, process and store information.

Memory, Reading, and Learning

Huitt (2000) outlines four general principles of cognitive psychology that inform a basic information-processing model of memory. First, there is an assumption that the human mental system has a limited capacity, with constraints being placed on the amount of information that can be processed at any given time. These constraints occur because of bottlenecks at specific points in the system. A second principle is that part of the
processing power of the brain is reserved for an overarching control mechanism that oversees the encoding, transformation, processing, storage, retrieval and utilization of information. Third, our perception and understanding of the world results primarily from two sources of information, one being the information coming to us through our senses, and the other being our stored (i.e., long-term) memories. And the fourth principle is that humankind is genetically predisposed to process and organize information in specific ways. For example, human infants are more likely to look at a human face than any other stimulus within their 12 to 18 inch field of focus, which is apparently an important aspect of the infant’s survival.

While no one can claim to have completely deciphered the human memory process, current information-processing theories give us some insight into how we humans perceive, process, store information, and, thus, learn. The so-called “stage model,” based on the work of Atkinson and Shiffrin (1968), posits that information is processed and stored in the human brain in three stages: (1) external stimuli enters the sensory memory, (2) information that survives the sensory memory is transferred to the short-term memory, and (3) information that survives the short-term memory is deposited in the long-term memory (Gordon, 1994; Hergenhahn, 1988; Huit, 2000; Mazur, 1990). The first two stages describe limitations on the processing power of the brain.

In the first stage of the memory, the various types of information we receive via our senses are converted into a form of energy that the brain can handle. During this “transduction” process, an extremely short-lived memory (anywhere from a half a second to several seconds, depending on the type of information) is created (Gordon, 1994; Huit, 2000). If the information does not have an interesting enough feature or if it does
not activate a known pattern, it will more than likely not survive to be transferred to the short-term memory.

Once in the short-term (or “working”) memory the information has our attention. However, the information will survive for only about 15 to 20 seconds before it is dropped, unless it is immediately repeated (Gordon, 1994; Hergenhahn, 1988; Huitt, 2000). If it is repeated, the information will stay available for up to 20 minutes (Gordon, 1994; Huitt, 2000). This is the stage during which Miller’s (1956) “magical number seven, plus or minus two” comes into play. Miller’s number refers to the apparent limit on the number of items of information that the human brain can, on average, process at any one time: seven, give or take two items. More recent research has demonstrated, however, that that number drops to around five, plus or minus two, if the information item is complex (Gordon, 1994; Huitt, 2000).

Since the human sensory system attempts to process all external stimuli, it can be easily overloaded by too much stimulation (Kruse & Keil, 2000, p. 115). Short-term memory is, therefore, highly volatile due to its high susceptibility to disruptions due to distracting stimuli in the environment (Shneiderman, 1998). Visual and/or auditory (i.e., noise) distractions can interfere with the cognitive processing of information (Kruse & Keil, 2000; Shneiderman, 1998). Emotional states, such as anxiety, can also cause loss of information during the processing because preoccupation with whatever is causing the anxiety reduces the amount of processing power available to transfer new information into long-term memory (Shneiderman, 1998).

In addition, delays in the transfer of information due to distractions can require that the memory be refreshed (Shneiderman, 1998). Therefore, organization and
repetition are indicated as the most important means for insuring information in short-
term memory will make it into long-term memory, which is the last stage in this
information-processing model (Gordon, 1994; Hergenhahn, 1988; Huit, 2000; Mazur,
1990). Long-term memory is apparently limitless, storing and organizing information
according to one or more of three types of memory structures: declarative, procedural,
and/or imagery (Huit, 2000; Gordon, 1994).

Reading involves both memory and the context within which the learner is
learning (Grabinger & Osman-Jouchoux, 1996). Instructional text displayed on a
computer screen is acquired, organized and processed, resulting in a message that is
intended to be deposited into the learner’s long-term memory. Tinker and McCullough
(1962) defined reading as involving:

...recognition of printed or written symbols which serve as stimuli for the recall of
meanings built up through past experience, and the construction of new meanings
through manipulation of concepts already possessed by the reader. The resulting
meanings are organized into thought processes according to the purposes adopted
by the reader. Such an organization leads to modified thought and/or behavior, or
else leads to new behavior which takes its place, either in personal or in social
development. (p. 13)

It is the WBT designer’s job to arrange all the text elements on the screen in such
a way as to facilitate the learner’s perception, reading, and understanding of the
instructional message (Alessi & Trollip, 2001; Fleming & Levie, 1993; Grabinger &
in human-computer interaction is focused purely on ways to reduce the load on the human user’s memory” (p. 110). By understanding how human memory works, we can develop effective strategies for aiding memory and, therefore, improving instructional programs.

Producing lean instructional text is one such strategy. By distilling the instructional message down to its purest, simplest form, the learner’s cognitive load is lessened because he/she does not have to filter through extraneous and distracting stimuli. It would stand to reason, then, that the probability of the message being attended to, processed and deposited into long-term memory would be increased. And if this is so, then the case can be made that a full-page design would better facilitate the production of lean instructional text than would a partial-page design. With less screen real estate to work with, the designer is forced to “chunk up” and refine the instructional content such that each screen will contain a low-text density message that carries a high instructional value.

Chunking Up to Produce Lean Instructional Text

As Kruse and Keil (2000) point out, “the ultimate goal of training and education is to get relevant information through short-term memory and into long-term memory, where it can be accessed at a later time ” (pp. 110-111). To that end, one of Shneiderman’s (1998) “Eight Golden Rules of Interface Design” is “reduce short-term memory load” (p. 75).

Again, because humans have a very limited amount of processing capacity, learners can reach their cognitive limit fairly quickly, depending on the amount and/or
complexity of the information they are attempting to absorb. Even though sensory memory can receive a great deal of information, only a very small part of that information will make it into working memory. Gordon (1994) explains:

... it takes cognitive resources to attend to subsets of that information and transform it for use in working memory. The limits in our cognitive resources dictate the amount of information we can transform. Sperling (1960) found that we can only transform 4-5 items within the 1-second time span before information in sensory memory decays or is replaced. The implication is that of all the information a trainee may “see” or “hear” in a training program, he/she can only bring in a small subset of items for actual cognitive processing at any given time...

In a training environment, the information that gets the most extensive processing will depend on the amount [emphasis his] of information being presented, the salience of various stimuli, the degree to which the information is “interesting [emphasis his],” and the degree to which the information is called for by short-term or long-term goals [emphasis his] of the trainee. (pp. 131-132)

Again, the conclusion this leads to is that WBT designers should refrain from putting too much information on the screen at one time. There appears to be an expert consensus on the wisdom of constructing lean, chunked up instructional content (Alessi & Trollip, 2001; Fleming & Levie, 1993; Grabinger & Osman-Jouchoux, 1996; Horton, 2000; Kruse & Keil, 2000; Merrill, 1994; Nielsen, 2000; Piskurich, 2000; Shneiderman, 1998; Tullis, 1997). Horton (2000) implores designers to avoid the “Great Wall of Text [that consists] entirely of great, gray blocks of text” (p. 447). He considers this to be one
of the biggest pitfalls in WBT, because to many learners, large blocks of continuous
texts, especially displayed on a computer screen, are intimidating or boring, taxing their
endurance and severely testing their level of motivation (Horton, 2000). Unfortunately, a
great many, if not the majority, of WBT programs found on the Web today perpetrate this
design flaw. Although there are certainly times when large blocks of continuous text are
unavoidable or even desirable (Alessi & Trollip, 2001), it does not, in general, follow
good instructional design guidelines.

The remedy to this “Great Wall of Text” problem is to chunk large blocks of
information up into smaller, more digestible pieces (Alessi & Trollip, 2001; Fleming &
Levie, 1993; Horton, 2000; Kruse & Keil, 2000; Merrill, 1994; Nielsen, 2000;
Shneiderman, 1998). Significantly, Merrill (1994) refers to these smaller pieces as “mind-
sized chunks” (p. 153).

Furthermore, the chunking process facilitates the production of lean instructional
text, which, in turn, facilitates learning (Alessi & Trollip, 2001; Merrill, 1994). Designers
should be aiming to design screens that contain only the minimum amount of information
necessary to accomplish the purpose of that screen (Alessi & Trollip, 2001; Galitz, 1993;
Smith & Mosier, 1986; Tullis, 1997). Tullis (1997) expands on this point:

A designer should ensure that each screen or window contains only the
information that is actually needed by the users to perform the expected tasks at
that point in the interaction. The temptation to provide additional data just
because it is available should be avoided, since extra clutter clearly degrades the
users’ ability to extract the relevant information (p. 509).
To Scroll or Not to Scroll

The amount of information that goes on a single page of a WBT program is not of great concern if one does not aspire to produce lean (but potent) instructional content, and/or there is no concern about ending up with content that is too large to fit on the screen all at once. However, WBT designers intent on developing the most instructionally sound programs based on what we know or think to be good instructional design guidelines for WBT have to be concerned with a number of issues related to the quantity (and quality) of information displayed on a WBT screen. If the latter is the case, then screen real estate, screen density, chunking large blocks of continuous text, and generating lean instructional content all become problematic. They become problematic for WBT designers right from the get-go because a decision has to be made about whether or not to design a screen layout that will require learners to scroll. This is so because the ability to scroll has implications for all four aspects of screen design just mentioned.

What is problematic about learners having to scroll? It is problematic if you believe Alessi and Trollip (2001) when they advise CBI and WBT designers to design alternatives to scrolling whenever possible. Scrolling becomes problematic if you believe that it violates any of Nielsen’s (2000, 2003) or Shneiderman’s (1998) tenants of usability, such as efficiency or user satisfaction. It becomes problematic if you believe the studies of viewer preferences that demonstrate a user preference for shorter rather than longer lines of text. It is problematic if you believe that building it in as a design choice served as a disincentive to produce lean instructional content, resulting in superfluous material being incorporated into the instructional program that might detract
from the program’s effectiveness. Scrolling is problematic if you believe that having to scroll interferes in any way with the learning process, that it might constitute a “distracting stimuli in the environment” that “can interfere with the cognitive processing and retention of information.” On the other hand, the decision to not allow scrolling also becomes problematic if you cannot prevent users from changing their Web browser default settings (e.g., font typeface and size).

If the ultimate goal of a WBT designer is the construction of a screen layout that facilitates the most beneficial instructional experience possible for learners, then the decision to include or disallow scrolling is of great importance. This decision has great importance not only because scrolling can be problematic in the ways just listed, but also for several other reasons which are discussed in the following sections.

Comparing Partial-Page and Full-Page WBT Screen Designs

The main difference between partial-page and full-page WBT screen designs can probably be boiled down to the issue of scrolling. A partial-page screen design is, for all intents and purposes, unconstrained in terms of the length of its constituent Web pages, which means scrolling is a planned design feature. A full-page design, on the other hand, is constrained in dimension to the size of a window that, while possibly smaller than the viewable screen area of the computer monitor, should never exceed the dimensions of the screen area.

The question of interest in this study is which screen design might have greater instructional benefits, both in terms of learner performance and in terms of satisfaction? Since there appears to have been no previous research conducted on the relative
instructional benefits of the two screen designs in WBT, one must look to other related fields and studies, with an eye toward extrapolating from that literature. That is where the scrolling versus paging studies comes in with regard to this research.

*Scrolling vs. Paging Studies*

It should be remembered here that, in the earlier literature, paging often referred to an alternate method of moving around a single page that contained content too large to fit on the screen all at once (Kolers, Duchnicky & Ferguson, 1981; Piolat, Roussey, & Thunin, 1997; Schwartz, Beldie, & Pastoor, 1983). Some considered it a different form of scrolling over a long page of content, with the difference being that in regular scrolling, movement is in small increments (typically, line by line), whereas paging moves through a page in large increments (roughly one entire screenful of information at a time). This usage of the term was, of course, usually in relation to partial-page interface designs.

More recently, however, paging has been used most often in the context of non-scrolling, full-page screen designs, where the user moves multiple contiguous pages of instructional content linked by hypertext links (Baker, 2003; Bernard et al., 2002; Harrell, 1999; Parsons, 2001). But it is important to note that even though earlier paging studies were conducted in relation to a partial-page screen design, the paging condition still shared some of the same qualities of paging as it has been more recently conceived in the context of full-page screen design. For instance, in both contexts, paging results in one screenful of content being replaced in its entirety with another at the press of key or click of the mouse. Of course, there are important differences that cannot be overlooked and serve to definitively differentiate them. For example, in the context of paging down a
single page, other program features move out of the user’s view, whereas all program features remain in view when paging through a full-page interface. Nevertheless, the findings from earlier paging studies conducted using a partial-page interface are still useful for informing the discussion of full-page versus partial-page screen designs.

While there is precious little literature specifically comparing partial-page and full-page designs in WBT design, there have been a number of studies that have looked at differences in learner performance, satisfaction, and/or preference outcomes between scrolling and paging in other contexts, such as Web searches (Bernard et al., 2002), online text readability, comprehension, and retention (Baker, 2003; Dyson & Kipping, 1998; Kolers, Duchnicky, & Ferguson, 1981; Piolat, Roussey, & Thunin, 1997), word reading, line searching, and term sorting (Schwartz, Beldie, & Pastoor, 1983), location orientation (Beard & Walker, 1990), the usability of online newspapers (van Oostendorp & van Nimwegen, 1998), and finding information in text passages on a web page (Parsons, 2001). Most of these studies concluded that paging held an advantage over scrolling, although at least one found the opposite to be true (Baker, 2003).

For those finding an advantage in paging, a primary factor for the differences in outcomes was identified as spatial orientation (or encoding), which involves the learners “building a mental representation of the location of text information [on a page]” (Piolat, Roussey, & Thunin, 1997). Other authorities in the fields of instructional and human-interface design support this finding (Alessi & Trollip, 2001; Muter, 1996; Severinson-Eklundh, Fatton, & Romberger, 1996). Severinson-Eklundh, Fatton, and Romberger (1996) explain:
When writing or reading on paper, we make constant use of the spatial arrangement of the text to remind ourselves of its inherent structure. This holds in a local as well as a global sense. By a quick visual inspection of a book in our hands, and by flipping the pages for a few seconds, we get a preliminary feel for the size, structure, and content of the text material. Not only are we guided by those physical cues when approaching a new document, they also enable us to remember the text by its appearance and spatial arrangement (p. 139).

This same sort of process occurs with electronic text on the screen. These orientations hold pretty well when paging because an entire page (screen) is replaced when paging, allowing the physical and spatial cues used for orientation to remain pretty well in tact. However, with scrolling, learners frequently lose their place and have to re-orient themselves each time – a tiring and often unmotivating activity. Because scrolling moves down the page incrementally, the spatial encoding that occurs when the learner scans an entire page becomes useless. The physical cues and spatial relationships that learners depend on to orient them to where things are on a page have disappeared.

Thus, scrolling versus paging studies are relevant to this study because spatial orientation is a factor in both partial-page and full-page designs. The difference is that with the partial-page design, spatial orientation is disrupted to a significantly greater degree than in full-page designs. In the latter, when moving from one page to another page, the entire interface (including all operational and navigational features) remains in view; thus, the physical cues and spatial orientation on which learners rely remain entirely intact, the same as they do when leafing through a book. We know that spatial
orientation is a key factor in learner performance and satisfaction because in partial-page designs, the greater degree of spatial orientation is the reason for the difference in outcomes between scrolling and paging, in favor of paging. Therefore, it seems reasonable to extrapolate that if paging is superior to scrolling by virtue of its greater possibility for spatial encoding, then full-page designs might yield superior learner performance and satisfaction outcomes over partial-page designs since its design and mode of navigation appears to be inherently more conducive to spatial encoding than scrolling.

Summary

This literature review has been an attempt to do two things: (1) to convey the rationale for investigating which of two WBT screen designs might hold a greater instructional benefit: partial-page or full-page, and (2) to provide a convincing argument for why this issue is important to WBT instructional design. The dearth of literature specific to the topic of this research in WBT design is, at once, both unfortunate and fortuitous. Although this study must rely on literature from related fields and of related topics, it provides an opportunity to at least shed some light on a fundamental design issue that appears to get glossed over on a regular basis. In a very real sense, it is an opportunity to add one small, but informed piece to the WBT design puzzle.
Chapter Three – Research Methods

Study Overview

The overarching question addressed by this research was whether or not the type of overall screen design selected by a WBT designer has implications for how well learners learn the material and/or are satisfied with the learning experience. In particular, this study was conducted in an effort to determine if there was a significant difference between two types of WBT screen designs with regard to either learner performance or learner satisfaction. For the purposes of this study, the two screen designs in question have been designated as full-page and partial-page, with the distinguishing feature being the latter’s necessitating vertical scrolling in order to view all of a WBT page’s features and/or content. The full-page design allows the learner to view an entire WBT page at once, but only by limiting the amount of instructional content per page, whereas the partial-page design can provide more instructional content per page, but requires the learner to scroll down an indeterminate amount in order to view all a page’s content and/or features.

The study design was originally piloted during the spring of 2004, the results of which led to the modification of some of the data collection procedures and instruments initially proposed for the study (see Appendix B for more information). A second pilot study was conducted during January 2005, which led to further instrument refinements. A third pilot study was conducted in March and April of 2005, yielding results that justified
continuing on with the main study. The main study was conducted from April through June 2005.

All three pilots and the main study were conducted at a large metropolitan university in the southeastern United States. Quantitative data were collected via computer on participant performance, and qualitative data regarding participant satisfaction with the instructional experience were collected both by computer and through post-interview sessions. The vehicle for this research was a Web-based instructional program entitled Basic Web Page Programming (BWPP), for which both a partial-page version and a full-page version were constructed.

One hundred twenty-nine undergraduate students participated in the study. All 129 students came to participate in the study by responding to one of a variety of recruitment notices disseminated by this researcher. (The recruitment methods are discussed in a later section.) Participants scheduled themselves for a study session at a Web site set up specifically for the study. At the beginning of each study session, participants were first randomly assigned into one of the two treatment groups after which they completed, in turn, a brief online Web Skills Assessment (WSA) program, the BWPP tutorial, and a satisfaction survey. In addition, post-session interviews were conducted for a randomly selected subset (59) of the 129 participants.

This chapter describes both the procedures followed and the instruments employed in conducting the study.
Research Design

This study employed a mixed-method design, generating both quantitative and qualitative data. The main phase of the study was experimental, following a factorial design to explore the relationships between a single treatment variable (WBT screen design) in two treatment conditions (partial-page WBT design and full-page WBT design) and two dependent variables (learner performance and learner satisfaction).

Participants’ BWPP exam scores constituted the performance data for this study. Satisfaction data came from an online satisfaction survey that all participants completed following the WBT exam. A semi-structured post-study session interview conducted with a randomly selected subset of study participants provided further qualitative information.

Study Participants

The target population for this study was undergraduate students at a major Southeastern urban university who met two primary criteria: a minimum level of Web proficiency and very little or no experience with HTML (the authoring language for creating Web pages). The study was confined to undergraduate students in an effort to bolster its internal validity. The requirement that participants possess a functional level of Web proficiency was to control for the possibility of confounding effects related to inexperience with using the Web (and, by extension, computers in general). Recruitment materials for this study described this criteria as “adequate Web skills, meaning that [the prospective study participant is] not a complete novice to computers and the Internet/World Wide Web - that [he/she knows] how to use a Web browser and are fairly familiar with how to get around on the Web” (see Appendix D for recruitment samples).
The second primary criterion, little or no experience using HTML, was important since familiarity with HTML could conceivably give some students a performance edge over those who have had no experience with HTML. Thus, in order to control for variability that might be attributable to different levels of familiarity with HTML, students who had significant experience with HTML were excluded from participating in this study. Recruitment materials for this study described this criterion as follows:

You know little or nothing at all about how to create Web pages using HTML by itself. If you are fairly familiar with HTML - even if through the use of a design view application, such as [Macromedia’s] Dreamweaver - [you do not qualify for this study]. However, if you do not know how to create a Web page, or if you somehow create Web pages without ever seeing any of the HTML code, you would be a candidate for [this] study (assuming you meet the other… criteria).

Thus, participants in this study were filtered for experience with both the Web and HTML prior to their participation in this study. How participant Web proficiency and level of familiarity with HTML were determined in this study are explained later in this chapter.

Descriptive Statistics for the Total Study Group

One-hundred twenty-nine undergraduate students participated in this study. The demographic data collected included gender, age, awareness of HTML (i.e., what it is and what it is used for), and years of experience using HTML. The group as a whole consisted of 44 males (34%) and 85 females (66%) and ranged in age from 18 to 52 years, with a mean age of 21.9 years ($SD = 4.86$). Table 1 provides more detail regarding
the total group’s gender and age demographics. The sample, as a whole, was relatively young, with 109 participants (89%) between ages 18 and 24 years. This was not unexpected for a group of undergraduate students, although the presence of older undergraduates was somewhat a surprise. A frequency table for participant ages can be found in Appendix C.

Table 1

**Total Group Gender and Age Demographics**

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Age Range</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>44 (34%)</td>
<td>18 - 44</td>
<td>22.8</td>
<td>4.719</td>
</tr>
<tr>
<td>Female</td>
<td>85 (66%)</td>
<td>18 - 52</td>
<td>21.4</td>
<td>4.897</td>
</tr>
<tr>
<td>Combined</td>
<td>129 (100%)</td>
<td>18 - 52</td>
<td>21.9</td>
<td>4.863</td>
</tr>
</tbody>
</table>

A majority of participants (58%) reported having no prior awareness of the HTML Web programming language. This was also true within gender groups, although a higher percentage of females had no prior HTML awareness. A more complete breakdown of prior HTML awareness by gender is provided in Table 2.

Table 2

**HTML Awareness by Gender**

<table>
<thead>
<tr>
<th>Prior HTML Awareness</th>
<th>Gender</th>
<th>Total Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>No</td>
<td>24 (54.5%)</td>
<td>51 (60%)</td>
</tr>
<tr>
<td>Yes</td>
<td>20 (45.5%)</td>
<td>34 (40%)</td>
</tr>
<tr>
<td>Combined</td>
<td>44 (100%)</td>
<td>85 (100%)</td>
</tr>
</tbody>
</table>
As a group, 111 (86%) participants reported having absolutely no experience using HTML. Of the 18 that reported some experience using HTML, nine reported less than a year’s experience, five indicated 1 to 2 years, one reported 2 to 5 years experience, and three said they had over 5 years experience. A more complete breakdown of HTML awareness by gender is provided in Table 3.

Table 3

<table>
<thead>
<tr>
<th>HTML Experience</th>
<th>Gender</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
</tr>
<tr>
<td>None</td>
<td>37 (84.1%)</td>
<td>74 (87.1%)</td>
</tr>
<tr>
<td>Some</td>
<td>7 (15.9%)</td>
<td>11 (12.9%)</td>
</tr>
<tr>
<td>Combined</td>
<td>44 (100%)</td>
<td>85 (100%)</td>
</tr>
</tbody>
</table>

Sample Size and Selection

Prior to the start of this study, a search of the literature for guidance in determining an appropriate sample size for this study yielded only a few studies of comparable concern. Piolat, Roussey, and Thunin (1997) published a single paper describing two separate studies investigating “the effects of two types of text presentation (page-by-page vs. scrolling) on participants’ performance while reading and revising texts” (p. 565). In their first experiment, they employed a sample of 54 participants, while in the second experiment their sample was composed of 26. Each sample was drawn from “second-year undergraduate psychology students,” though there was no specific indication both samples were drawn from the same population or if any of the individuals participated in both experiments. Bernard, Baker, and Fernandez (2002) sought to
determine the best way to display large amounts of information on the web by comparing paging versus scrolling screen designs. They used a sample of 18 volunteers, all of whom were subjected to three separate conditions. In another study examining the effects of scrolling on the usability of an online newspaper (van Oostendorp & van Nimwegen, 1998), the sample consisted of 20 (unclassified) students. Schwarz, Beldie, and Pastoor’s (1983) study comparing user preference between “paging and scrolling” screen designs was also conducted with a sample of 20 participants. And finally, Kolers, Duchnicky, and Ferguson (1981) used 20 paid volunteers to compare the effects of scrolling rates on the readability of text on a CRT (i.e., television) screen.

Unfortunately, none of the these studies provided sufficient information to ascertain how their respective sample sizes were determined and, therefore, could not appropriately be used to inform this study. On an intuitive level, the sample sizes of these studies (54, 26, 18, 20, 20, and 20) would appear to be suspect, especially if one were assuming a .05 alpha level and a medium effect size.

Given the lack of strong precedence in the literature, this researcher turned to Cohen’s (1992) power table to determine the sample size for this study. Given that the study participants were randomly assigned to the two treatment groups (see the Data Procedures section below), and an assumption of a moderate effect size at a power of .80 for a .05 alpha, Cohen’s power table group recommended that each treatment group contain 64 participants, for a total sample size of 128. This recommendation was followed for the study.

Like many such studies that target the population of university undergraduates, the problematic nature of obtaining a truly random sample made such a prospect for this
study severely impractical, if not impossible. Because of limited access to the target population in conjunction with the limited timetable within which to conduct the research (all study data had to be collected by the end of June 2005), the study sample was obtained via various means of recruitment, essentially, on a first-come-first-serve basis.

Advertising in the university’s student newspaper and direct dissemination of handbills at various on-campus locations where students frequented and/or congregated (such as the student center and main library) proved the most productive. Other methods of recruitment included posting recruitment flyers around campus, direct emails to student-led and student-oriented university organizations, and instructors of undergraduate classes, and word-of-mouth. All recruitment materials except the newspaper advertisement included the general purpose of the study, the criteria for participating in the study, the amount of cash compensation for participating in the study, the average length of a study session, and a Web site URL where prospective participants could get further details, sign up for the study, and schedule a study session. For brevity sake, the newspaper advertisement included only the compensation amount and the Web site URL. Samples of these recruitment materials can be found in Appendix D.

Cash compensation for participation in the study ($20.00 for a single study session) was employed as a means of generating interest among the university’s undergraduate population. The decision to provide monetary compensation stemmed from the researcher’s recruitment experiences during the first instantiation of the study, which featured a different Web-based instructional program. More detail about this and other modifications to the original study design are discussed in Appendix B.
Regarding the length-of-session time advertised, the average given of approximately one hour was actually the true average of all length-of-session times, updated in real-time. The WBT program collected start and stop time data for every participant’s study session, with the difference calculated in minutes and rounded to the nearest minute. At any given moment, the study Web site’s home page displayed the average of all length-of-session times currently in the study database, such that the average length-of-session time was updated with every completed study session. Throughout the entire study, this average remained at about one hour, give or take a few minutes. At the conclusion of the study, the average length-of-session stood at 63 minutes.

As was indicated earlier, participants were included into the study on a first-come-first serve basis, providing, of course, that they met the stated criteria for participation in the study. Virtually all of the participant session scheduling was done automatically via the study Web site, which was programmed to accept no more than 128 total participants for the study.

(The total number of study participants came to be 129, because of a suspicion that arose toward the end of the data collection process regarding the integrity of one participant’s data. Because this participant took the shortest amount of time to complete a study session and obtained the lowest score on the BWPP exam, there was some concern that he had not made a good-faith effort during his study session, thus rendering his data unreliable. Therefore, as a precaution in case that individual’s data had to be discarded, an additional participant was recruited as a possible replacement. Analyses of the BWPP data, both including and excluding the suspicious exam score, eventually proved the
concern to be unfounded and that individual’s data was retained. But since the data from the additional recruit had already been collected, it was also included in the study, bringing the total $N$ of the study to 129.)

The details of the session scheduling process can be found in Appendix E, but it is important to note here that the study Web site was programmed to manage participant slot availability on the fly based on the number of active session appointments in the study database at any given time. Participants scheduled their own session appointment from an online calendar of dates and times prepared by the researcher. They could also cancel and/or reschedule their appointment online themselves. The site automatically adjusted the number of slots available for each session, as well as the number of total available slots for the study. The number of slots available was incremented and decremented in real time to reflect the scheduling or cancellation of session appointments. In like fashion, sessions were automatically closed when all their available slots had been taken and reopened again if any of their scheduled participants cancelled an appointment. Thus, who participated in study and in what order was an effectively random process.

As far as assuring participant suitability for the study, it was stated at the outset of this chapter that, in addition to the undergraduate status requirement, prospective study participants were screened for two other suitability criteria: level of Web proficiency and level of familiarity with HTML. Because it was important to control, as much as possible, outcome variability due to differences in Web skills and/or HTML experience, a premium was put on making sure prospective participants understood and met the
suitability criteria. To this end, the criteria were presented to each prospective participant multiple times before allowing them to participate in the study:

1. In all recruitment materials.

2. At the start of the online scheduling process.

3. In the online appointment confirmation provided participants after scheduling a study session (which was also emailed to the participant).

4. Verbally by this researcher when participants arrived for their study sessions.

5. On the online informed consent Web page that participants had to “sign” (by clicking their agreement to consent) before they could begin their study session.

In addition, this researcher made sure to include the criteria in any other form of communication with prospective participants that might have occurred, such as phone or email contacts. Thus, even if participants never saw any of the recruitment materials (e.g., they learned of the study via word-of-mouth), the suitability criteria were presented to each individual at least three times before being allowed to participate in the study. With no other way of definitively confirming their suitability for participation, participants were allowed into the study, essentially, on the basis of this self-report honor system.

In summary, the sample selection process employed for this study was fairly random and ensured that only suitable participants were allowed to participate. While a truly random sample selection was all but impossible for this study, the sample selection process implemented was as random as could have been managed under the
circumstances. As well, the process of having each participant confirm his or her suitability on multiple occasions was as definitive as could be reasonably achieved.

Measures

The single independent variable in this study, WBT screen design, had two conditions: partial-page and full-page. The two dependent variables were learner performance and learner satisfaction. In order to control for effects deriving from variations in participants’ Web experience/proficiency, all study participants had to meet a minimum level of Web proficiency. Participants also were required to have very little or no significant familiarity/experience with HTML so as to control for variability stemming from significant differences in participants’ familiarity with HTML. The screening method for these criteria is presented in the next section.

One hundred twenty-nine subjects were recruited on a first-come-first-serve basis for this study. At the beginning of each study session each participant was randomly assigned to one of the two treatment conditions (the process of which will be detailed later in this chapter).

Data Collection Procedures

The Computer Lab

In order to collect performance and satisfaction data for this study, a computer lab was set up in an office on the main campus of the university. The lab consisted of three similarly configured and powered computer workstations. All three workstation boxes
were older Pentium II-based computers that had been reconditioned just prior to and especially for use in this study. Each computer was loaded with the Windows 2000 operating system, Internet Explorer 6.0, and McAfee VirusScan, and all were protected by the same server firewall. All three work stations were configured with standard Windows-enhanced keyboard, a two-button wheel mouse, and mouse pad. While all three computers were configured with a sound card, none were equipped with external speakers.

The only difference of note between the three workstations was that two of the systems were equipped with 17-inch CRT monitors, while the third was equipped with a 15-inch CRT monitor. This was because, just prior to the start of the study, the original 17-inch monitor for the third workstation malfunctioned, and there were no other 17-inch monitors available to replace it. Though it was preferable to have identical workstations in order to control for possible confounding differences attributable to inequitable equipment, there was no evidence that the difference in monitor size impacted the outcome of the study.

All three workstations were connected via Ethernet card to the university’s network, through which they accessed the World Wide Web and, thus, the study’s Web-based measurement instruments (i.e., the Web Skills Assessment Program, the BWPP tutorial, and the online satisfaction survey). The entire study Web site, including all online measurement instruments, was located on a protected university server. All but the session scheduling pages of the study Web site were restricted, requiring a username and password to access it.
All three workstations were located in the same room and set in a row against the same wall. However, stacks of heavy, rectangular storage boxes were positioned between each workstation such that anyone working at one could not see the monitor screens of either of the other two. The computer lab was also equipped with a couch and chairs, as well as a fourth computer station on which the study proctor could work during the study sessions and even monitor the progress of study participants. The three computer workstations were set apart from the rest of the room by a series of tall bookcases, with a gap between two of the bookcases serving as a passageway.

The lab itself was located off of a small alcove in a fairly quiet, isolated area of the building. The alcove, which was used for some of the post-session interviews, was equipped with a pair of chairs and a coffee table.

Pilot Studies

As was briefly mentioned at the beginning of this chapter, three separate pilots were conducted to test the study design prior to initiating the main study. This section provides only a brief synopsis of the pilot study sequence. Descriptions of the instruments mentioned in this section will be provided later in this chapter.

The first pilot, conducted during April and May of 2004, involved 24 participants and employed an online tutorial for a standard clinical assessment tool used by mental health professionals entitled, *The Global Assessment of Functioning Rating Scale (GAF)*. The Cronbach’s alpha calculated for the GAF exam was unacceptable (-.40), and that of the satisfaction survey was not much better (.13). These poor outcomes resulted in a decision to replace the GAF tutorial as the instrument for generating performance data.
Modifications to some of the other data collection procedures and instruments were also indicated. Some of these alterations represented a substantial departure from the study protocol originally proposed. Appendix B provides more detail about these modifications.

The second pilot, in which the first instantiation of the BWPP tutorial appeared, was conducted in January 2005 with 12 participants. This first rendition of the BWPP consisted of six content sections, a review section, and a 22-item final exam. While the reliability coefficient for the 22-item exam was acceptable (.76), the Cronbach’s alpha calculated for the satisfaction survey (-.45) was actually worse than that of the first pilot. The main results from this pilot were the deletion of the content section on creating tables in a Web page, modification of the BWPP tutorial final exam to reflect the deletion of the tutorial section on creating tables, and a complete re-working of the satisfaction survey instrument.

The reason for abridging the BWPP content was that the study sessions, while shorter than those of the GAF tutorial, still averaged about an hour and a half to complete. This was a bit worrisome because after the first pilot test there was speculation that the long session times (two hours on average) might have negatively impacted participants’ motivation and, thus, performance. Although there was no way to verify this suspicion, it seemed to be a reasonable possibility. By removing the section on creating tables, the session time was reduced to about an hour.

The third and final pilot for this study was conducted in March and April 2005 and involved 10 participants. The reliability coefficient for the BWPP exam scores (.75) was considered reasonable for an 18-item exam, and the Cronbach’s alpha computed for the satisfaction survey (.89) was an acceptable improvement over the first two pilots.
Since no significant modifications were indicated for any aspect of the study design, the decision was made to launch the main study.

Initiation of the Main Study

The main study, initiated in April 2005, was essentially seamless with the conclusion of the third pilot test. In fact, with the permission of this researcher’s doctoral committee, the data generated from that 10-participant pilot study was folded into the main study. Thus, there was a need to recruit only 118 more participants in order to reach the target sample size of 128. (Again, the final N of this study was 129, for reasons discussed earlier in this chapter.)

The design and execution of the main study mirrored the protocol established by the third pilot. This protocol is described in the following several sections and should be understood as also describing the protocol of the third pilot study.

Study Session Preparation

Every study session was prepared and proctored by the principal investigator of this study. Prior to each study session, each workstation was prepped in the same manner: after an initial check to ensure it was functioning properly, it was logged into the study site via Internet Explorer, and set to display the participant login screen.

When participants arrived for a session, the suitability criteria were recited to them, and they were asked if they met those criteria. Those who stated they did not meet one or more of the criteria were told they could not participate in the study, and their appointment was cancelled in the study database, which automatically incremented the
number of available slots on the study Web site’s sign-up page by one. Fortunately, this scenario occurred only a couple of times.

Those who did meet the participation criteria, were given an overview of the session protocol, some general instructions and, and asked if they had any questions information (see Appendix F for this prep sheet). The next step, then, was to randomly assign each participant into one of the two treatment groups. The procedure for random assignment procedure is discussed next.

Random Assignment of Participants into Treatment Groups

The assignment of participants into the two treatment conditions was guided by two concerns: randomization of the process and conformity to the Cohen’s power table recommendations of at least 64 participants per treatment group (see the section on sample size above). To these ends, this researcher devised an assignment method that resulted in an equal number of participants in both treatment groups, while retaining a sufficient degree of randomization to ensure the two treatment groups were equivalent.

The random assignment of participants to treatment groups was accomplished through a relatively simple lottery system. In preparation for the study, 128 white poker chips were each coded with a unique six-digit number (e.g., 163425) and placed in a black cloth bag. The six-digit code served three purposes, the first of which was to designate one of the two treatment groups. Half of the 128 codes ended in “00,” representing the full-page condition, and the other half ended in “25,” representing the partial-page condition. The second purpose of each chip’s unique code was as a login
code that would be entered on one of the computer workstations in order to access to the online study site.

Each code could only be used once to log into the study site because after login, its third function kicked in; namely, to serve as a unique user ID for that session. All data generated under that user ID were stored as a separate record in a database table located on the study Web site’s server.

After study participants were prepped for their session, the bag of poker chips was shaken vigorously for a few moments. Then, each participant was instructed to reach into the bag without looking and pull a single poker chip from the bag. Once a chip was selected it was never placed back into the bag in order to prevent a participant from drawing a previously used code.

The participants were told only that the number on the chip was their login code for the study. However, as discussed above, the codes actually determined the treatment group to which each participant was assigned. Participants who logged in with codes ending in “00” received the full-page version of the BWPP tutorial, while those logging in with codes ending in “25” received the partial-page version.

*Random Selection for Post-Session Interviews*

Once participants were assigned to their treatment groups, another drawing was conducted to select one of the participants in that study session for the post-session interview. (If there was only one participant in a study session, he or she would be selected for the interview by default.)
For this drawing, one chip was placed into a small white bag for every participant in the study session. The chips were uncoded, with only one being red and the rest blue. So, for example, if there were three participants in a study session, the bag would contain one red and two blue chips. The bag was shaken vigorously for a moment, after which participants took turns drawing a chip out of the bag. Whichever participant drew the red chip would be interviewed following his or her completion of the BWPP tutorial. After the drawing the red and blue chips were retrieved from the participants.

*Informed Consent*

Once the interview selection was finished, the participants were told to sit at one of the computer workstations and to log into the study site using the code on their white chip. The participant slated for the post-session interview, however, was instructed to replace the first digit of the code (which was always a one) with a nine. Doing so would cause that person’s record in the study database to be flagged as an interviewee. It also triggered a pop-up message to appear at the end of that person’s computer session, reminding him or her that they were slated to be interviewed.

The first thing presented to participants after logging in was a consent to participate form. The consent form gave the short title of the study, the study’s Institutional Review Board status, and outlined the purpose of the study, the benefits for those participating in the study, compensation for the study, confidentiality and the use of data collected, and the consequences for not participating in the study, which was simply that they would not receive the benefits as described on the form. (See Appendix G for the contents of the consent form.) Participants were instructed to read the contents of the
form, then to click “yes” if they wished to participant in the study or “no” if they declined to participant. All participants who showed up for their scheduled study session consented to participate in the study.

*The Web Skills Assessment Program (WSA)*

After the consent form, participants completed the WSA program, which will be described later in this chapter. The initial screen told participants that the program was designed to “interact” with them by name, then instructed them to create a code name (i.e., something other than their real names so as to maintain their anonymity). The WSA program collected data on participant gender, age, prior level of HTML awareness (i.e., what it is and what it is used for), and experience using HTML. It also generated data on how well participants performed the various tasks presented to them during the program.

It is important to note that, unlike the BWPP tutorial, there was only one version of the WSA program. Thus, all participants experienced the exact same WSA program, regardless of which treatment group they were assigned to.

*The Basic Web Page Programming Tutorial (BWPP)*

Immediately upon completion of the WSA program, participants were automatically taken to the BWPP tutorial, which is also described in detail later in this chapter. Participants’ experience of this program varied according to which of the two treatment groups they had been randomly assigned.

Those assigned to the full-page condition could see the entire program interface at once, meaning that all navigation controls and features of the program could be accessed
without having to scroll down. Of course, this arrangement limited the amount of
instructional content that could be displayed on a page, resulting in more pages per
section than the partial-page version. Clicking forward (or back) through the pages of the
program was analogous to turning pages in a book.

Participants assigned to the partial-page version of the BWPP tutorial saw a
similar interface in terms of how the controls and features of the program were
configured. The only difference in this version of the tutorial was that a good deal more
instructional text was presented on a page, relative to the full-page version. This resulted
in fewer pages per section, but required the participant to scroll down each page in order
to view all of the page’s contents, as well as the program’s navigational controls and
features menu.

Participants of both versions ran into a few program errors, requiring them to
perform a task in order to correct the error and get the program “back on track.” For
instance, after clicking on to the next page in the Images section, they were met with an
error message stating that the image on the page could not be found and instructing them
to notify the system administrator by clicking on the “Send Email” button at the bottom
of the page. Such errors were intentionally programmed into the courseware in an effort
to force participants to utilize features of the program that they might not otherwise use
during the course of the program, such as the “Previous” (page) button or the “Send
Email” button. These errors were interspersed through the BWPP tutorial at the same
locations in each of the two versions.

The purpose of these manipulations was to give participants a fuller experience of
the program interface to reflect upon when answering the satisfaction survey and/or post-
session interview questions. Because introducing errors into the program flow risked biasing participants against the program, the number of these designed errors was very limited.

Following the five content sections and the review section of the program, participants completed the final exam. However, participants were required to complete the satisfaction survey before learning their exam score in an effort to mitigate any effect the exam score might have on their answers to the survey. All participant exam and satisfaction data were entered into their respective database records. As discussed earlier, the exam score was the performance measure, and the satisfaction survey the primary measure of learner satisfaction for this study.

Upon completion of the BWPP tutorial, participants not slated for the post-session interview were given $20.00 in cash and asked to sign a payment receipt. They were thanked for their participation, then dismissed. Their coded white poker chips were taken out of circulation by placing them in a box.

The participant who was selected for the post-session interview remained in the computer lab. If this participant finished the BWPP tutorial before any of the other participants in that session, the interview was conducted just outside the lab in an adjacent alcove. Otherwise, the interview was conducted in the lab itself. The next section describes the interview process.

*The Post-Session Interview*

All interviews were conducted by this researcher in the same manner, conforming to the question order in the interview guide described later in this chapter (see Appendix
The interview format was semi-structured, allowing for follow-up questions to informant’s comments. No time limit for the interview was set.

The interview was recorded on a digital audio recorder. Each interview was prefaced with the date of the interview and the informant’s user ID code off of his or her white poker chip. This was to maintain the anonymity of the informant, but also provided a means for matching the interview with that person’s session data record in the study database, which allowed for cross-referencing during the analysis process.

Upon conclusion of the interview, the informant was given $20.00 in cash and asked to sign a payment receipt, after which he or she was dismissed. The digital audio file of the interview was transferred to this researcher’s desktop computer. The original audio file on the digital recorder was then erased.

Confidentiality and Use of Data Collected for This Study

None of the data generated by any of the participants in this study could be identified with a particular individual in any way. The six-digit login/user ID code with which participants logged into the study site was the only unique identifier for all data entered into the study database or recorded in a digital audio file. Those codes had absolutely no connection to any participant’s identity.

The data generated from this study were accessed only by this researcher, one research assistant, and members of this researcher’s doctoral committee on an as-needed basis. Neither the research assistant nor the doctoral committee members could identify any participant of this study based on the data to which they had access.
The primary use of the participant data collected during this study was for the writing of this dissertation report, although the data may be published in other venues in the future. All study data will be retained by this researcher on a CD-ROM indefinitely.

Finally, confidentiality of participant identity and data extended, as well, to all data collected during the three pilot studies preceding the main study.

Data Collection Instruments

The variables of interest to be measured in this study were learner performance and learner satisfaction. Learner performance was measured as the score on the BWPP tutorial’s final exam, while a satisfaction survey was the primary instrument used to measure learner satisfaction. Post-session interviews were conducted with 59 study participants, generating some additional satisfaction-related data, as well as some perceptual data pertaining to elements of learning through Web-based instructional programs.

Other, primarily demographic, data were also collected for each participant at the beginning of his or her study session. More specifically, gender, age, prior awareness of HTML (i.e., what it is and what it is used for), level of experience using HTML, and length-of-session data were collected during each study session, although not originally with the intention of using any of it for analysis purposes. Instead, these data were originally intended as a second-level check for each participant’s suitability for the study; in other words, as a control for variability in outcome due to differing levels of participant Web skills and experience with HTML. In the end, because of the multiple self-report mechanisms, it was deemed unnecessary to use these data as a filtering
mechanism for participant suitability. Nevertheless, the demographic data did prove to be useful in, among other things, determining the equivalence of the two treatment groups.

The following subsections discuss the instruments used to measure each of these data points, beginning with the variables of primary interest first.

**Participant Demographics – The WSA Program**

The Web Skills Assessment program (WSA) as a data collection instrument cannot be dealt with in as straightforward a manner as the other instruments employed in this study. It is, essentially, an historical artifact from a previous incarnation of this study. As such, it requires some context and a bit of a preface.

The WSA program was developed by this researcher originally as a primary filter for participant suitability for the first pilot study conducted in April and May of 2004. It consisted primarily of a set of questions and tasks representing some of the basic concepts and activities with which one possessing functional Web skills (and, by extension, functional computer skills) should be familiar.

The Web concepts and skills targeted in the WSA program are familiarity with Web forms and Web form elements, point and click mouse skills, the ability to navigate among, orient oneself within and manipulate multiple open windows, and familiarity with scrolling. Asking for participants to enter their gender and age was simply as a convenient way of having participants interact with form radio buttons and textboxes.

The WSA concludes with two questions pertaining to participants’ level of familiarity with the topic covered in the study’s main tutorial, which, as was mentioned earlier, was originally the GAF tutorial. It also entered the session start time for
participants into their respective database records, which was used to help compute how long it took them to complete their study session (i.e., their length-of-session data). (See Appendix I to view the WSA instrument.)

The original idea was to have all prospective study participants complete the WSA program before being allowed to participate in the study. Only those who performed adequately on the WSA or those that indicated little or no familiarity with and/or experience using the GAF were to be allowed to participate in the study. However, before a grading rubric for the WSA could be developed and implemented, it was decided that the process of having prospective participants show up at the study lab with no guarantee they would be allowed to participate would probably be an ineffectual way to recruit study participants.

Even though the idea to use the WSA as a control for Web skills and familiarity with the GAF was dropped, it was left in the study protocol primarily because it had already been integrated into the study Web site and would take too much time to programmatically untangle and remove it. This decision was made more palatable by its virtues of being a very short program and harmless to the rest of the study. The fact that it collected data that might prove to be useful later was considered a potential bonus. When the GAF tutorial was replaced by the BWPP tutorial, it was a simple matter to modify the WSA’s last two questions to refer to the topic of HTML.

For this study, then, the WSA provided the demographic data of gender, age, questions prior awareness of HTML (i.e., what it is and what it is used for), and experience using HTML. While these demographic data were not originally intended to be nor specified as variables of interest for analysis purposes, their collection did allow
for the investigation of several other interesting relationships, such as exam score by HTML experience.

Finally, despite the fact that the “Web Skills Assessment” moniker might imply that it was designed to measure participants’ level of Web skills, the WSA was never used as a measurement instrument. Therefore, there is no validity or reliability report to offer for this instrument.

**Learner Performance – The BWPP Exam**

The measure for learner performance in this study was participants’ scores on the BWPP exam. It should be noted here that using the BWPP exam score as the study performance measure was, perhaps, a less direct way of gauging whether or not participants actually learned the material. A more direct measure would have been to have participants actually construct a Web page upon the completion of the tutorial and score it according to an established rubric. However, doing so would have been quite problematic and ultimately impractical. It would have required that the scoring of the task be carried out either by the BWPP tutorial, the programming of which was beyond the capabilities of the researcher, or by the researcher, which would have extended the already lengthy session time to an unreasonable duration.

The BWPP tutorial was a replacement for the original WBT program used in the first pilot study conducted in April and May 2004 (see Appendix B for more information). Whereas, the original WBT program involved highly subjective decision-making during its exam, producing highly unreliable data, the BWPP courseware
provided a tutorial on a fairly straightforward topic, with the promise of generating much more reliable data.

The BWPP tutorial used in this study was actually a much pared-down version of a CBI program entitled, *Internet Programming* (IP), that was developed by Tina Majchrzak for her 2001 dissertation research with undergraduate students in an instructional technology program (Majchrzak, 2001). The IP program’s selection as a replacement for the original WBT program was due in large part to the solid reliability coefficient (r = .81) of its posttest.

The intact IP content proved to be too extensive and, thus, time-prohibitive for the purposes of this study. Therefore, with the permission of Dr. Majchrzak, this researcher culled out certain sections of the IP courseware to create a much shorter program focusing solely on how to create a very basic Web page using HTML. By the end of the development process, the tutorial component of the BWPP tutorial consisted of only five of the IP’s courseware’s original 15 sections: Introduction to HTML, The HTML Document Structure, Logical and Physical Tags, Lists, and Images. (See Appendix J for a more detailed description of the BWPP tutorial.)

Because the tutorial portion of the BWPP tutorial represented only five of the IP courseware’s original sections, the final exam for the program had to be adjusted accordingly. Only 15 of the 36 IP posttest questions related to the five sections in the BWPP tutorial. A reliability test of Majchrzak’s study data on those 15 questions yielded a rather marginal Cronbach’s alpha of .68. At the suggestion of Dr. Majchrzak, three of her study’s retention test questions (all relating to the BWPP tutorial content) were added to the 15 posttest questions, and another reliability test was conducted for her study data.
The Cronbach’s alpha calculated for all 18 questions combined was a more respectable .72, which was a defensible reliability coefficient for an 18-item instrument intended to measure learner performance.

Thus, the BWPP final exam consisted of 18 multiple choice items pertaining only to the five content sections of the BWPP tutorial. Each of the test questions had four possible answers to choose from. A score of 78% (i.e., at least 14 out of 18 questions answered correctly) was considered to be a passing score. This exam score was used to measure the participant performance in this study.

Finally, the BWPP exam was administered in the exact same format as the rest of the BWPP tutorial, respective to the two screen design treatments. The exam items were constructed in the exact same way and followed in the same order for both the full-page and partial-page treatment groups. The only difference between the treatment conditions was that for the full-page group each exam item was presented one-at-a-time on separate non-scrolling pages, whereas all 18 items were displayed on the same, scrollable page for the partial-page group. The final exam items can be viewed in Appendix K.

Since the purpose of this study was to compare the learner performance and satisfaction effects of two different Web-based training screen designs, two versions of the BWPP tutorial were constructed. The first version produced was a full-page design, where no vertical scrolling was required in order to see the entire page content. Once the full-page version was validated, a partial-page version was then constructed. Every effort was made to insure that the partial-page version was the operational (e.g., its feature set and navigation set) and content equivalent to the full-page version. The only difference was that it provided more instructional content per page by coalescing a number of the
full-page version pages into a single page. This, of course meant that one had to scroll down an indeterminate amount in order to view all a page’s content and/or features. For a graphic comparison of the two versions, see Appendix A.

Validity. The validity of the scores from this instrument as an acceptable measure of performance rests on the precedent of Majchrzak’s IP posttest. In her dissertation, she documents in detail the process by which she established the validity of the IP posttest (Majchrzak, 2001, pp. 55-60). Given that all 18 items of the BWPP final exam were taken verbatim from Majchrzak’s IP posttest and that each of the BWPP tutorial’s five content sections were represented in the exam, it was reasonable to assume that the BWPP exam inherited the construct and content validity of the IP posttest.

The tutorial and exam components of the BWPP tutorial were reviewed by Dr. Majchrzak throughout the development process, with her providing a good deal of valuable editorial and design input. When the BWPP tutorial was finally complete, Dr. Majchrzak communicated her satisfaction with the program’s fidelity to her original IP content, as well as her opinion that the BWPP courseware constituted a coherent, well designed instructional program on basic Web page programming using HTML. The contents of her email containing her approval can be found in Appendix L.

In addition to Dr. Majchrzak’s positive assessment of the BWPP tutorial, a content analysis of the tutorial was conducted by five independent reviewers: two instructional technology faculty members and three advanced instructional technology doctoral students. All of these reviewers had expertise in instructional design and four had expertise in using HTML to create Web pages. All reviewers agreed both that the
BWPP tutorial adequately represented the domain of Web page construction using HTML and that the final exam sufficiently sampled the tutorial content. Therefore, the BWPP tutorial final exam was found to be acceptable as an instrument for measuring learner performance in this study.

With the validity of the full-page version already established, the partial-page version was subjected only to a verification review. This process involved three independent reviewers, with its purpose being to verify that the organization, structure, instructional content (i.e., text, graphics and interactions), final exam items, and supplemental features of the two versions were exactly the same. Since the Learner Satisfaction Survey was integrated into the tutorial, its items were also reviewed.

The verification was performed by having each reviewer go through both versions of the BWPP tutorial simultaneously and note any discrepancies. This was accomplished via a workstation that had been outfitted with two computers, each set up to run one of the two versions. Upon completion of the review, all three reviewers verified that the two versions of the tutorial were identical except for the amount of text presented on a page.

**Reliability.** Apart from the reliability test using Majchrzak’s study data described above, two other reliability tests of the BWPP exam were conducted. The first test was performed on data from the 12 participants who took part in the pilot study conducted during January 2005. At that time, the tutorial component of the BWPP tutorial included a sixth section on creating tables in a Web page, and the exam consisted of 22 items, reflecting the expanded curriculum. With the exception of the satisfaction survey, the study design was the same as for the main study. After eliminating the four questions...
relating to tables, a Cronbach’s alpha of .75 was computed for the remaining 18 test items.

After modifications to the satisfaction survey were completed (see Appendix B for more information about these modifications), a third, 10-participant pilot study was carried out during March and April of 2005. The Cronbach’s alpha for that pilot’s exam data was calculated as .75. With reliability coefficients of .72, .75, and .75 across three separate samples of participants, it was concluded that the BWPP exam score reliability was fairly stable and of sufficient magnitude to warrant its use in the main study.

Learner Satisfaction – The Learner Satisfaction Survey

Learner satisfaction was measured primarily by an online 10-item, self-report of their attitude toward the design of the BWPP tutorial which they had just completed. Each survey item was constructed as a concise, positively phrased statement that characterized either the program design using an adjective or (e.g., “The program design was user-friendly”) or the participant’s general disposition toward the program design (e.g., “I liked the way the program was designed”). Participants were asked to rate their level of agreement with each statement on a five-point Likert scale, with one being strongly disagree and five being strongly agree (see Appendix M for all 10 items). Participants also had the option to submit comments for each of the survey items, as well as submit final comments regarding any aspect of the program interface.

The satisfaction survey was strategically integrated into the study session protocol as a requirement for completion of the WBT program. It was presented to participants immediately after all their exam answers had been submitted, but before they were given
their exam scores. The perceived benefits of this arrangement included not only an assurance that each participant would complete the survey, but also that a participant’s reported level of satisfaction would not be influenced by his or her exam score.

Taken as a whole, the survey instrument was designed to elicit only participants’ overall level of satisfaction with the BWPP tutorial design. The survey items pertained, essentially, only to a general characterization of the program design, rather than to any specific feature of the program design, such as the presence or absence of scrolling or the amount of instructional text displayed on a page. The goal was to generate a measure that could be used to detect any significant differences in satisfaction level between the groups. A more pointed inquiry into participants’ perceptions regarding the impact of program design on learner satisfaction (and performance) was reserved for the post-session interviews, which will be discussed below.

Finally, like the BWPP exam, the construction and order of the satisfaction survey items were identical for both treatment groups, with the only difference being that each survey item was presented on a separate page for the full-page group, whereas all 10 items were displayed on the same page for the partial-page group.

*Validity.* The validity of the satisfaction instrument for this study was established through four independent content analyses. Two university faculty members with instructional design and two advanced instructional technology doctoral students with substantial real-world experience in designing instructional courseware were asked to assess the content validity of the satisfaction survey. At least three of the four reviewers
had considerable experience in constructing survey instruments. No changes were made to the satisfaction survey based on their reviews.

*Reliability.* The reliability of scores obtained from the satisfaction survey was established from the results of the pilot study conducted during March and April of 2005. An analysis of the pilot data yielded a Cronbach’s alpha of .89 for this instrument.

*The Post-Session Interview*

One participant from each study session was randomly selected for a post-session interview. As a result, 59 interviews were carried out during the course of this study, each one conducted by the study’s principal investigator. All interviews were recorded on a digital audio recorder and transferred to a desktop computer, with each audio file’s name consisting of that participant’s study session userid code and the interview date (e.g., 314225_[05-05-23].wav). The random selection process and the interview protocol are described later in this chapter.

The interview was semi-structured, progressing through a series of ordered questions, but allowing the interviewer to pose follow-up questions. The questions revolved around the following:

1. Whether or not the participant liked the interface design of the BWPP tutorial

2. The participant’s perceptions pertaining to the impact a WBT’s screen design might have on learner performance and/or satisfaction.
3. The participant’s preferences regarding the amount of text displayed on Web pages; especially, instructional Web pages.

4. The participant’s perceptions regarding the impact scrolling in a WBT program might have on learner performance and/or satisfaction.

5. The participant’s preferences with regard to scrolling in WBT programs.

A list of the interview questions can be found in Appendix H.

Each question was presented in two-parts, with the first part phrased as a closed-ended question (e.g., “Overall, did you like the program interface of this instructional experience?”) and the second part being a request for the participant to elaborate on their answer to the first part.

The interviews solicited participant perceptions and preferences regarding the primary research questions posited in this study; specifically whether or not the interface design of WBT programs has an appreciable impact how well students learn the instructional content of the program and/or how satisfying the instructional experience is.

Whereas the issue of scrolling in a WBT program - a prominent feature of concern at the base of this study - was approached only obliquely in the BWPP tutorial and not at all in the satisfaction survey, it was given particular focus in the post-session interviews.

The audio recording of each interview was reviewed by the study’s principal investigator and transcribed into a database via a Web-based form created for that purpose (see Appendix N). The data generated during the post-session interviews were qualitative in nature. However, because the interview questions were initially presented as closed-ended questions, it was possible to categorize and codify participants’ responses to each question. The discrete responses participants gave to each question fell
into done of four categories: “no,” “yes,” “it depends,” or “no preference.” These responses were numerically coded (e.g., no = 0, yes = 1, it depends = 2, no preference = 3) and entered into the database. So coded, it became possible to conduct certain types of quantitative analyses with the interview questions.

The anecdotal aspect of the post-session interview data (i.e., participants’ explanations of their responses) provided deeper insight into participants’ perceptions and/or preferences regarding both general and specific aspects of WBT interface design. These perceptions and preferences were used to cast the results of this study’s quantitative analyses into clearer relief.

A sample transcribed interview can be found in Appendix O.

*Interview Inter-Rater Reliability Procedure*

Inter-rater reliability for the post-session interview data was established by having an independent research assistant record data for a random sample of the interviews, then conducting a cross tabulation analysis between the originally recorded interview data and the assistant’s recorded data. The procedure by which both the original and the reliability data were recorded was essentially the same: both data sets were entered while the respective rater was listening to digital audio files of the interviews, and the same database entry form was used. The only difference was that the reliability data were entered into a separate (but identical) database table. The research assistant was trained in how to enter the interview data in the database. She was also trained in how to operate the audio player computer application in tandem with the database entry form.
The participant interviews used to determine inter-rater reliability were randomly selected by first writing the userid codes for all 59 interview audio files on separate slips of paper, wadding the slips up, placing them in a shoebox, then shaking the shoebox vigorously for a few moments. The research assistant was then instructed to select 15 of the paper slips without looking. This sample of 15 interviews represented 25% of all interviews.

*Interview Inter-Rater Reliability Outcome*

The original and reliability data recorded for each interview question in the inter-rater reliability sample were cross tabulated to determine the level of agreement. This yielded a reliability ranging from 80% to 100% across all 12 interview questions, with three questions posting a 80% reliability, two question posting a 93% reliability, and seven questions posting a 100% reliability. Thus, using the percent-agreement calculation for inter-rater reliability (dividing the number of total observations by the total number of agreements between the original and reliability raters) yielded an average reliability of 93.8%. On this basis, it can be concluded that the originally recorded interview data were reliable.

*Data Analysis*

This study generated data that enabled an analysis of the two primary research relationships of concern in this study: the impact a WBT program’s screen design might have on learner performance and the impact a WBT program’s screen design might have on learner satisfaction. Data on participant performance were collected as percent scores
on the BWPP tutorial’s final exam. Participant satisfaction data were collected as five-point Likert scale ratings for each of 10 survey items pertaining to participants’ level of satisfaction with the program design. The 10 satisfaction survey responses were combined to give a single satisfaction measure (i.e., the mean of the 10 responses). The satisfaction survey also generated some qualitative data regarding participant satisfaction in the form of optional comments submitted by a number of participants.

In addition, a post-session interview conducted with a randomly selected subset of study participants yielded some perceptual data regarding the impact a WBT program’s screen design may or may not have on learner performance and satisfaction, as well as preference data pertaining to the two screen designs of interest (i.e., full-page and partial-page). This information allowed for a keener insight into participants’ attitudes, beliefs, and preferences regarding WBT screen design, whether or not it has any impact on learner performance and/or satisfaction, and, if so, in what ways and to what degree. Participant interview responses were also coded in such a way as to allow for some quantitative analyses to be conducted on the data.

Although no other relationships were specifically targeted for analysis in this study, other data collected incidental to the main thrust of the study allowed for additional investigations. In particular, gender, age, prior awareness of HTML (i.e., what it is and what it is used for), experience using HTML, and length-of-session data provided opportunities to explore their relationship to the two primary dependent variables of learner performance and learner satisfaction.

The two primary questions investigated in this study are reiterated below, along with the particular analysis methods employed to investigate them:
1. Is there a significant difference in performance between learners using a scrolling, partial-page WBT and those using a non-scrolling, full-page WBT design? An independent t-test was employed to investigate if WBT screen design had any significant impact on learner performance, with the dependent variable being the BWPP tutorial exam score.

2. Is there a significant difference in satisfaction between learners using a partial-page WBT and those using a full-page WBT design? An independent t-test was also used to look at the relationship between WBT screen design and learner satisfaction. The dependent variable for this analysis was the mean of satisfaction survey responses.

In addition to these two primary study questions, two other lines of investigation were also pursued. One was the possible effects of several variables (gender, age, prior awareness of HTML, experience using HTML, and total session time) on both the BWPP exam score and satisfaction level, for which a multiple regression was performed. The other was a chi-square analysis of the coded post-session interview data to see if a significant difference existed between how each treatment group responded to the questions. The next chapter presents the results of these analyses.
Chapter Four – Results

Introduction

This chapter provides the results of the analyses conducted on the data generated during this study. Descriptive statistics of the two treatment groups are provided first. This is followed by the analysis results for the two primary research questions posited by this study: is there a significant relationship between WBT screen design and (a) learner performance and/or (b) learner satisfaction. After that, the possible effects of several variables (gender, age, prior awareness of HTML, experience using HTML, and total session time) on both the Basic Web Page Programming (BWPP) exam score and satisfaction level are explored. The chapter concludes with an analysis of the results of the participant responses elicited during the post-session interviews.

Performance and satisfaction data analyses are based on the participation of 129 undergraduate students who were randomly assigned to two conditions of WBT screen design: full- and partial-page screen design. Finally, an alpha level of .05 was used for all statistical tests.

Equivalence of the Two Treatment Groups

The 129 undergraduate students who participated in this study were randomly assigned to two conditions of WBT screen design: full- and partial-page screen design. The two treatment groups appeared to be very similar across all variables tested. There
were no significant differences between these the two groups for any of the demographic variables of gender, age, prior awareness of HTML (i.e., what it is and what it is used for), or Experience using HTML. The same can be said for total session time. More to the point of this entire study, there did not appear to be any significant differences between the treatment groups in terms of BWPP exam score and satisfaction. Each of these factors will be considered in turn.

**Gender Equivalence**

The percentage of participants of each gender did not significantly differ by treatment group, $\chi^2(1, N = 129) = 0.65$, $p = .42$. A small effect size of 0.14 was found for the difference in gender between treatment groups. Table 4 shows the result of a chi square test of independence for gender by treatment group.

Table 4

**Gender by Treatment Group**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Total Group $N = 129$</th>
<th>Full-Page $n = 65$</th>
<th>Partial-Page $n = 64$</th>
<th>$\chi^2$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>44 (34.1%)</td>
<td>20 (30.8%)</td>
<td>24 (37.5%)</td>
<td>0.65</td>
<td>.42 ns*</td>
</tr>
<tr>
<td>Female</td>
<td>85 (65.9%)</td>
<td>45 (69.2%)</td>
<td>40 (62.5%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ns = not statistically significant ($p > .05$).

**Age Equivalence**

Treatment groups did not differ significantly by age, $t(127) = 1.33$, $p = .19$, with the difference representing a small (0.21) effect in the direction of the full-page group. Table 5 reports the means and standard deviations for age grouped by treatment group.
Table 5

**Age by Treatment Group**

<table>
<thead>
<tr>
<th>Treatment Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-Page</td>
<td>65</td>
<td>22a</td>
<td>6.16</td>
<td>1.33</td>
<td>127</td>
<td>.19 ns*</td>
</tr>
<tr>
<td>Partial-Page</td>
<td>64</td>
<td>21a</td>
<td>2.96</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. In years rounded to the nearest year.

* ns = not statistically significant (p > .05).

**Prior HTML Awareness Equivalence**

There was also no significant difference between treatment groups regarding prior HTML awareness, $\chi^2(1, N = 129) = 3.46, p = .06. A small effect size of 0.33 was found for the difference in prior HTML awareness between treatment groups. Table 6 shows the result of a chi square test of independence for prior HTML awareness grouped by treatment group.

Table 6

**Prior HTML Awareness by Treatment Group**

<table>
<thead>
<tr>
<th>Prior HTML Awareness</th>
<th>Total Group</th>
<th>Full-Page</th>
<th>Partial-Page</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>75 (58.1%)</td>
<td>43 (66.2%)</td>
<td>32 (50%)</td>
<td>3.46</td>
<td>.06 ns*</td>
</tr>
<tr>
<td>Yes</td>
<td>54 (41.9%)</td>
<td>22 (33.8%)</td>
<td>32 (50%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. In years rounded to the nearest year.

* ns = not statistically significant (p > .05).

**HTML Experience Equivalence**

With regards to HTML experience, only 18 (14%) of study participants reporting they had some level of experience using HTML. The decision was made to collapse the four categories of experience into a single group, called *some experience*, and compare it to the group who had no experience. A chi square was conducted, resulting in finding no
significant difference in HTML experience between treatment groups, $\chi^2(1, N = 129) = 0.001, p = .97$. A very small effect (0.01) was calculated. Table 7 shows the result of a chi square test of independence for HTML experience grouped by treatment group.

Table 7

<table>
<thead>
<tr>
<th>HTML Experience by Treatment Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTML Experience</td>
</tr>
<tr>
<td>No experience</td>
</tr>
<tr>
<td>Some experience</td>
</tr>
</tbody>
</table>

* ns = not statistically significant ($p > .05$).

**Total Session Time Equivalence**

There was also no difference in the two treatment groups with regards to the amount of time it took to complete the study session, $t(127) = 0.56, p = .58$. A small effect size (0.10) was calculated for the session time difference between treatment groups. Table 8 shows the result of an independent t-test of total session time by treatment group.

Table 8

<table>
<thead>
<tr>
<th>Total Session Time by Treatment Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Groups</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Full-Page</td>
</tr>
<tr>
<td>Partial-Page</td>
</tr>
</tbody>
</table>

* $a$ In minutes.
* $ns = not statistically significant ($p > .05$).
Conclusion Regarding Equivalency of Treatment Groups

With no significant differences between the treatment groups on the demographic variables or with total session time, it appears that the procedure for randomly assigning participants to the treatment conditions resulted in groups that evidenced no statistically significant differences. Since equivalency in treatment groups tends to mitigate the effects of any threats to internal validity that might exist, any differences found regarding learner performance and/or satisfaction can be reasonable attributable to WBT screen design with a high degree of confidence.

The BWPP Exam Score and Satisfaction Level

A correlation analysis was conducted to gauge the relationship between BWPP exam score and satisfaction level for all participants combined. The correlation coefficient for the BWPP exam scores and satisfaction level was found to be significant ($r = .22, p = .01$), with exam scores sharing about 5% of its variability with satisfaction level ($R^2 = .05$). This suggests that, across both treatment groups, participants with higher exam scores tended to express higher levels of satisfaction.

When this relationship was examined within the full-page and partial-page treatment groups separately, the correlation coefficients in both groups were similar, although non-significant ($r = .21, p = .09$ and $r = .22, p = .09$, respectively).

One thing to keep in mind here is that participants did not see their exam score until after they had completed the satisfaction survey. Therefore, whatever else may be concluded about the relationship between participant exam score and satisfaction level, it
cannot be said that participants’ satisfaction level was attributable to having known how well they did on the BWPP final exam.

Learner Performance Effects

Data on participant performance were collected as percent scores on the BWPP tutorial’s final exam. An independent t-test was employed to determine if a significant difference existed between the exam score means of the two treatment groups: full-page and partial-page. The t-test yielded a non-significant t-value, $t(127) = -0.834, p = .41$; thus, the null hypothesis for this research question cannot be rejected. A small effect size (0.15) was calculated in favor of the partial-page group. Table 9 provides more detail regarding this test result. While the partial-page group performed, on average, slightly higher on the BWPP exam than the full-page group, this difference was not significant.

Table 9

<table>
<thead>
<tr>
<th>Treatment Groups</th>
<th>N</th>
<th>$M$</th>
<th>$SD$</th>
<th>$t$</th>
<th>$df$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-page</td>
<td>65</td>
<td>69.25</td>
<td>17.01</td>
<td>-0.83</td>
<td>127</td>
<td>.41 ns*</td>
</tr>
<tr>
<td>Partial-page</td>
<td>64</td>
<td>71.81</td>
<td>17.93</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ns = not statistically significant ($p > .05$).

Learner Satisfaction Effects

Participant satisfaction data were collected as five-point Likert scale ratings for each of 10 survey items pertaining to participants’ level of satisfaction with the program design. A mean rating for the 10 survey items was computed and an independent t-test was conducted to test the hypothesis that there would be a significant difference in
satisfaction level between learners in the two treatment groups. However, this test also resulted in a non-significant t-value, $t(127) = -1.293$, $p = .20$, with a small effect size (0.22) calculated in the direction of the partial-page group. Table 10 provides more detail regarding this test result.

Table 10

<table>
<thead>
<tr>
<th>Treatment Groups</th>
<th>$N$</th>
<th>$M$</th>
<th>$SD$</th>
<th>$t$</th>
<th>$df$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-page</td>
<td>65</td>
<td>4.09</td>
<td>0.51</td>
<td>-1.29</td>
<td>127</td>
<td>.20 ns*</td>
</tr>
<tr>
<td>Partial-page</td>
<td>64</td>
<td>4.20</td>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* ns = not statistically significant ($p > .05$).

Secondary Relationships

The demographic and length-of-session data generated incidental to the study’s primary data collection allowed for the testing of several other secondary relationships of possible interest. Multiple regression was used to examine the possible effects of several variables on both the BWPP exam score and satisfaction level. The variables used as predictors were treatment group, gender, age, prior awareness of HTML, experience using HTML and total session time. Multicollinearity was not an issue, as none of the predictor variables was highly correlated. Correlations ranged from -.134 (gender with age) to .164 (treatment group with prior awareness of HTML).

The possibility of interactions between each predictor variable and treatment group was explored for both the exam score and satisfaction. For the exam score, when the interactions of each predictor with treatment were added to the main model, the change in $R^2$ ranged from 0% to less than 2%. For satisfaction, the change in $R^2$ for each
added interaction was less than 1%. None of these interactions was found to be statistically significant, and therefore only the main effect models for the exam score and satisfaction are reported here.

The six predictor variables of treatment group, gender, age, prior awareness of HTML, HTML experience and total session time explained 20.6% of the variance in the exam scores, \( F(6,122) = 5.281, p = .000 \). Using the beta coefficient, which statistically controls for the other variables in the model, age was a significant predictor of scores \((\beta = -0.166, p = .048)\), with scores decreasing with age. Prior awareness of HTML was also a significant predictor of score \((\beta = 0.295, p = .001)\), indicating that those with some level of awareness were more likely to score higher on the exam. Experience in using HTML was another significant predictor \((\beta = -0.191, p = .022)\), with lower scores associated with higher levels of reported experience. Total session time was yet another significant predictor \((\beta = 0.255, p = .002)\), with higher scores accompanying more time taken in the study session. Treatment group and gender were the only two non-significant predictors in this model.

As for satisfaction, the same six predictor variables explained 13.9% of the variance in satisfaction levels, \( F(6,122) = 3.290, p = .005 \). Here, again focusing on the beta coefficient, only two variables were found to be significant predictors: gender \((\beta = 0.220, p = .011)\) and prior awareness of HTML \((\beta = 0.191, p = .029)\). Females generally reported higher levels of satisfaction than did the males in this study. And like exam scores, having some awareness of HTML was associated with greater satisfaction levels. All other variables tested were non-significant predictors. Table 11 shows the results of the multiple regression analysis.
Table 11

Multiple Regression Results of Both Exam Score and Satisfaction Level (N = 129)

<table>
<thead>
<tr>
<th>Predictor Variables</th>
<th>BWPP Exam Score</th>
<th>Satisfaction Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R² = 0.206</td>
<td>R² = 0.139</td>
</tr>
<tr>
<td></td>
<td>β</td>
<td>t</td>
</tr>
<tr>
<td>Treatment group</td>
<td>0.020</td>
<td>0.237</td>
</tr>
<tr>
<td>Gender</td>
<td>0.006</td>
<td>0.073</td>
</tr>
<tr>
<td>Age</td>
<td>-0.166</td>
<td>-1.995</td>
</tr>
<tr>
<td>Prior HTML awareness</td>
<td>0.295</td>
<td>3.563</td>
</tr>
<tr>
<td>HTML experience</td>
<td>-0.191</td>
<td>-2.329</td>
</tr>
<tr>
<td>Session time</td>
<td>0.255</td>
<td>3.106</td>
</tr>
</tbody>
</table>

Note. * ns = not statistically significant (p > .05).

Post-Session Interviews

Fifty-nine of the 129 study participants were randomly selected for post-session interviews. The random selection procedure for the post-session interview is described in Chapter Three.

Of the 59 participants interviewed, 24 (41%) were male, ranging in age from 19 to 32 years (M = 22.83, SD = 3.32) and 35 (59%) were female, ranging in age from 18 to 26 years (M = 20.66, SD = 1.91). The demographic make-up of interviewees split by treatment group is provided in Table 12. Thirty-two (54%) of this group reported having no prior awareness of HTML and 53 (90%) said they had no experience in using HTML. Table 13 shows how the treatment groups were split in terms of HTML awareness and experience.
Table 12

Post-Session Interviewees’ Gender and Age Split by Treatment Group

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Gender</th>
<th>N</th>
<th>Range in Years</th>
<th>Age</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-Page</td>
<td>Male</td>
<td>10</td>
<td>20 - 30</td>
<td></td>
<td>22.80</td>
<td>2.82</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>17</td>
<td>18 - 23</td>
<td></td>
<td>20.47</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td>Combined</td>
<td>27</td>
<td>18 - 30</td>
<td></td>
<td>21.33</td>
<td>2.30</td>
</tr>
<tr>
<td>Partial-Page</td>
<td>Male</td>
<td>14</td>
<td>19 - 32</td>
<td></td>
<td>22.86</td>
<td>3.74</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>18</td>
<td>18 - 26</td>
<td></td>
<td>20.83</td>
<td>2.31</td>
</tr>
<tr>
<td></td>
<td>Combined</td>
<td>32</td>
<td>18 - 32</td>
<td></td>
<td>21.72</td>
<td>3.13</td>
</tr>
</tbody>
</table>

Table 13

Post-Session Interviewees’ HTML Awareness and Experience Split by Treatment Group

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>N</th>
<th>Prior HTML Awareness</th>
<th>HTML Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Full-Page</td>
<td>27</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>Partial-Page</td>
<td>32</td>
<td>17</td>
<td>15</td>
</tr>
</tbody>
</table>

With regard to the specific responses to the interview questions, response frequencies for each of the 12 interview questions were calculated and converted into percentages. A chi-square was then conducted for each of the 12 items to determine if any significant difference existed between the responses of the two treatment groups. The
response frequencies and percentages, as well as the chi-square results for each interview question are provided in Table 14.
Table 14

**Post-Session Interview Responses for Total Group and by Treatment Group**

<table>
<thead>
<tr>
<th>Interview Question</th>
<th>Categories of Responses</th>
<th>Total Group N = 59</th>
<th>Full-Page N = 27</th>
<th>Partial-Page N = 32</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overall, did you like the program interface of this instructional program?</td>
<td>a) No</td>
<td>2 (3.4 %)</td>
<td>0</td>
<td>2 (6.3%)</td>
<td>1.75 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>57 (96.6 %)</td>
<td>27 (100%)</td>
<td>30 (93.8%)</td>
<td></td>
</tr>
<tr>
<td>2. Did the design of program interface influence whether or not you felt satisfied with (or liked) this instructional experience?</td>
<td>a) No</td>
<td>7 (11.9 %)</td>
<td>3 (11.1%)</td>
<td>4 (12.5%)</td>
<td>0.03 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>52 (88.1 %)</td>
<td>24 (88.9%)</td>
<td>28 (87.5%)</td>
<td></td>
</tr>
<tr>
<td>3. Do you think that how an instructional program’s interface is constructed has an impact on how well people like the program?</td>
<td>a) No</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.02 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>57 (96.6 %)</td>
<td>26 (96.3%)</td>
<td>31 (96.9%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>2 (3.4 %)</td>
<td>1 (3.7%)</td>
<td>1 (3.1%)</td>
<td></td>
</tr>
<tr>
<td>4. Do you think that how an instructional program’s interface is constructed has an impact on how well people learn the material?</td>
<td>a) No</td>
<td>8 (13.6 %)</td>
<td>2 (7.4%)</td>
<td>6 (18.8%)</td>
<td>4.95 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>48 (81.4 %)</td>
<td>22 (81.5%)</td>
<td>26 (81.3%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>3 (5.1 %)</td>
<td>1 (3.7%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5. Do you prefer to have an idea of how much text is on a Web page at the start before you start reading it?</td>
<td>a) No</td>
<td>16 (27.1 %)</td>
<td>9 (33.3%)</td>
<td>7 (21.9%)</td>
<td>4.50 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>39 (66.1 %)</td>
<td>17 (63.0%)</td>
<td>22 (68.8%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>1 (1.7 %)</td>
<td>1 (3.7%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>d) No Preference</td>
<td>3 (5.1 %)</td>
<td>0</td>
<td>3 (9.4%)</td>
<td></td>
</tr>
<tr>
<td>6. How do you prefer to have instructional text presented to you on a Web page: in relatively small chunks or in longer passages?</td>
<td>a) Small Chunks</td>
<td>58 (98.3 %)</td>
<td>27 (100%)</td>
<td>31 (96.9%)</td>
<td>0.86 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Longer Passages</td>
<td>1 (1.7 %)</td>
<td>0</td>
<td>1 (3.1%)</td>
<td></td>
</tr>
<tr>
<td>7. Do you find it easier to read, understand, and remember new material on a Web page if there is a limited amount of text on the page?</td>
<td>a) No</td>
<td>3 (5.3 %)</td>
<td>0</td>
<td>3 (9.7%)</td>
<td>3.45 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>46 (80.7 %)</td>
<td>21 (80.8%)</td>
<td>25 (80.6%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>8 (14.0 %)</td>
<td>5 (19.2%)</td>
<td>3 (9.7%)</td>
<td></td>
</tr>
<tr>
<td>8. Do you think the amount of scrolling involved in an online instructional program has any effect on your satisfaction level regarding the instructional experience?</td>
<td>a) No</td>
<td>31 (52.5 %)</td>
<td>12 (44.4%)</td>
<td>19 (59.4%)</td>
<td>2.84 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>24 (40.7 %)</td>
<td>14 (51.9%)</td>
<td>10 (31.3%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>4 (6.8 %)</td>
<td>1 (3.7%)</td>
<td>3 (9.4%)</td>
<td></td>
</tr>
</tbody>
</table>
Table 14 (Continued)

<table>
<thead>
<tr>
<th>Interview Questions</th>
<th>Categories of Responses</th>
<th>Total Group N = 59</th>
<th>Full-Page N = 27</th>
<th>Partial-Page N = 32</th>
<th>χ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Do you think the amount of scrolling involved in an online instructional program has any effect on how well you learn the material?</td>
<td>a) No</td>
<td>37 (62.7%)</td>
<td>12 (44.4%)</td>
<td>25 (78.1%)</td>
<td>8.52**</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>19 (32.2%)</td>
<td>12 (44.4%)</td>
<td>7 (21.9%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>3 (5.1%)</td>
<td>3 (11.1%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>10. If you wanted to find some information in the program you had read previously, would you prefer to have to scroll back up a page to find it, or to click back through the previous pages where scrolling is not required to see the pages’ content?</td>
<td>a) Scroll Back</td>
<td>17 (28.8%)</td>
<td>6 (22.2%)</td>
<td>11 (34.4%)</td>
<td>1.28 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Click Back</td>
<td>37 (62.7%)</td>
<td>19 (70.4%)</td>
<td>18 (56.3%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>5 (8.5%)</td>
<td>2 (7.4%)</td>
<td>3 (9.4%)</td>
<td></td>
</tr>
<tr>
<td>11. Do you think having to scroll down a page to view more content and/or to get to some features of an instructional program distracts you from focusing on the material?</td>
<td>a) No</td>
<td>30 (50.8%)</td>
<td>10 (37.0%)</td>
<td>20 (62.5%)</td>
<td>3.85 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Yes</td>
<td>20 (33.9%)</td>
<td>12 (44.4%)</td>
<td>8 (25.0%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) It Depends</td>
<td>9 (15.3%)</td>
<td>5 (18.5%)</td>
<td>4 (12.5%)</td>
<td></td>
</tr>
<tr>
<td>12. Given the choice in an online instructional program, do you have a preference between having to scroll down each page to view more instructional information or having to click a button to move between pages where you can see all of the page’s information at once?</td>
<td>a) Scrolling</td>
<td>9 (15.3%)</td>
<td>4 (14.8%)</td>
<td>5 (15.6%)</td>
<td>1.52 ns*</td>
</tr>
<tr>
<td></td>
<td>b) Non-scrolling</td>
<td>45 (76.3%)</td>
<td>22 (81.5%)</td>
<td>23 (71.9%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) No Preference</td>
<td>5 (8.5%)</td>
<td>1 (3.7%)</td>
<td>4 (12.5%)</td>
<td></td>
</tr>
</tbody>
</table>

Note. * Question 7 was inadvertently skipped for two (3.4 %) respondents, so N = 57 for this question.
* ns = not statistically significant (p > .05).
** statistically significant (p = .01).
Interview Question 1

Item 1 of the post-session interview asked, “Overall, did you like the program interface of this instructional program?” An overwhelming majority of the interviewees (96.6%) said they did like the program interface, with just 3.4% indicating they did not. Interestingly, both negative responses were from members of the partial-page group. A comparison of the treatment groups found no significant difference in responses for this item, $\chi^2(1, N = 59) = 1.75, p = .19$.

Reasons provided by respondents who liked the interface design of the BWPP tutorial, regardless of which treatment group they were in, revolved around its functionality (e.g., ease of navigation, overall interface design). The reasons provided by the two respondents who did not like the program were that it was a “boring” color scheme and contained insufficient text emphasis (such as color or bold). One of the two respondents, however, indicated he did not like having the program controls located at the bottom of the screen, primarily because he was used to having controls at the top of the page. When asked if having navigation buttons at the top of the program interface might tempt one to move on before reading all information on the page, he said it would, especially for novice computer users who might not even be aware there was anything further down on the page. Even so, his preference was having controls located at the top.

Interview Question 2

The second interview item asked, “Did the design of program interface influence whether or not you felt satisfied with (or liked) this instructional experience?” Again, the majority of interviewees (88.1%) responded in the affirmative, with 11.9% responding in
the negative. No significant difference in responses between treatment groups was found
\( \chi^2(1, N = 59) = 0.03, p = .87 \).

While most respondents in both treatment groups thought the program interface had an impact on their level of satisfaction with the learning experience they had just completed, the perceived strength of that impact ranged from slight (e.g., "Only to a very minor degree.") to considerable (e.g., “If it's complicated, it'll make me frustrated, and I'll just want to completely quit the program.”). Unfortunately, the seven respondents who said the interface design had no impact on their satisfaction level were not asked why they thought that was so. Interestingly, however, all seven answered the next interview question – which basically asked the same thing, but generalized the focus to other people – in the affirmative.

*Interview Question 3*

Item 3 asked, “Do you think that how an instructional program’s interface is constructed has an impact on how well people like the program?” Here, there were no negative responses, with 96.6% indicating that a WBT’s interface did have an impact on how well people liked the program itself. However, 3.4% of the respondents were equivocal, saying it may or may not depending on certain factors. No significant difference was found between the two treatment groups, \( \chi^2(1, N = 59) = 0.02, p = .90 \).

The main reasoning behind the majority opinion was that a WBT interface must be “user-friendly,” a term frequently employed by respondents. In this regard, references were made to a program’s ease of navigation. One common thrust of opinion was that anything about a program’s interface that led to a user’s frustration would negatively
impact his or her level of satisfaction with the program and the learning experience. The more time and energy one has to expend in learning and maneuvering within the program interface, for instance, the more frustrating of an experience it would likely be. From a more positive angle, several respondents indicated that, inasmuch as the interface design helps motivate or keep the person interested, it would positively impact one’s level of satisfaction. The two equivocal respondents both indicated that an individual’s personal preferences and level of familiarity with computers and the Web probably play a major role in how satisfactory they judge a WBT to be. One made a distinction between the aesthetic and functional aspects of an interface design, saying that the latter would have much more of an impact on satisfaction level than the former. Finally, as previously pointed out, it was an interesting finding that seven of the respondents who said that a program’s interface influenced how satisfied people, in general, are with a learning experience nevertheless reported that the BWPP’s interface had no impact on their personal satisfaction with the study learning experience (interview question 2).

*Interview Question 4*

Post-session interview question 4 asked, “Do you think that how an instructional program’s interface is constructed has an impact on how well people learn the material?” Here, 81.4% answered in the affirmative, 13.6% in the negative, and 5.1% saying it may or may not depending on certain factors. A comparison of the treatment groups found no significant difference in responses for this item, $\chi^2(2, N = 59) = 4.95, p = .08$, although it may be of interest to note that all three equivocal respondents were members of the full-page treatment group.
The consensus among those who think that a program’s interface design has an impact on how well people learn the program material was that the more time and energy one has to expend in learning and working with the program interface, the less focused he or she can be on the instructional material. However, there was much less consensus on how much of an impact it might have on learning, with opinions ranging from slight to heavy. Unlike opinions regarding a program’s interface impact on satisfaction, fewer respondents thought it had any influence on how well one learns the program material.

Seven respondents essentially divorced the interface from the instructional material, saying that the material was there regardless of how it was presented or accessed. One added that learning was most influenced by the quality of the instructional material. For those who were equivocal, individual preferences, interests, attributes and characteristics determine whether or not a program's interface might impact how well they learn the material. For instance, someone who easily remembers what he or she has read or who was very interested in the subject matter might remain focused on the material regardless of the clunkiness of the interface design, while another might more easily distracted by a problematic interface.

Interview Question 5

For question 5, which asked “Do you prefer to have an idea of how much text is on a Web page at the start before you start reading it?,” about two-thirds (66.1%) said they did, 27.1% said they did not, 5.1% said they had no preference, and 1.7% said it probably depended on certain factors. No significant difference was found between the two treatment groups regarding this item, $\chi^2(3, N = 59) = 4.5, p = .21$, although it should
be noted that all three respondents who reported having no preference were all in the partial-page group.

Those respondents who preferred to have some prior idea of the amount of text on a Web page indicated they wanted to be able to set their expectations for how much reading they were in for and about how much time it would take to finish the material on that page. Some said that it would also provide a measure of their progress as they read. Those who preferred not to know how much text was on a page all indicated that knowing they had a lot of text to read on a Web page ahead of time was intimidating or otherwise de-motivating and might be inclined to either skim the page or skip it altogether. As one person put it, “if it was a lot of text, I probably wouldn't read it. If I knew it was really long, I'd probably skim it, but if I didn't know how long it was, and I didn't know what was coming next I'd be more apt to just keep reading, ‘cause I wouldn't want to miss anything.” The one equivocal respondent said her preference depended on what the topic was and whether or not she was pressed time.

Interview Question 6

Interview item 6 asked, “How do you prefer to have instructional text presented to you on a Web page: in relatively small chunks or in longer passages?” All but one respondent (98.3%) said they preferred to have text presented in smaller chunks. A member of the partial-page group, the sole respondent preferring text presented in longer passages. No significant difference in responses was found between treatment groups, $\chi^2(1, N = 59) = 0.86, p = .35$. 

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Several reasons were voiced for preferring instructional text presented in small chunks rather than longer passages: it makes it more likely that one will read all of the information rather than just skim it; it makes it easier to stay focused on, interested in and/or pay attention to the material; it provides a better sense of progress (i.e., it is more positively reinforcing); it makes it easier to comprehend and absorb information; and it seems like less and/or faster reading (even though it may not be in actuality). The single respondent who preferred text presented in longer passages said he liked having more information readily available to him rather than having to navigate through menus and or more pages to get to more information.

**Interview Question 7**

Question 7, which asked, “Do you find it easier to read, understand, and remember new material on a Web page if there is a limited amount of text on the page?,” was inadvertently skipped for two of the respondents, so all results for this item reflect an N of 57. The majority of respondents (80.7%) responded in the affirmative, 5.3% answered in the negative. Eight respondents (14%) were equivocal, indicating that it depended on certain factors. No significant difference in responses was found between treatment groups, \( \chi^2(2, N = 57) = 3.45, p = .18. \)

The reasons provided by those who found limited amounts of text on a Web page easier to read, understand, and remember mirrored those provided for preferring chunked instructional text. However, three respondents, all of whom previously stated their preference for chunked instructional text, indicated that the amount of text presented on a Web page had no impact on their ability to read, comprehend or remember the page’s
material. For the eight respondents who were equivocal on this question, it depended on how interested they were in the topic and/or what type of information was being presented (e.g., straight text, interactive examples, etc.).

*Interview Question 8*

Question 8 asked, “Do you think the amount of scrolling involved in an online instructional program has any effect on your satisfaction level regarding the instructional experience?” For this item, a slim majority (52.5%) said they did not think scrolling affected their satisfaction level, while 40.7% said it did have an impact and 6.8% said it might or might not depending on certain factors. Again, there was no significant difference in responses between treatment groups, $\chi^2(2, N = 59) = 2.84, p = .24$. Even so, it is interesting to note that three of the four equivocal respondents were members of the partial-page treatment group.

For those who thought scrolling did impact their satisfaction with a WBT learning experience, some said the process of having to orient their eyes to moving lines or blocks of text required more effort to stay focused on the actual material and/or interfered with the flow and continuity of information. Others indicated that having to scroll through a body of text makes it more likely they will skim rather than thoroughly read the material. It is noteworthy, however, that none of these respondents considered scrolling to have any more than a moderate impact on their level of satisfaction; in fact, most indicated the effect on satisfaction was small. For those who found scrolling to have no impact on their satisfaction level, virtually every one said that they were accustomed to having to scroll through Web pages, with some adding that the advent of the wheel mouse made the act of
scrolling much less of an issue. It should also be noted that many of those for whom scrolling was a factor in their satisfaction level also recognized the ubiquity of scrolling on the Web. For those who gave an equivocal answer to this question, the amount of scrolling involved seemed to be key: if scrolling was limited, there was little or no impact on satisfaction level, but if the amount of material on a page required more extensive scrolling to get through, then they would be less satisfied with the learning experience. Other factors for some of these respondents were one’s level of familiarity with the Web and computers, the type of information being presented (e.g., graphics, text) and/or whether text was presented in small chunks or longer passages. Scrolling would likely have more of an effect for more novice computer/Web users and scrolling through pictures and/or chunked text was perceived as less aversive than scrolling through long passages of uninterrupted text.

*Interview Question 9*

Interview item 9 asked, “Do you think the amount of scrolling involved in an online instructional program has any effect on how well you learn the material?” The majority of respondents (62.7%) said scrolling had no impact on how well they learned the material in a WBT, while 32.2% said it did and 5.1% said it may or may not have an impact depending on certain factors. This question was the only post-session interview item where a significant difference in responses between treatment groups was found, \( \chi^2(2, N = 59) = 8.52, p = .01 \). A large effect size of 0.82 was computed, indicating that how a respondent answered this question was related to the treatment to which they were exposed. In this study, 78.1% of the partial-page group denied any scrolling effect on
learning the material in a WBT, compared to 44.4% in the full-page group. Considering the breakout of responses by treatment group in Table 14, the full-page group was essentially evenly split on the issue (44.4% for both negative and affirmative responses), although it should be noted that all three equivocal respondents were in the full-page group. Thus, participants in the partial-page group were much less likely to perceive scrolling as having any impact on how well they learned in a WBT program.

The reasoning of respondents for this item, was essentially the same as that provided for the previous question where the object of scrolling’s impact was one’s satisfaction level. However, 17 respondents (28.8%) shifted their position on the effects of scrolling when its impact was focused on learning rather than satisfaction. Of the 31 respondents who said scrolling had no impact on satisfaction, two said that it did have an impact on learning, while two others became more equivocal. Of the 24 respondents who said scrolling did not have an effect on satisfaction, a third (eight) said it had no impact on learning, while one other became more equivocal. In addition, all four respondents who were equivocal regarding the impact of scrolling on satisfaction level became more definitive when asked about scrolling’s effect on learning, with two asserting there was no effect and two saying there scrolling had no impact on learning. A slight majority of these 17 respondents (10 or 58.8%) were members of the full-page treatment group. The majority of the opinion shifts (10 or 58.8%) were in the direction of scrolling having no impact on learning, with six (60%) of these shifts occurring within the partial-page group.
Interview Question 10

Question 10 asked, “If you wanted to find some information in the program you had read previously, would you prefer to have to scroll back up a page to find it, or to click back through the previous pages where scrolling is not required to see the pages’ content?” Slightly less than two-thirds of respondents (62.7%) preferred to click back through previous pages, 28.8% preferred to scroll up on a page, and 8.5% said it probably depended on certain factors. No significant difference in responses was found between treatment groups, $\chi^2(2, N = 59) = 1.28, p = .53.$

Respondents who preferred to scroll back up to locate information on a Web page essentially considered scrolling up as more efficient than clicking back through previous pages. This efficiency was characterized in the following ways: scrolling requires less effort than clicking (especially when using a wheel mouse); scrolling up was more convenient and faster than clicking back since one does not have to leave the page he or she is already on; scrolling up the same page was functionally safer (e.g., the link for clicking back may be broken or incorrect); and, perhaps related to the previous point, lag time in the loading of previous pages was wasted time (which could greatly contribute to a less satisfying and effective learning experience). For the more equivocal respondents, their preference depended on whether or not there was a delay in the loading of previous pages and/or how far back the desired information was in the program. If there was no delay in the reloading of pages, the preference would be to click back, whereas scrolling would be preferred if there was a delay in the reloading of previous pages. There also seemed to be a positive correlation between search mode preference and how far back the desired information was; that is, clicking back would be preferred if the information was located
only a few paragraphs away (translated as a couple of pages away), whereas scrolling up was more desirable if the information was many paragraphs away.

Among those with a preference for clicking back, many thought that the act of clicking required less effort than that of scrolling (even with a wheel mouse). However, the most frequent reason given for the click back preference was the perception that it was easier to locate the information based on physical and spatial cues provided by the pages they had already read. As one respondent described it, he inherently has a “snapshot” in his mind of the page where the information was located, and when he clicks back through previous pages, he looks for the page that matches the contours of this snapshot. Thus, his first level of orientation to the information is based on an image of the page containing the information rather than on, say, a search of the text the each previous page. Another reason given, seemingly related to the issue of orientation on a page, was the possible difficulty in finding one’s place after locating the previous information. With clicking back, one has a good sense of the number of pages that were clicked back through; thus, making it a simple task of clicking forward that many pages. With scrolling up a page, however, one may have to put in more effort (e.g., skimming the text again) in finding the original stopping point.

It should be noted here that this question was, in part, intended to get at the importance of spatial orientation in electronic text, which was discussed in Chapter Two. Thus, respondents who did not broach the subject on their own were usually asked a follow-up question as to which method (scroll back or click back) better facilitated their orientation to previously read information. While all those preferring to click back indicated that method as being superior (i.e., scrolling interferes with their picture of
where the information is), all but a very few of those who preferred to scroll back reported either that it was easier for them to orient by scrolling or that they perceived no appreciable difference between the two methods.

Finally, after the conclusion of this study, it was realized that the possibility of participants using the Web browser’s *Find* feature was not anticipated or addressed in the study protocols. This was an oversight that is commented on in more detail in Chapter Five as one of the recommendations for improving the study.

*Interview Question 11*

Item 11 asked, “Do you think having to scroll down a page to view more content and/or to get to some features of an instructional program distracts you from focusing on the material?” Half of the respondents (50.8%) said that scrolling was not a distraction, while 33.9% thought it was. Of note, this question produced the greatest number of equivocal responses (15.3%). A comparison of the treatment groups found no significant difference in responses for this item, $\chi^2(2, N = 59) = 3.85, p = .15$.

The great majority of respondents who said having to scroll down an instructional Web page was not a distraction offered simply that scrolling was the prevalent method for viewing the content of Web pages. In other words, they were quite used to scrolling and did so pretty much without thinking about it. Some added that the act of scrolling was greatly facilitated by the wheel mouse. A couple of these respondents said that they did not consider the act of scrolling any less distracting than clicking a button to move through separate Web pages. Those respondents who considered scrolling to be a distraction varied in their assessment of the magnitude of that distraction, but most said it
was a minor distraction. By far, the most common reason for viewing scrolling as a
distraction was the temptation for skimming through a page, which could easily result in
missing some important information. A few of these respondents said that scrolling
required a greater effort to keep one’s place on the page because of the shifting text. For
those respondents giving a equivocal answer to this question, the amount of scrolling
appeared to be the main concern: the more scrolling required, the greater likelihood of it
becoming a distraction, as more focus might be given to just traversing the program than
the material. Finally, for those who perceived scrolling either as a definite or possible
distraction, the impact on satisfaction level was considered slightly greater than on
learning the material.

*Interview Question 12*

The final post-session interview item 12 asked, “Given the choice in an online
instructional program, do you have a preference between having to scroll down each page
to view more instructional information or having to click a button to move between pages
where you can see all of the page’s information at once?” Over three-quarters of the
respondents (76.3%) said that in the end they preferred a non-scrolling WBT interface.
Even among the partial-page group, the majority of respondents (71.9%) stated a
preference for a non-scrolling WBT interface design. Only 15.3% preferred a scrolling
format, while 8.5% had no preference. No significant difference in responses was found
between treatment groups, \( \chi^2(2, N = 59) = 1.52, p = .47. \)

Of those respondents indicating preference for a scrolling WBT screen design, the
reasons given included the following: scrolling is faster and than clicking (especially if
there each new page takes time to load); scrolling is more efficient time-wise; scrolling requires less effort than clicking (especially when using a wheel mouse); scrolling provides the user with more control over how much text is displayed (i.e., information can be scrolled through slowly, line by line versus clicking to a whole page of text; scrolling pages are technologically safer (e.g., less possibility of broken navigation links/buttons); scrolling is less distracting than clicking back; and more information can be placed on a page at once.

Those respondents preferring a full-page, non-scrolling screen design cited the following reasons: it chunks the information up, making it less intimidating and easier to absorb and digest the information; it provides a more streamlined and aesthetically pleasing instructional experience; it requires less manipulation of the mouse (i.e., less effort); it makes it more likely one will read all the information presented rather than skim through it or even skip it entirely; it suggests the instructional program was well-designed and of high quality (i.e., the perception that a full-page interface design requires more effort and thought to construct leads to the assumption that as much effort and thought went into every aspect of the program); it is easier to navigate; it is easier to remain oriented within (e.g., when returning to one’s place after looking up previously read information); and it provides a greater sense of forward progress, which translates to more motivation and satisfaction with the experience.
Chapter Five – Discussion

Introduction

This chapter first summarizes the purpose of the study, the research questions and the results obtained for those questions. A more detailed discussion of the study results follows, covering not only the primary research questions, but several secondary questions that were not originally delineated in the study proposal. This is followed by recommendations for the design of the WBT program interface, with the chapter concluding with suggestions for future research.

Purpose of the Study

The purpose of this study was to investigate whether or not the interface design of a Web-based instructional programs has an impact on how well learners learn the program material and/or how satisfied learners are with the learning experience. More specifically, the study sought to determine if there was a significant difference between two particular WBT screen designs, referred to in this study as “full-page” and “partial-page.” Again, the full-page design allows the learner to view an entire WBT page at once, but only by limiting the amount of instructional material displayed on the page. The partial-page design provides more instructional content per page, but requires the learner to scroll down the page in order to view all of the page content and program features.
Review of the Research Questions

There were two primary questions fueling this study:

1. Is there a significant difference in performance between learners using a scrolling, partial-page WBT and those using a non-scrolling, full-page WBT design?

2. Is there a significant difference in satisfaction between learners using a partial-page WBT and those using a full-page WBT design?

It was hypothesized at the outset of the study that the full-page design would yield superior performance and satisfaction results.

Results for the Research Questions

An analysis of the performance and satisfaction data collected for this study yielded the following results for the two research questions:

1. No significant difference was found in performance between the full-page and partial-page treatment groups. Thus, the null hypothesis for this question could not be rejected.

2. No significant difference was found in satisfaction level between the full-page and partial-page treatment groups. The null hypothesis for this question could also not be rejected.

Discussion

Performance data were obtained through participants’ completion of the Basic Web Page Programming (BWPP) tutorial’s final exam. Satisfaction data were generated
through an online satisfaction survey that participants completed immediately following the exam, but before they received their exam scores. Additional demographic data were collected during participants’ completion of the Web Skills Assessment (WSA) program. This included participant gender, age, prior awareness of HTML, and experience using HTML. The total length of time it took each participant to complete his or her study session was also collected. Qualitative data regarding participants’ perceptions and preferences pertaining to WBT interface design, in general, and toward scrolling, in particular, were obtained through post-session interviews conducted with 59 randomly selected study participants.

The full-page and partial-page treatment groups were compared on BWPP exam score and satisfaction level, as well as on gender, age, prior awareness of HTML, experience using HTML, and total session time. Analysis results indicated that there was no significant difference between the groups for any of these variables. It was concluded, therefore, that the treatment groups were equivalent for all variables measured.

Please note that for the discussion presented in this chapter, scrolling (or rather its presence or absence) will be referred to as the single difference between the full-page and partial-page WBT screen designs. As a feature of WBT interface design, however, scrolling and the amount of instructional content contained on a WBT page should be considered as two sides of the same coin. In other words, it is a given that when a WBT page contains more instructional content than can be displayed at one time, scrolling will necessarily be present. In the interest of brevity, references to scrolling should be read as “the absence or presence of scrolling along with its implications for the amount of instructional content contained on a WBT page.”
Learner Performance Outcomes

Analysis of the BWPP exam scores indicated that there was no significant difference in performance between the two treatment groups. It would appear, then, that scrolling (the single difference between the full-page and partial-page screen design) had no significant effect, by itself, on how well participants performed on the tutorial exam.

One expectation at the outset of this study was that the full-page group would outperform the partial-page group. Much (though not all) of the literature reviewed in Chapter Two seemed to suggest learning might be better facilitated by a non-scrolling WBT screen design: screen density studies with electronic text; the perceived benefits of informationally lean instructional text chunked into smaller, more digestible portions; the possible disruption of information processing and retention resulting from the often distracting and disorienting activity of scrolling; and the frequently negative effects of large blocks of text on learner attention, endurance and motivation. Together, they seemed to make a reasonable case that learners would likely perform better using a non-scrolling WBT interface.

As it turned out, however, the average exam score of the partial-page group was marginally higher than that of the full-page group. While there was no statistically significant difference in BWPP exam scores between the two groups, it was still an interesting finding in light of initial expectations to the contrary.
Learner Satisfaction Outcomes

There was also no significant difference found in satisfaction level between the full- and partial-page groups. Therefore, it can be concluded that scrolling alone was not a significant factor in how satisfied participants were with the learning experience.

On average, participants in both treatment groups indicated about the same level of satisfaction regarding their learning experience, with the partial group participants tending to rate their level of satisfaction slightly higher than did the full-group participants. This was a bit more of a surprise than the performance outcome in that the bulk of the literature pertaining to learner satisfaction indicated that the level of satisfaction with an online instructional experience might be more susceptible to the effects of scrolling than performance due to factors such as the disruption of spatial orientation, inefficiency of navigation, copious amounts of instructional text, and the diversion of attention away from the instructional material.

Reflections on the Performance and Satisfaction Outcomes

As to why scrolling appeared to have had no appreciable effect on learner performance or satisfaction, the post-session interview data may cast some helpful light. The reader should, however, remember that only 59 (about 46%) of the 129 study participants were interviewed.

All but two of the interview respondents reported that they liked the interface design of the BWPP tutorial. This was regardless of the version to which they were assigned. User-friendly aspects of the program’s interface were provided as reasons, such as ease of navigation accessibility to program features. The two respondents – members
of the partial-page group – who did not like the screen design pointed to certain of its aesthetic qualities, such as the color scheme, but neither indicated scrolling as a factor for their dislike of the program.

While 85.7% of all interview respondents thought that a WBT’s program interface either did or could have some impact on learning, nearly two-thirds did not think scrolling, as a distinct interface feature, did. According to respondents’ comments, the more time and effort a learner has to spend working with the program interface, the less learners tend to focus on the instructional material, which could hinder learning and performance. However, scrolling was generally perceived as a fairly innocuous aspect of the program interface, primarily because of its ubiquitousness on the Web. In addition, the advent of the wheel mouse has seemed to make the process of scrolling much less aversive than it once was (Nielsen, 1997, 2003, 2005b; Spool, Snyder, DeAngelo, & Schroeder, 1999). Half of respondents did not consider scrolling to be a distraction from focusing on the instructional content, and even the majority of those who thought it was a distraction indicated it was only a minor one. Apparently other factors pertaining to the screen design, such as, perhaps, poorly located navigation buttons, are more apt to be an influential distraction.

While spatial disorientation during scrolling was a distracting factor for a few respondents, for most it apparently was not. Perhaps this may be attributable to the pervasiveness of scrolling on the Web in that, through repetition, one either becomes accustomed to the phenomenon and/or develops a personal strategy to compensate for it.

Individual learner attributes, interests, preferences, and characteristics might almost certainly play a role in whether or not a program’s interface affects one’s learning
experience. For instance, several respondents, especially those who were equivocal on one or more interview questions pertaining to screen design effects on learners, claimed that such effects could be mitigated or exacerbated by how interested they were in the subject matter. Others pointed out that one’s level of familiarity with computers and the Web might well factor into whether or not one’s performance was impacted by the program interface. This particular possibility, of course, was anticipated in this study, as evidenced by the participant suitability criteria instituted for this study (see Chapter Three for more information).

Another reason why scrolling may not have an impact on learning indirectly harkens back to Clark’s (1983, 1991, 1994) argument that only instructional methodology, not learning media or its attributes, has any effect on learning. Several respondents said the interface had nothing at all to do with learning the material, asserting simply that instructional material was there to be had regardless of how it was presented or accessed.

The question of scrolling’s impact on learning was the only interview item for which a significant difference was found in how the treatment groups responded. As to why more than three-quarters of the participants in the partial-page group saw scrolling as having no impact on learning versus less than half of the full-page group participants, it can only be speculated. Perhaps, partial-page participants were afforded a greater clarity regarding their experience of scrolling, by virtue of having just completed an online learning experience that involved a scrolling interface. Those in the full-page group would have had to think back on past experiences with scrolling interfaces. Separated by the fog of time from those past experiences, their immediate experience
with the non-scrolling screen design might have prejudiced many of them against scrolling.

While no significant difference in satisfaction level was found between the two treatment groups in this study, data from the post-session interviews suggests that a WBT’s screen design can be an issue for some when it comes to one’s satisfaction level with the learning experience. For the interview respondents, all said that a program’s interface either definitely does or could have an impact on one’s satisfaction level. That impact could range from slight to considerable, depending on factors related to the interface itself (e.g., how complicated the interface is perceived to be or how functional and/or aesthetically pleasing one finds the interface), and/or to learner’s personal attributes, characteristics and preferences (e.g., one’s level of computer and Web skills). The interview data also suggests that the user-friendliness of a program interface might have the greatest impact on level of satisfaction. This, of course, is right in line with Nielsen’s (1993, 2003) and Shneiderman’s (1998) usability attributes.

Interestingly, only about 90% of the respondents reported that the BWPP tutorial’s interface contributed to their satisfaction level with the overall BWPP learning experience. This would seem to indicate that some respondents were somewhat self-contradictory, on the one hand saying that a program’s interface impacts learner satisfaction, but on the other that their satisfaction level with the BWPP experience had nothing to do with the BWPP screen design. The reason for this discrepancy is unclear, since none of these respondents was asked to clarify the apparent contradiction. Perhaps the order of questioning contributed to this seeming contrariety. Instead of proceeding
from the personal and specific to the non-personal and general, it may have been more
cognitively coherent to advance in the opposite order.

Even though the majority of respondents were of the opinion that a WBT
program’s interface had an impact on satisfaction level, only about 41% of them
considered scrolling to be a significant factor in satisfaction. Disruption of spatial
orientation, the temptation to skim the material (or even skip large parts of it altogether),
and the amount of scrolling involved were a concern for some, but overall, respondents
said they had simply acclimated to the reality of scrolling on the Web.

Switching the focus from participant perceptions about scrolling’s effect on
performance and satisfaction, to their more general preferences regarding WBT screen
design, over three-quarters of the respondents said that, given the choice, they would
prefer a non-scrolling, full-page interface design for Web-based instructional programs.
This position was supported in the overwhelming preference for WBT pages consisting
of limited amounts of leaner, chunked-up instructional text. Very few preferred long
pages of big blocks of uninterrupted text. In addition, two-thirds of the respondents said
they preferred to have some idea of how much text is on a WBT page at the outset,
primarily to gauge how much effort and time they will be expending on it. And when it
comes to having to locate previously read information for review, nearly two-thirds stated
a preference for clicking back through a series of full-screen, non-scrolling pages rather
than scrolling up on a long page.

All of these preferences would appear to favor the full-page interface design over
the partial-page design, if not in terms of performance and learning, then certainly in
satisfaction levels. Nevertheless, it must be remembered that neither participants’
performance on the BWPP exam nor their reported satisfaction levels with the learning experience was distinguished in any statistically significant way. So if the general preference of participants was for the non-scrolling, full-page design, but scrolling was not indicated as a significant factor in their performance or, especially, their satisfaction levels, then what else might be able to account for this apparent discrepancy?

One final factor in this study’s finding of no significant difference in learner performance or satisfaction might be the fact that the instructional content of the partial-page version was an exact duplicate of the full-page version. That is to say, that the full-page version was developed first, and that a single page in the partial page version consisted simply of several pages of content from the full-page version. The full-page version not only required more time and effort to program, but it also required a great deal of effort to ensure that the tutorial’s instructional content followed good instructional design practices, while fitting well into the limited dimensions of the content area. The result was lean, chunked up instructional content – a goal often discussed in the literature (Alessi & Trollip, 2001; Fleming & Levie, 1993; Galitz, 1993; Grabinger & Osman-Jouchoux, 1996; Horton, 2000; Kruse & Keil, 2000; Merrill, 1994; Nielsen, 2000; Piskurich, 2000; Shneiderman, 1998; Smith & Mosier, 1986; Tullis, 1997).

Since the instructional content of the partial-page version was an exact duplicate of the full-page version, it shared some of the benefits of the latter’s instructional design. Therefore, the partial-page version did not suffer from some of the pitfalls of scrolling pages discussed in the literature, such as, long, uninterrupted blocks of text (Horton, 2000). While its pages contained more text and other instructional content than did those of the full-page version, that instructional material was lean and chunked-up. Thus,
participants in the partial-page group may not have experienced the level of intimidation, spatial disorientation, or a sense of slow progress that they might otherwise have. So, in effect, the difference scrolling made in this study may have been mitigated to some degree by the way the instructional text was constructed.

Secondary Relationships

Interactions between the two dependent variables in this study (learner performance and satisfaction) and other possible predictor variables (age, gender, prior awareness of HTML, experience using HTML, and total study session time) were also investigated. The results suggest that learner performance was impacted by more of these predictor variables.

BWPP exam scores tended to increase with both prior awareness of what HTML was and what it was used for, as well as with the length of study session time. It was also found that exam scores tended to decrease with age and experience using HTML.

It makes sense that having some idea of HTML could provide a performance edge if that prior awareness included a deeper familiarity with HTML other than just term recognition. Otherwise, it is difficult to explain why simply having heard of the term and/or knowing what HTML is used for should result in any performance increase. If one’s knowledge of HTML is more than cursory, then a better argument for this relationship can be made. But if this were the case, it would imply that performance would, of course, increase with more knowledge of and/or experience with using HTML.

This, surprisingly, was not the case in this study. That performance tended to actually decrease with HTML experience would appear to be counterintuitive. If it was
difficult to understand why prior awareness of HTML would lead to better performance, it is doubly so to imagine why more experience using HTML would result in poorer performance.

In this latter case, however, it is possible that some prior familiarity with HTML served as a barrier for some participants to absorbing the information presented in the BWPP tutorial. Having some familiarity with HTML, perhaps some participants proceeded through the tutorial more quickly than they would have otherwise, possibly only skimming or even skipping over significant portions of the instructional material. Doing so might have come back to haunt them during the BWPP exam, where some exam questions might have pertained to those inadequately read or skipped content areas. Another way prior HTML experience might have served as an obstacle for a participant is in the form of cognitive dissonance, wherein either new information about some instructional topics might have been different from what the participant thought he or she already knew or the information was presented in manner unfamiliar to the participant. This situation may be related to research on learners’ mental models and their preconceptions, positing that learners’ strongly held preferences way interfere with their performance on new tasks (Donovan, Bransford & Pellegrino, 1999; Bransford, Brown & Cocking, 1999). In either situation, it could be that the new information did not register and supplant the participant’s prior understanding, such that when faced with an exam question on the topic, the participant automatically falls back on that prior understanding of the topic.

It might also be that suspicion should fall on the questions posed to participants regarding their prior HTML awareness and HTML experience. It is possible that one or
both of the questions, which were presented to participants during the Web Skills Assessment program, could have been better constructed to enhance participants’ clarity about what they were being asked.

However, it is all but impossible to gauge if there were errors in how participants responded to these two questions. Even if it was known that self-report errors occurred, there is no way to determine the nature of those errors; for example, whether or not a participant understood the question properly, intentionally gave a false response, or if he or she simply clicked the wrong button. Therefore, it seems all that can done is to report these findings, speculate as to their accuracy and significance, and suggest that, perhaps, a better way of asking the questions could be found.

The other findings for performance here are a bit more understandable; that exam scores increased with the amount of time spent in the study session, and that scores tended to decrease with age. Session time is not always positively related to better performance, since it is possible that the longer it takes a learner to complete a particular learning experience, the more difficulty he or she may be experiencing with the material. This may be especially true with tests. However, in this study, it makes sense that, on average, the more time the participants took with the material, the better they performed.

HTML – even very basic HTML – can be difficult to learn, even when the learning process is stretched out over days or weeks. In this study, the learning process was condensed into a very short time frame (on average one hour). Coupled with the fact that the participants could not actually practice creating a basic Web page from scratch during the BWPP tutorial, it seems reasonable that participants who took more time with the content sections stood a better chance of doing well on the final exam.
Unfortunately, no data were collected on the time it took for participants to complete just the BWPP exam; Thus, it can only be speculated that the bulk of time participants spent in their respective study session was devoted to the content sections.

As far as exam scores decreasing with age, it may be that older participants (and 14 were 25 years or older) had, on average, less overall computer and Web experience, which, in some way translated to lower exam scores. However, with no other study data being able to credibly contribute to an explanation for this phenomenon, this is only speculation.

With regard to satisfaction level, gender and prior awareness of HTML were the only significant predictors. Females tended to report higher levels of satisfaction than males in the study, as did those with some prior awareness of HTML. Even though females tended to rate their level of satisfaction with the program interface higher than males, both genders tended to report high satisfaction levels, with males averaging 4.0 on a 5-point Likert scale and females averaging 4.23. Unfortunately, no other data from this study illuminated either of these findings.

**Recommendations Deriving From This Study**

Based on the experience gained from conducting this study, as well as from its outcomes, a number of recommendations can be made regarding: (1) the design of WBT programs; (2) how this study can be improved; and (3) further research. The following sections discuss each set of suggestions in turn.
Recommendations for the Design of WBT Programs

1. *Make instructional text lean and chunked.* No matter the screen design employed, much of the available evidence in the literature, as well as from the data gathered in this study suggests that there are both learning and satisfaction benefits of lean and chunked instructional information. Lean instructional text maximizes the instructional message, while minimizing distracting, superfluous information. Chunking up text into “mind sized chunks” (Merrill, 1994, p. 153) facilitates the absorption, comprehension, and retention of information. In contrast to blocks of long, uninterrupted text, chunked text is much less intimidating, and may reduce the temptation to skim or skip parts of the instructional information. Finally, chunked text seems to provide a greater sense of forward progress through the material, leading to a greater sense of accomplish and motivation.

2. *Limit the amount of scrolling on pages.* If, for whatever reason, a partial-page interface design is selected for the WBT, it would probably be wise to limit the amount of scrolling required on its pages. This would result in more pages, but participant comments in this study indicate that too much scrolling can be tiring and lead to frustration, which, in turn, can impact learner motivation. No more than a few screenfuls of information should be placed on a page (Koyani, Bailey & Nall, 2003; Nielsen 1997). This study’s post-session interview data also support this recommendation, as most respondents indicated that, while they did not mind having to scroll some, they would find copious amounts of scrolling aversive.

3. *Place visible cues on scrolling pages to compensate for spatial disorientation.* Based on some of the anecdotal data from the post-session interviews, if scrolling pages
are employed in a WBT, it might be a good idea to devise a system of visual cues that can be interspersed throughout the instructional text to help users stay oriented to where they are in the program as they scroll. The trick here, of course, would be to make these cues apparent enough to register with the learner, but innocuous enough so that they do not create a distraction and interrupt the learner’s focus.

Visual cues could be text-based or image-based, with the caveat that graphics used as visual cues are of no use if the user has his or her Web browser set to not display graphics. Each cue may also need to be unique; otherwise, in a long scrolling page, with the visual cues rolling up or down the screen, they would probably not be nearly as identifiable and, thus, effective.

4. Let learners choose the interface design. If scrolling truly does not produce a significant difference in performance or satisfaction, as the results of this study appear to indicate, then it might be appropriate to allow learners to select the type of WBT screen design they prefer. However, the resources needed for developing, producing, and maintaining separate versions of a WBT program might make this untenable.

An alternative approach would be to enter all instructional content into a database, then develop a Web-delivery system flexible enough to construct the selected interface design on the fly and insert the instructional content into it. This option could also be costly, especially on the front-end of the develop process. However, if the system was flexible and robust enough, then it may prove to be cost-effective over the long term, as additional instructional courses could be developed (within the guidelines established for this system), without having to duplicate the delivery system.
5. Consider employing a non-scrolling, full-page interface design. While this study found no statistically significant performance or satisfaction difference between full-page and partial-page designs, anecdotal data from the post-session interviews indicated a fairly strong preference for the full-page interface design. Among the chief reasons given by participants for this preference for a full-page design were: information was provided in smaller, easily consumed chunks; information presented in smaller portions is less intimidating; it provided a greater sense of forward progress and accomplishment, which was more motivating; and it increases the likelihood that the learner will not skip any of the information. Of course, one downside to the full-page interface design is that it can cost more to develop, in terms of effort, time, and expense, than a partial page interface due to the greater number of pages that must be created, programmed, and tested, as well as the process of parsing the instructional content to fit within the space limitations of a full-page design.

Recommendations for Improving This Study

1. Eliminate the hybrid characteristics of the partial-page treatment. Even though the partial-page design contained large amounts of instructional content which required participants to scroll, each content section still consisted of several individual contiguous pages hyperlinked to one another in the same fashion as the full-page design. Coalescing all of a section’s content into a single scrolling page would perhaps have provided partial-page participants a more intense scrolling experience and possibly bring some of the perceived advantages and/or disadvantages of scrolling into starker relief.
2. Collect data on the amount of time spent on each WBT page. This would be a relatively simple programming addition that would allow a comparison of the average time participants spent per page between the full-page and partial-page groups. Time comparisons could also be made for specific pages or sets of pages (for the full-page version, times spent on the pages that make up one scrolling page can be combined). Such time-per-page comparisons could provide valuable insight into how well each version facilitates both the overall learning experience, as well as specific tasks and/or functions. It might also indicate differences in how people work with and in each type of screen design.

3. Intersperse inquiries into participants’ satisfaction level throughout the program. Essentially, this would be taking a series of satisfaction readings during the course of the study session by asking the participant to rate their level of satisfaction with the learning experience at that particular moment in time. These intermittent inquiries would need to be phrased in exactly the same way each time.

This string of dynamic satisfaction data points would reveal changes in participants’ level of satisfaction at different points in the program. These data could be monitored remotely in real time by programming the study’s Web delivery framework to deliver these data to the computer screen of the researcher as it is collected. If a participant’s satisfaction data fluctuates in a curious way, the researcher could ask that participant about the changes at the conclusion of his or her study session.

The downside to this is that interrupting the learning experience could conceivably have a negative effect on a participant’s performance and/or satisfaction level. Therefore, if implemented, such interruptions would best be located just prior to the
start of the BWPP tutorial and at the end of each section. The existing Learner Satisfaction Survey would, of course, be the final check.

4. Program keyboard hotkeys for some or all program features and functions. For instance, to move to the next page in the tutorial, a participant could either use the mouse to click the “Next” button or press, say, the right directional arrow key. The BWPP program could be programmed to capture these keyboard data for each tutorial page. Participants would, of course, have to be alerted to these keyboard equivalents at the start of the tutorial.

The benefit to this would be to see how often and under what circumstances keys were used instead of the mouse to operate the program. More particular to the focus on scrolling, it would be interesting to learn if some participants preferred to use hotkeys over the mouse for scrolling up and down pages in the partial-page version.

5. Have participants indicate their level of interest in the tutorial topic at the beginning, and end of the tutorial. This would be similar to the intermittent satisfaction inquiries discussed in number 2 above, except that these interest inquiries would not interrupt the flow of the tutorial.

The purpose of these inquiries would be to see if participants’ interest in the tutorial topic might be a factor in their performance and/or satisfaction level. At the end of their study sessions, participants could be shown their reported interest level data before and after the tutorial, then asked if their level of interest in the topic had any effect on how much effort they put into the learning experience and whether or not it affected how satisfied they were with the learning experience. Another question could ask if their
interest level had more or less impact on their performance and satisfaction level than other factors, such as scrolling.

6. **Time a task for finding previously read information.** This idea derives from post-session interview question 10 where participants were asked if, when trying to locate information they had previously read, they would prefer to click back through a series of full-page, non-scrolling pages or scroll up on a long page in search of the information. In this study, participants gave contrasting reasoning for their preferences, with some saying that scrolling was more efficient (i.e., faster) than clicking and others asserting the exact opposite.

The idea would be to insert one or more tasks into the tutorial where participants would need to go back to some previous point in the tutorial, then measure the amount of time it took them to do this. Exactly how this would work is unclear, but the start and stop times for this task would have to be triggered by some participant-induced event, such as a clicked link or button.

A comparison of average task completion times for the two treatment groups could reveal if one method was, indeed, more efficient than the other to any appreciable degree. Having a quantitative measure for this question would also allow good commentary on the differences in participant perception on this matter.

7. **Replace artificial program errors with reasonable, learning-supportive participant tasks.** This suggestion pertains to the four artificial program errors each participant experienced during the BWPP tutorial. This matter is covered in Appendix J, but briefly, four “errors” were intentionally programmed into the BWPP tutorial, each requiring participants to use some feature of the program to correct it. The purpose was to
provide participants with a richer experience of the program interface, by forcing them to use several features of the program they might not otherwise use. Once the error was "corrected," the participant could continue on with the tutorial.

There was a concern that these program errors could conceivably have a negative impact on participants’ performance and/or satisfaction level. While there was no evidence that this was the case, it would seem a more constructive tact to design positive, topically relevant tasks to achieve the same purpose as the program errors.

8. Insert a “Skip This Page” link or button at the top of each tutorial page. This suggestion derives from participant comments regarding scrolling pages containing a great deal of information and the temptation some have to skim or just skip these pages altogether. While it is unclear how data on skimming could be collected, putting a “Skip This Page” button or link at the top of each tutorial page might be one way of garnering some data about skipping pages.

The “Skip” would be more relevant to and telling for the partial-page participants, since it would give them the option to skip long, scrolling pages without having to scroll down to the bottom of the page in order to click the “Next” button. The “Skip” and “Next” buttons would both be programmed to record if they were clicked. If the former was clicked, but the latter was not on a page, then it could be warranted to assume that the participant did not view the entire page. The only other explanation would be that, after scrolling down to view the entire page, the participant scrolled back up and clicked the “Skip” button, which would be much less likely. Of course, in the case of the full-page version, one could not make that assumption, since both buttons would be visible at
the same time. The unknown for the full-page group participants would then be whether or not they used the “Skip” button in lieu of the “Next” button to move to the next page.

A comparison of these skip data between the two treatment groups might shed some light on this “temptation to skip” theory. If the partial-page group used the “Skip” button significantly more than the full-page group, it could be suggested that scrolling does result in more skipped, or at least partially-read, pages.

9. Collect all key press and mouse click event information. This would be a matter of programming the BWPP tutorial to collect the sequence of the keys participants press, as well as the tutorial links and buttons they clicked during the tutorial. An analysis of this sequence of participant activity might reveal some interesting information regarding how members of the two treatment groups operated the program.

10. Refine the post-session interview questions. After a review of the post-session interview audio files, it became apparent that several of the questions could have been better constructed to more clearly and directly get at the issue of scrolling and its impact on learning and learner satisfaction. Some respondents seemed to have difficulty understanding what was being asked at times. Perhaps, it would be advantageous to prepare a list of defined terms for the interviewees and even some visual aids for illustrating some terms and concepts that are referred to in the interview.

11. Be prepared to ask respondents about apparent discrepancies in their responses. During the course of the interviews, participants would sometimes provide a response to a question that appeared contradictory to a response they gave earlier to a different question. Sometimes this was caught and addressed in the interview, but review of the interview audio files revealed other instances that were not. Perhaps the solution to
this problem would be the development of an interview tracking sheet that would help the interviewer keep track of:

1. Which questions have been asked. This is to make sure no questions are inadvertently skipped during the interview, as was done twice in this study. (See the discussion of post-session interview question 7 in Chapter Four.)

2. Participants’ discrete responses to each question (e.g., “yes,” “no,” “it depends,” “no preference,” etc.).

3. Participants’ response consistency by cross-referencing related questions. In other words, each interview question on the tracking sheet is flagged with an indication of which previous questions it is related to. After the participant gives a response to a question, the interviewer can check to see if the participant’s response is consistent with the responses given for all other related questions. If it is not, the participant can be asked to clarify the apparent discrepancy.

12. Construct clearer questions for gauging participants’ knowledge of HTML. Given the confusing and inexplicable results obtained for the BWPP exam score’s relationship to participants’ prior awareness of HTML and their experience using HTML, it would make sense to revamp the way this information was approached. Originally, only one question was asked for each of these concepts (see Appendix I). However, it would probably be a better idea to triangulate on each concept by asking a series of more specific questions that, taken together better exemplify each of the concept.

For example, instead of simply asking, “Do you know what HTML is and what it is used for?,” participants could be asked to select the correct definition of HTML from a
number of possible choices. This question could be followed by a multiple select question that asks the participant to identify all purposes for which HTML is used.

13. Control for and or track the use of the Web browser’s “Find” feature. In this study, no attempt was made either to control or to gather information about the use of the Web browser’s Find feature during participants’ study sessions. This was perhaps an oversight, as use of the Find feature could circumvent some of the issues involved in finding previously read information and in reorienting back to a person’s point of forward progress – activities that were suspected as having a possible impact on participants’ performance and/or satisfaction level. Use of the Find feature might well negate the need to scroll during such activities and, therefore, entirely avoid any possible performance and/or satisfaction effects that might be associated with scrolling in the performance of these tasks. If so, one role of scrolling would be eliminated (or at least diminished) and cease to be a factor in the study – if it is even warranted to be considered as such.

This issue is, of course, most relevant for those undergoing the partial-page treatment, where the amount of information contained on a single page exceeds the bounds of the screen. Since a Web browser’s Find feature is functional only within the page that is currently being viewed by the user, it would be of no use in finding information located on previous pages. This is true for both full- and partial-page screen designs. Thus, the Find feature’s only usefulness would be for locating information within the current page. And while this would be a practical use for partial-page participants, it would be much less so for full-page participants, given the limited amount of text on a page in a full-page interface design.
The question of how to handle the issue seems to yield no practical alternatives other than to instruct participants not to use the Find feature and/or to ask participants to report on their use of the feature after completing the BWPP tutorial. Disabling the Find feature might be an option, but how this could be done is not readily apparent short of hacking the browser’s programming code. However, both disabling the feature and instructing participants to not use the feature would seem to impose unrealistic and unjustifiable restrictions on the participants. Tracking the actual use of the Find feature might also be possible and even desirable, but would, to the best knowledge of this researcher, require either a relatively high degree of technological prowess or a high level of direct observation. While either or both of these steps could be implemented, it would undoubtedly require more expenditure of time, effort, and money. It would seem, then, that the most readily practical alternative would be to ask participants to self-report on their use of the Find feature after they have completed the tutorial. This could be done programmatically or through direct questioning by the study session proctor.

Regardless of the level of information gathered regarding participants’ use of the Find feature, its synthesis could reveal important details about if, when, and how users might use the Find feature in a WBT program, and to what degree it might mitigate, or otherwise impact, user scrolling – especially in the context of investigating differences between full- and partial-page WBT interface designs.

Finally, this discussion of the Find feature seems to also call for some comment regarding the possibility for inclusion of a Search feature in the tutorial. The most salient difference between the Find and Search features is that the former is limited to a single page (i.e., the page the user is currently viewing), while the latter ranges across all – or at
least a large number of – pages in the WBT program. While there are certainly benefits from a Search mechanism in WBT programs, it would seem that its functional range would be an issue for linearly designed WBT programs (such as the BWPP used in this study), where the student must complete all sections in order. In other words, the restrictions of access imposed by a linear program would need to be safeguarded in the Search mechanism, which one might suppose would mean that its functional range would be limited to only those sections of the instructional program that the student has completed. The practicality of this would be dictated by the technological capabilities of the researcher(s), as well as other considerations, such as time and money. It is for this reason that, within the confines of improving this study, a Search mechanism is not being recommended.

Recommendations for Future Research

1. Let all participants experience both interface designs. In this proposed study, participants would experience both interface designs. There are several ways in which to organize these experiences: (1) having two separate tutorials (one full-page and the other partial-page) taken one after the other; (2) breaking a single tutorial up into two sub-tutorials (one full-page and the other partial-page); (3) alternating section screen designs within one tutorial (e.g., Sections 1, 3, and 5 are of full-page design, while Sections 2, 4, and 6 are of partial-page design); or (4) randomly determining the screen design of each section within one tutorial, as long as each design was represented equally. For the first three renditions, which screen design comes first could be randomly determined.
2. *Vary the load time of next and previous pages in a full-page, non-scrolling format.* This proposed study was prompted by participants in the current study who indicated that a major factor in their preference for or against a non-scrolling screen design was how fast pages load. While the specific focus in the current study was the loading of previous pages, it could be broadened to both previous and next pages, since the full-page design requires more pages to be load and more often than in the partial-page design. The main purpose of this proposed study would be to determine the load-time threshold at which point it starts to affect the learner’s satisfaction level.

3. *Place navigational controls at the top and bottom of each tutorial page.* The tutorial would keep track of which buttons were clicked for each page. The idea here is twofold: (1) to see if there is a clear preference for location of the navigational controls; and (2) to gauge whether or not participants in the partial-page group might be more tempted to skip text on a page. The concept is very similar to the *Recommendations for Improving This Study* section above.

4. *Vary the amount of scrolling involved in a partial-page design.* The idea for this proposed study is to gauge the acceptable limits of text (amount and density) on a scrolling page. The question relates to participant statements in the current study who said they did not mind scrolling as long as there was not too much of it. The organization of the study could follow the renditions outlined in item 1 above, except that page length would replace screen design.

5. *Test retention over time.* This would basically be an extension of the current study, where participants would take another exam on HTML after a certain amount of time had elapsed since taking the tutorial. A comparison of exam scores might provide a
better indication of whether one screen design might be more instructionally advantageous than the other.

**Conclusion**

This study failed to find that the presence or absence of scrolling alone is a significant factor either in how well a person performs in a WBT program or how satisfied they are with the learning experience. Post-session interview data were consistent with these results by revealing that a majority of interview respondents did not think scrolling had any impact on either learning or satisfaction with the learning experience.

Perhaps the main reason behind these results is that the pervasiveness of scrolling pages on the Web has instilled an expectation of scrolling among the majority of users. It may be, as more recent literature on Web scrolling suggests, that Web users, over time, have simply become more accustomed to and, thus, tolerant of scrolling. Also, there is little doubt that the advent of the wheel mouse has taken the edge off the act of scrolling for many people.

It is interesting to note, however, that even though the majority of post-session interview respondents saw no relationship between scrolling and their performance or satisfaction level, most of the respondents indicated a preference for a full-page WBT interface. They provided a number of reasons for this preference, many of which revolved around the idea of chunking-up the instructional content into smaller, more digestible portions. Whether or not these anecdotal preferences constitute a compelling enough reason for a WBT designer to choose a full-page design over a partial-page
design, however, must be debated on grounds other than the results of this particular study, such as time- and cost-effectiveness.

Do the findings of this study, then, put the issue of scrolling in WBT screen design to rest? Hardly. As was pointed out in Chapters One and Two, there is a dearth of research looking at the effects of scrolling specifically within the domain of Web-based instructional programs. Guidelines proffered pertaining to scrolling in WBT interface design are derived primarily, if not in entirely, through extrapolations from research on scrolling as it is manifested in other contexts, such as Web searches and finding information in a text passage. While these guidelines have merit and may well be useful in informing WBT interface design decisions, they have not yet been tested sufficiently in the complex environment of Web-based instruction.

Hopefully, this study provides one more thread with which to help weave a more useful, evidence-based set of WBT development guidelines. That no significant differences in performance or satisfaction between full-page and partial-page groups was found in this particular study does not mean that WBT instructional designers are now free to decide this design issue on a whim or with the simple toss of a coin. What it does mean is that both interface designs remain viable options for the WBT designer for the time being.
While the term “frame” is sometimes used synonymously with “page” or “screen” to refer to a single computer screen of information, it has an alternative meaning with regard to the Web. In Web terminology, a frame refers to “the division of a Web page into individual sections, each with its own hypertext reference” (Alden, 1998, p. 69) where “one or more parts of the screen can remain static while the other part or parts change and/or scroll” (Barron, 1998, paragraph 13). A frame-based screen design might be considered a hybrid of partial-page and full-page designs. While conceptually, the frame-based design might solve some issues of screen design (Bernard, 2001), such as navigation and program feature buttons disappearing as users scroll down a Web page (although this is also solved by the full-page design), it can also create and/or exacerbate other design problems (Barron, 1998; Bernard, 2001). For instance, it can make printing more difficult, as well as increase access time due to having to transmit multiple pages (Barron, 1998). In any case, for the purpose of this study, the frame-based design does not present a screen design option substantially unique from either the partial-page or full-page designs.

The Cronbach’s alpha coefficient of the Internet Programming posttest was actually reported to be .89 (Majchrzak, 2001, p.39); however, this was including all 37 posttest questions. The 37th posttest question was an essay question and could not be included in this study’s WBT exam because it was beyond the capabilities of this researcher to
program an adequate computer scoring rubric for an essay question. Thus, for the purposes of this study, it was more proper to calculate the reliability coefficient of the Majchrzak’s 36 multiple choice posttest questions, which turned out to be .80.

The Global Assessment of Functioning Rating Scale (GAF) is a composite index that mental health clinicians use to judge a person’s highest level of functioning during the past year (Kaplan & Sadock, 1991). A GAF score “reflects [an individual’s] current overall occupational, psychological, and social functioning [but] is not supposed to reflect physical limitations or environmental problems” (Morrison, 1995). The GAF is used as Axis V in the multiaxial diagnostic system of the Diagnostic and Statistical Manual of Mental Disorders (fourth edition), which is the primary reference for clinical diagnoses of mental illnesses in the United States (American Psychiatric Association, 2000).
References


Mwaura, C. (2003). *An investigation of the innovation decision process of faculty members with respect to web-based instruction.* Ph.D. dissertation, Department of Educational Studies, Ohio University, Athens, OH.


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http://alexia.lis.uiuc.edu/~haythorn/cmc_bs.htm


Appendices
Appendix A: Comparison of Full-Page and Partial-Page WBT Screen Designs

A Non-Scrolling, Full-Page Design

(Separate screens are at 600 x 480 resolution.)

A Partial-Page, Scrolling Design

(Black box approximates view on 17-inch monitor with a printout of the Web page equaling two 8.5 x 11” pages.)

Figure 1. Comparison of Full-Page and Partial-Page Screen Designs
Appendix B: Modifications to the Original Proposed Study

Prior to the first pilot test for this study in April 2001, three proposed instruments were dropped from the study protocol: the *Study Suitability Survey*, the *Participant’s Web Skills Assessment Sheet*, and the *GAF Worksheet*. The *Study Suitability Survey* was a proposed filtering tool for making sure that all prospective study participants met certain criteria for taking part in the study. It was originally conceived as a paper-based instrument that was to be administered to all undergraduate students enrolled in designated social work, rehabilitation, and psychology classes during the term the study was conducted. The survey was intended to assess each student’s level of experience with the Web, as well as his or her familiarity with the *Global Assessment of Functioning Rating Scale* (GAF), which is discussed below. Only those students demonstrating a certain level of Web proficiency and who have had no significant experience with the GAF would have qualified for participation in this study, and it was this filtered group from which a random sample was to be drawn. The idea of limiting inclusion into the study to only those who meet these criteria was to control for any interaction effects related to prior Web experience and/or HTML experience.

However, during the initial development of the study’s Web delivery framework, the *Study Suitability Survey* protocol was determined to be too impractical to implement as originally conceived. It was also redundant, as participants would also be completing a brief Web-based program intended to assess their level of Web skills and familiarity with the topic of the WBT program. This Web skills program was the *Web Skills Assessment* (WSA) program discussed in Chapter Three. And as discussed in Chapter
Appendix B: (Continued)

Three, while the WSA program remained a part of the study protocol, it was never used as a filtering mechanism for study participation. For same reasons, the proposed Participant’s Web Skills Assessment Sheet was also deleted from the study protocol.

Once study was ready to pilot for the first time in April 2004, it became apparent that other modifications were needed with regard to the sampling process for study participants. First, the study’s principal investigator (PI) did not have the desired level of access to the target population, which limited the pool of potential participants and forced the PI to undertake a more direct recruitment campaign. The recruitment of participants was severely hampered by the fact that test runs of the study’s WBT program averaged around two hours. This made participation in the study a hard sell to potential participants, as it became clear that original incentives proposed for study participation (class extra credit and a free WBT program on a mental health related topic) were outweighed by the time and effort students would have to expend to participate.

This realization led to more changes in the sampling protocol. The next round of recruitment measures included the additional incentive of $20.00 in cash to those who participated in the study. The recruitment campaign itself expanded from targeting students and classes in specific mental health related academic programs to general recruitment of any undergraduate student in any academic program, as long as he or she met the participation criteria. The methods of recruitment are described in Chapter Two.

The combination of expanded recruitment campaign and the promise of pecuniary reinforcement resulted in the recruitment of the participants needed in order to conduct the first pilot test in April 2004. It also negated the need for selecting an over-sample of
150 participants, as originally proposed (to offset the possibility of attrition). The recruitment campaign was so successful, that there was a perpetual waiting list of potential replacement participants to draw from if any scheduled participant cancelled an appointment or simply no-showed. Also, the fact that participation was first-come-first-served (as long as the participant met the participation criteria) maintained an adequate randomness to the sampling process.

The outcome of that first pilot resulted in some further modifications, this time to some of the original data collection procedures and instruments, most notably the WBT program around which the entire study revolved.

The WBT program used in the first pilot was entitled the *Global Assessment of Functioning Rating Scale* (GAF). The GAF tutorial was developed by *Community Mental Health Online Education* (CMH OLE), a Web-based education and training initiative of the Department of Mental Health Law & Policy, Louis de la Parte Florida Mental Health Institute at the University of South Florida in Tampa. CMH OLE developed and offered a number of continuing education credit WBT programs to mental health professionals across the United States. This study’s PI was the primary instructional designer and Web programmer for these WBT programs, including the GAF tutorial.

Participants in this first pilot study were required to complete the GAF tutorial, which consisted of four content sections, a practice section and culminated in an eight-item final exam. Each of the eight GAF exam items had the participants read a brief vignette involving a fictional person, then entering a GAF score (between 0 and 100) for that fictional person. While there was a single digit “best answer” each of the exam items,
he correctness of participant answers were judged by the computer based on a 21 point range, extending from 10 points below the best answer to 10 points above the best answer. For example, if the best answer for one of the exam items was 42, then any answer between 32 and 52 was considered correct.

The reason for this range of correct answers reflects the problematic nature of the GAF instrument itself. As an assessment tool, the procedure for using the GAF rating scale was very straightforward; however, the crux of its successful utilization was the level of knowledge, skills, and facilities of the practitioner employing it. Clinical judgment in assigning GAF scores is paramount. Because of the inherent subjectivity involved in clinical assessments, practitioners do not always agree with each other when it comes to the GAF scores assigned for particular cases. And with a 100-point scale to work with, practitioners rarely assign the exact GAF score. Thus, the scale allows for some flexibility. In fact, for the development of the GAF tutorial, the best answer for each vignettes of the GAF tutorial’s final exam was derived essentially as the average of the ratings submitted for that vignette by a panel of 33 practitioners with experience and expertise in using the GAF. The individual GAF ratings for each vignette varied – sometimes quite widely.

It is no secret that, in practice, learning how to use the GAF rating scale skilfully is challenging to most working mental health practitioners (licensed and paraprofessionals, alike). The CMH OLE’s GAF tutorial results provided ample evidence of this, as the majority of mental health practitioners who took this online course had to retake the tutorial at least twice before successfully completing it.
Appendix B: (Continued)

In hindsight, it is no wonder complete novices to the GAF (as were the first pilot study participants) would have a very difficult time in successfully completing the GAF tutorial. Aside from the fact that it took pilot participants an average of nearly two hours to complete the tutorial, the main problem stemming from this pilot was the failure to establish a strong enough reliability coefficient to justify continuing with the main study. The original GAF exam data from 24 pilot participants yielded a Cronbach’s alpha of - .40. Several alternative methods of analysis were conducted in an effort to salvage the study, but to no avail. The Cronbach’s alpha never rose above .322. It was eventually determined that the nature of the GAF was far too problematic to ever yield reliable results for the study’s target population. Therefore, the decision was made to replace the GAF tutorial with one pertaining to a much more concrete subject matter. Eventually, a CD-ROM-based instructional program, entitled Internet Programming (IP) was identified as a possible replacement for the GAF program (see Chapter Three for more information).

Once the first pilot was underway, it became apparent that the selection process for the post-session interview needed to be slightly modified. While the study computer lab could accommodate up to four participants at a time (the computer lab for the first pilot study was located in a suite of rooms that allowed for four Internet-connected computer workstations), the actual number of participants participating in a study session at any one time varied from one to three. Therefore, instead of focusing on the random
selection of every third participant for the interview, it was decided to randomly select one participant from each study session. This new random selection process is discussed in Chapter Three.
Appendix C: Frequency Table of Participant Ages

Table 15

Frequencies of Study Participant Ages \((N = 129)\)

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<th>Age</th>
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<td>.8</td>
<td>100.0</td>
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Appendix D: Samples of Recruitment Materials

Figure 2. Sample Recruitment Poster

Research Subjects Needed for Dissertation Study

$20.00 for Single Session

Sign Up Online @ http://xxxxxxx.xxxx.xxx.xxx/study.htm

Appointments available through Tuesday, June 7.

Only 25 slots still available.

The purpose of this study pertains to instructional programs offered over the Web. Subjects will be taking a short course on creating a basic Web page. Subjects would participate in a single study session that is currently averaging around one hour. Subjects will be paid $20.00 cash for their participation.

Criteria for Participation:
1. Must be an undergraduate
2. Must possess adequate Web skills (explained on site)
3. Has NOT created Web pages using HTML code

Get more information and sign up online at:
http://xxxxxxx.xxxx.xxx.xxx/study.htm

IRB Protocol No. 102185
Appendix D: (Continued)

Research Subjects Needed for Dissertation Study
$20.00 for Single Session
Get Info & Sign Up Online @ http://xxxxxx.xxxx.xxx.xxx/study.htm

Appointments available through Tuesday, June 7.
Only 25 slots still available.

This study pertains to instructional programs offered over the Web. Subjects will be taking a short course on creating a basic Web page. Subjects participate in a single study session that is currently averaging around one hour. Subjects will be paid $20.00 cash for their participation.

Criteria for Participation:
1. Must be an undergraduate
2. Must possess adequate Web skills (explained on site)
3. Has NOT created Web pages using HTML code

Get More Information & Sign Up Online @ http://xxxxxx.xxxx.xxx.xxx/study.htm
IRB Protocol No. 102185

Figure 3. Sample Recruitment Handbill

The following is a sample recruitment Email (in courier font) that was disseminated to various university contacts, such as undergraduate class instructors and student organizations:

Hi.

I'm now recruiting research subjects for my main dissertation study. If you know of anyone who meets the criteria below and who would like to earn $20.00 cash for a single study session, please forward them this information.

The study is running through May. At the moment, I have 96 slots available. I am opening sessions in phases. The current phase runs through May 6; however, if folks cannot come to any of these sessions, they can submit their email address to my waiting list, and I'll contact them as soon as more slots are available. These are single sessions, and while the length of study sessions will vary depending on how fast the individual works, the current average is around 65 minutes
(although subjects should be prepared to spend 2 hours). For most days, I will be running 3 sessions per day beginning at 9:00 AM, 12:00 PM, and 3:00 PM. I am also open to setting up special sessions on weekday evenings, Saturday and Sunday, but these would need to be set up by contacting me directly by office phone (xxx-xxxx), cell (xxx-xxx-xxxx), or email (XXXXX@xxxx.xxx.xxx).

PURPOSE OF THE STUDY:
The focus of this study is an inherent aspect of Web page design that could have important implications for the efficiency and effectiveness of Web-Based Training (WBT) programs. It is hoped that the results of this study will help inform current and future WBT designers in making fundamentally sound decisions about their instructional program designs.

Subjects will take an online course about how to create basic Web pages using HTML (the basic programming language for the Web). In addition, one person in each session will be randomly selected for a brief audio-taped interview.

The study is completely anonymous and innocuous. The only personal information asked is gender and age.

WHERE
The study is being conducted here at xxxx in xxx-xxxx.

PARTICIPANT CRITERIA:
1) They must be an undergraduate.

2) They must know little or nothing at all about how to create Web pages using HTML (the base language for constructing Web pages) by itself. If they are fairly familiar with HTML - even if through the use of a design view application, such as Dreamweaver - I'm afraid I will NOT be able to use them. However, if they do not know how to create a Web page, or if they somehow create Web pages without ever seeing any of the HTML code, they would be a good candidate for my study.

3) They must possess "adequate web skills." By this I mean that they are not a complete novice to computers and the Internet/World Wide Web - that they know how to use a Web browser and are fairly familiar with how to get around on the Web.

COMPENSATION:
Each subject will be paid $20.00 for completing a study session.
Appendix D: (Continued)

HOW TO SIGN UP
For more details and/or to sign up for the study, go to http://xxxxxxx.xxxx.xxx.xxx/study.htm. Subjects select a study session slot and are asked only for their first name, phone number, and email address in case they must be contacted about changes in appointment times. When they sign up, they will be issued a confirmation document that will include directions for canceling or changing their appointment, directions to the study site, and parking information.

Online registration is the preferred way of signing up for the study, as subjects receive a confirmation with directions and instructions. However, if necessary, students may also register by contacting me (phone: xxx-xxxx; cell: xxx-xxx-xxxx; or email:xxxxx@xxxx.xxx.xxx), and leaving their first name, phone number, and email address. I will return their call to either schedule an appointment or to inform them that all slots for the pilot study have been filled.

Thanks.

My Best,
Phil

The following is a recruitment advertisement placed in the university student newspaper:

Undergrad Subjects needed for USF study. $20 single session. Details and criteria at: xxxxxx.xxxx.xxx.xxx/study.htm
Appendix E: The Study Participant Scheduling Process

Virtually all of the participant sign-up and session scheduling was done automatically via the study Web site. The site’s home page provided links to a synopsis of the study, the criteria for participating in the study, a map and written directions to the study site, and to contact information for the study’s principal investigator (see Figure 4).

Students were instructed to read the criteria for participation in the study. The home page also displayed a message – updated in real time – about the status of the
Appendix E: (Continued)

study; that is, whether or not participants were still being accepted, and, if so, how many participant slots were still available over what time period. The message also included the current average session time, which was calculated directly from the start and stop times of those participants who had already completed their study sessions.

If no study slots were available, students could click on a button to put their email address and phone number on a waiting list to be contacted in the event slots were to open in the future. If an appointment was cancelled, an email was sent to those on the waiting list that a slot had opened and was available on a first-come-first-served basis. If sessions were not currently being scheduled for some reason a message to that effect would be provided, along with a date for when more sessions might be opened.

If slots were still available, students would click a button to continue on to the scheduling page. However, before arriving at the scheduling page, students were taken to a page that presented the participation criteria (see Figure 5). They would then click a button to continue on to the scheduling page, which was an interactive monthly calendar.
Appendix E: (Continued)

The calendar highlighted only the days on which study sessions were being held (see Figure 6). For time management purposes, study sessions were made available in roughly two-week blocks of time. This was an effort to fill each session with as many participants as possible, and, thus, maximize the time available for collecting data for this study. The days on which sessions were being scheduled contained links for the three daily study sessions.

Figure 5. Participation Criteria Page

The calendar highlighted only the days on which study sessions were being held (see Figure 6). For time management purposes, study sessions were made available in roughly two-week blocks of time. This was an effort to fill each session with as many participants as possible, and, thus, maximize the time available for collecting data for this study. The days on which sessions were being scheduled contained links for the three daily study sessions.

### Criteria for Participation in This Study
To participate in this study, you must meet the following three criteria.

1. You are an undergraduate student.
2. You possess adequate Web skills, meaning that you are not a complete novice to computers and the Internet/World Wide Web - that you know how to use a Web browser and are fairly familiar with how to get around on the Web.
3. You know little or nothing at all about how to create Web pages using HTML by itself. If you are fairly familiar with HTML - even if through the use of a design view application, such as Dreamweaver - I'm afraid I will NOT be able to use you. However, if you do not know how to create a Web page, or if you somehow create Web pages without ever seeing any of the HTML code, you would be a candidate for my study (assuming you meet the other two criteria).

**IMPORTANT**
Because my time and opportunity for conducting these study sessions are limited, it is important that you show up for your appointment (and on time). If you no-show, it may well waste a slot another person would otherwise have filled. If you cannot make your appointment, please cancel it ASAP, either online at http://techlab.fhs.usf.edu/study.htm (for which you'll need your confirmation number), by emailing me (grace@fhs.usf.edu) or by calling me at 813-985-6133.

Schedule an Appointment
Generally speaking, three session times were made available each weekday, with two hours and fifteen minutes allowed for a session. Session one ran between 9:00 AM and 11:15 AM, session two between 12:00 PM and 2:15 PM, and session three between 3:00 PM and 5:15 PM. Participants had until midnight the day before to schedule for the first session of the day, until 11:00 AM the day of for the second session, and until 2:00 PM the day of for the last session of the day.
Appendix E: (Continued)

Up to three participants could sign up for a particular session time, which meant that on a normal day up to nine subjects could participate in the study each day. Often, however, not all slots in a session would be filled, such that a session might consist of only one or two participants. There were, of course some days when one or more sessions times were not available due to conflicts in the principle investigator’s (PI) schedule. The PI could deactivate any given session if he was going to be unavailable during that period, making sure no one could schedule themselves during that time. (It should be noted, here, that this PI was the sole proctor for every study session.) In addition, “special sessions” could also be arranged for participants whose own schedules conflicted with the routine session times. Eleven such sessions were conducted, taking place at some alternate time on a weekday and consisting of a single participant. Except for the time frame, all other study sessions parameters were implemented as usual.

When a student selected (i.e., clicked on the session link) a session date and time from on the calendar, he or she was taken to the session sign-up form (see Figure 7), which asked for his or her first name only and a telephone number and email address where he or she could be reached if the PI needed to cancel that session for some reason.
Appendix E: (Continued)

To sign up for the following session please complete the form below, then click on the Sign Me Up button:

| Session #1  | Wednesday, May 11, 2005 | 9:00 AM - 11:15 AM |

CR, if you wish to return to the study session schedule, click here.

First Name ONLY: Kathy
Phone (incl. area code): 513-555-1234
Email: kath@aol.com

Sign Me Up

For questions or comments about this site, click icon: Send Email

Figure 7. The Session Sign-Up Form

After submitting the sign-up form for their selected day and time, they received a confirmation of their study session appointment containing a confirmation code they could use to cancel and/or reschedule their appointment online (see Figure 8). A link to the cancellation page was also located on the home page of the study site. An copy of the confirmation was also emailed to the address provided during sign-up.
Appendix E: (Continued)

To cancel a study session appointment online, a student would return to the study site home page and click the session cancellation button to take them to the cancellation form (see Figure 9). Online cancellation required the confirmation code given to the student when he or she first signed up.
Appendix E: (Continued)

Figure 9. The Cancellation Form.

Once the student submitted their confirmation code on the cancellation page, he or she receives a confirmation of cancellation message, with a button they could click if they wanted to re-schedule, in which case he or she would be taken to the scheduling calendar (see Figure 10). Students who cancelled their appointments were emailed an invitation to go back online and re-schedule.

Figure 10. The Cancellation Confirmation.
Appendix E: (Continued)

The study PI could also, of course, cancel a student’s appointment, which was not an uncommon occurrence. During the course of the study, 46 students no-showed for their scheduled study session. Many others cancelled by telephone or email.

Scheduling or canceling an appointment automatically updated the study database, decrementing or incrementing the overall number of slots available for the study (128), as well as the number of available study slots for each study session. Since the study Web site was controlled by this database, the management of study sessions to be largely automatic. For example, if all three slots for a session were filled, the Web site’s scheduling calendar would “gray” out (i.e., deactivate) that link, effectively “closing” that session. However, if one of the participants in a full session cancelled his or her appointment, the link for that session would automatically be reactivated and that session slot made available again, thus, re-opening that session. At the same time, the overall number of available slots for the study would be incremented by one. When all 128 slots were filled, the scheduling calendar would become inaccessible.
Appendix F: Subject Prep Checklist

Determine Their Appropriateness For Study:

1. Are you an undergraduate student?
2. Are you familiar with the Internet and the World Wide Web?
3. Are you familiar with a Web browser such as Internet Explorer or Netscape?
4. Do you think you could get around adequately on the Web?
5. Do you know how to create a Web page using only HTML code?

General Instructions and Information:

1. Overview session.
2. In the WSA program, use your best judgment for each question and task.
3. If an error occurs, first follow any instructions that might be provided. If there are no instructions or you follow the instructions and the error does not correct itself, notify me.
4. Don't share purpose of study w/ others who might wish to participate in the study.
5. Don't share answers with w/ others who might wish to participate in the study.
6. Interviews are audio taped, but identified with userid only.
7. Must complete and sign a receipt for payment - this information is kept confidential.
8. Orient to bathroom, water fountain, and vending machines.
Appendix G: Informed Consent Form

The following is the content of the consent form each participant was required to read and “sign” before being allowed to participate in the study.

<table>
<thead>
<tr>
<th>Consent to Participate in this Study</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructions</strong></td>
</tr>
<tr>
<td>Please read the following information and indicate whether or not you consent to participate in this study at the bottom of this page.</td>
</tr>
</tbody>
</table>

| **Short Title of Study** |
| Screen Designs in Web-Based Training |

| **Institutional Review Board (IRB) Status** |
| On February 5, 2004, the University of XXXXX XXXXXXX's Division of Research Compliance certified this study as having met the federal criteria as an exempt study (IRB Protocol No. 102185). |

| **Purpose of the Study** |
| The focus of this study is an inherent aspect of Web page design that could have important implications for the efficiency and effectiveness of Web-Based Training (WBT) programs. It is hoped that the results of this study will help inform current and future WBT designers in making fundamentally sound decisions about their instructional program designs. |

| **Benefits for Study Participants** |
| 1. The experience of participating in a dissertation study, especially if they are interested in pursuing a Ph.D. themselves. |

| 2. The “Basic Web Page Programming” program they will be taking during the course of this study can be considered an incentive, in and of itself – especially to students who are interested in learning how to create and/or modify basic Web pages using HTML (the basic Web page programming language). |

| 3. Each study participant will receive $20.00 in cash at the conclusion of their study session (see the section on “Compensation for Participation” below). |

| **Compensation for Participation** |
| Participants will each receive $20.00 in cash at the conclusion of their study session. Each subject receiving money will provide their full name, contact information (address, |
phone number, and email address), and signature as acknowledgment they received the payment. There will be no way to connect an individual payment record with any individual data record (see the “Confidentiality and Use of Data” section below for more information).

Confidentiality and Use of Data Collected for this Study
It is important that you understand that none of the data you generate during this study (including audio-taped interviews, if you are selected for such) will be identifiable with you in any way. The 6-digit study code with which you logged into the study site is the only unique identifier for the study records, and the study codes will have absolutely no connection to any individual identifying information.

The data generated from this study will be accessed only by XXXXXXX XXXXX (and members of his doctoral committee as needed). The data will be used in his dissertation report and may be published in the future. All data will be retained by Phillip Grace on a CD-ROM indefinitely. However, as indicated above, all data will be anonymous.

Consequences for Choosing NOT to Participate in this Study
The only negative consequences for you choosing not to participate in this study are that you would not receive the benefits delineated above under the section “Benefits for Study Participants.”

If you have any questions about any of the information above, please see the proctor. If not, please indicate your consent to participate in this study below.

________________________________________________________________________

**YES:** I have been provided an oral explanation of the study by the study's principal investigator, read the above information and consent to participate in this study.

**NO:** I have been provided an oral explanation of the study by the study's principal investigator, read the above information and DO NOT wish to participate in this study.
Appendix H: Post-Session Interview Guide

1. Overall, did you like the program interface of this instructional program? Why?
2. Did the design of program interface influence whether or not you felt satisfied with (or liked) this instructional experience? Explain.
3. Do you think that how an instructional program’s interface is constructed has an impact on how well people like the program? Explain.
4. Do you think that how an instructional program’s interface is constructed has an impact on how well people learn the material? Explain.
5. Do you prefer to have an idea of how much text is on a Web page at the start before you start reading it? Explain.
6. How do you prefer to have instructional text presented to you on a Web page: in relatively small chunks or in longer passages? Why?
7. Do you find it easier to read, understand, and remember new material on a Web page if there is a limited amount of text on the page? Explain.
8. Do you think the amount of scrolling involved in an online instructional program has any effect on your satisfaction level regarding the instructional experience? If so, in what way? Explain.
9. Do you think the amount of scrolling involved in an online instructional program has any effect on how well you learn the material? Explain.
10. If you wanted to find some information in the program you had read previously, would you prefer to have to scroll back up a page to find it, or to click back
through the previous pages where scrolling is not required to see the pages’ content? Explain.

11. Do think having to scroll down a page to view more content and/or to get to some features of an instructional program distracts you from focusing on the material? If so, how much of a distraction is it? Explain.

12. Given the choice in an online instructional program, do you have a preference between having to scroll down each page to view more instructional information or having to click a button to move between pages where you can see all of the page’s information at once? If so, why?
Appendix I: Web Skills Assessment Program (WSA)

The basic flow of the WSA is both described and graphically depicted here, beginning with the opening screen (see Figure 11). Some instruction screens and feedback screens that were displayed to study participants are not included here.

![Web Skills Assessment Program](image)

*Figure 11. The Opening Screen for the WSA Program*

Essentially, the intention of the WSA was to gauge how familiar the participant was with the types of tasks and situations he or she would be encountering during the BWPP tutorial. Its original purpose was to filter out as potential study participants those whose lack of Web (and, by extension computer) knowledge and skills might confound the study results. However, it was never used in this way. See Chapter Three for more information regarding the role of the WSA program in the study.

It should be noted that the WSA interface was primarily a full-page design, with the exception of page eight, which was intentionally designed to be a scrolling page. The
program was presented to members of both treatment groups as such. Also, while the WSA window covered the entire screen, the actual program interface was only 600 pixels wide by 450 pixels in height (again, except for page eight, whose length was intentionally exaggerated).

The first task was for the participant to enter some demographic information (see Figure 12). The primary reason for this was to see if the participant understood how to use these types of form elements to enter data on a Web page.

![Figure 12. Task 1: Using Form Elements on a Web Page](image)
Appendix I: (Continued)

The next task, shown in Figure 13, was intended to see if the participant could differentiate between certain form elements by name (at least with regard to radio buttons). The program recorded the number of tries it took the participant to make the correct selection, as well as the order of selections.

![Web Skills Assessment Program](image)

*Figure 13. Task 2: Differentiation Between Form Elements By Name*
Appendix I: (Continued)

The purpose of the next task (see Figure 14) was to gauge the participant’s understanding of the function of certain form elements. Taken together, the first three tasks of the WSA involved the specific types of form elements that the participant would encounter during the BWPP tutorial.

![Web Skills Assessment Program](image)

**Figure 14.** Task 4: Differentiation Between Form Elements By Function
Appendix I: (Continued)

Figure 15 shows the number sequencing task, where the participant was instructed to click on all the graphic numerals (i.e., white number on a black, circular background) in sequence as quickly, but as accurately, as possible. Once clicked each graphic numeral disappeared, while the number clicked appeared in the text box at the bottom of the page in the order it was clicked. The program counted the number of seconds it took for the participant to clicked all 10 numerals.

Figure 15. Task 5: Numbering Sequencing
Appendix I: (Continued)

When all numbers had been clicked, the participant was automatically taken to the next page (Figure 16) that consisted of a single link to be clicked in order to see how well he or she did on the task.

![Click here to see how well you did on the number sequencing task.](image)

*Figure 16. Link for Displaying Results of Number Sequencing Task*
Appendix I: (Continued)

The intention behind this task was to gauge the participant’s skill in using the mouse. While a scoring rubric was never developed or tested for this exercise, test runs by six different individuals of varying levels of familiarity with computers suggested that a person with functional computer skills should be able to click on all the numbers within roughly 10 to 17 seconds. Of course, this was only the most cursory of tests and lacked any credible validity or reliability measures.

When the participant clicked on the link to see how well he or she did on the number sequencing task, the WSA window automatically advanced to the next page (page 7). However, before the participant had a chance to see page 7, a new window opened on top of the WSA window. The new window displayed the results of the participant’s number sequencing task and instructed the participant to get back to the WSA window (see Figure 17).

---

You eliminated all the numbers in 9.72 seconds.

However, you did not eliminate them in order, clicking on 9 of the numbers out of sequence. Your sequence was 8, 1, 6, 3, 5, 9, 10, 7, 4, 2.

But that's OK, Kathy. Just carefully read and follow the instructions below.

You will have noticed that the information you are currently reading has come up in a new window, which has completely obscured the “Web Skills Assessment” (WSA) program window within which you were working. In other words, the WSA program is still open, but is now hidden.

Your next task is to bring the WSA program window back to the “top” of your screen where you can see it again. But DO NOT close this window to accomplish this task.

There are several ways to do this. However, if you DO NOT know how to bring the WSA program back to where you can see it, click here.

Figure 17. Number Sequencing Task Results Page
Appendix I: (Continued)

Because windows obscuring other windows is a common experience when working on the Web, and because the phenomenon might easily occur during the BWPP tutorial, the idea behind this task was to see if the participant knew how to both recognize and successfully maneuver within such a situation.

Since the new window completely covered the WSA window, the participant had at least three ways of getting back to the WSA window without closing the new window: (1) minimizing the new window, (2) using the Alt + Tab keyboard combination or (2) clicking the WSA window button located in the taskbar. If the participant successfully navigated back to the WSA window without having to close the new window, they saw page 7 of the WSA program displayed as in Figure 18.

Figure 18. Page 7 Content If New Window Was Not Closed
Appendix I: (Continued)

On the other hand, if the participant was not familiar with any of the methods mentioned above or otherwise had no idea of how to bring the WSA window “to the top,” he or she was instructed to click the link in the message. Clicking this link closed the message window, thus, revealing page 7 of the WSA program. However, if the participant clicked the link, page 7 displayed a different message (Figure 19). The program recorded whether or not this link was clicked.

![Figure 19. Page 7 Content If New Window Was Closed](image-url)
Appendix I: (Continued)

If the participant was able to get back to the WSA page 7 window without closing the new window, they were given the task of going back and closing that new window (see Figure 18 again). This could be accomplished using any of the techniques mentioned above. If the participant did not know how to do this, they were instructed to click on the link indicated, which closed the new window automatically. The program also recorded whether or not this link was clicked.

The next page in the WSA was a long that scrolled off the bottom of the screen (see Figure 20). At the top of this page was a pretense for the participant having to return to the previous page and instructions for the participant to scroll to the bottom and click on the “Previous” button located there.

Figure 20. Task 7: Scrolling To the “Previous” Button
Appendix I: (Continued)

The intent of this task was simply to see if the participant understood the concept of scrolling. The program recorded if the “Previous” button was clicked, the assumption being that the participant had performed some type of scrolling in order to reach the button.

Once back on page 7, the participant was told that the (imaginary) task had been completed after all and to click the “Next” button to continue. When page 8 displayed again, it was no longer a long, scrollable page, but conformed to the normal interface dimensions (see Figure 21). On this page, the participant was told that, next, he or she will be asked a couple of questions pertaining to HTML.

![Web Skills Assessment Program](image)

OK, Kathy. Now you're going to be asked a couple of questions pertaining to the subject you will be learning about shortly.

Click the Next button to continue.

*Figure 21. The New Page 8*
Appendix I: (Continued)

The next two pages in the WSA were questions related to the participant’s level of familiarity with HTML. The first asked about participant’s prior awareness of HTML (Figure 22) and the second about his or her level of experience using HTML (Figure 23).

*Figure 22. Question Regarding Prior Awareness of HTML*
Appendix I: (Continued)

![Figure 23. Question Regarding Experience Using HTML](image)

The last page of the WSA was simply thanked the participant for their cooperation and informing them that when they clicked the “Next” button, they would be taken to the BWPP tutorial.
Appendix J: Description of the Basic Web Page Programming Tutorial

This appendix provides a description of the structure, organization, and content of the tutorial. Please note that a full-page and a partial-page version of the BWPP tutorial were developed for this study, with both versions being identical in every way except for the amount of content contained on a page. All images of the tutorial in this appendix come from the full-page version, as its pages were more economical in terms of space.

*The Dimensions and Layout of the BWPP Tutorial Interface*

Figure 24 shows the tutorial’s title screen. The dimensions of the program interface for the full-page version was 600 pixels wide by 450 pixels in height; and neither vertical nor horizontal scrolling was required. While the partial page version was the same width, its pages varied in length, although none of its pages were less than 450 pixels high. While horizontal scrolling was not present in this version either, vertical scrolling was required for the vast majority of tutorial pages.
The layout of the program interface, keyed for identification of the interface elements, is depicted in Figure 25. Element 1 is simply the title bar of the program. Element 2 is the section header, which contained the number and title of the section a participant was currently in (in this case, Section 3: Logical and Physical Tags). The informational and instructional content of the tutorial was displayed in element 3, the content area. Element 4 is the navigation bar, which was the primary means for getting around in the tutorial. It consisted of two or three buttons, depending on the type and purpose of the page. Most pages provided three buttons (Restart, Previous, and Next), but some pages provided only the Restart and Previous buttons (e.g., the tutorial’s Main
Appendix J: (Continued)

Menu). The copyright statement is located in element five. Element 6 is the page counter, which informed the participant what page number they were on in relation to the total number of pages in the section. Element 7 is the menu bar, consisting of four buttons that provided access to a feature of the tutorial (Main Menu, Help, Resources, Glossary), as well as a Quit button, for exiting the tutorial. Finally, element 8 is the Send Email button, which could be used to email the study’s principal investigator, but also served a clandestine purpose during the tutorial. This will be discussed later.

Figure 25. Layout of the Tutorial Interface

*The Structure and Instructional Content of the BWPP Tutorial*

As discussed in Chapter Three, the “Basic Web Page Programming” (BWPP) tutorial was adapted from Dr. Tina Majchrzak’s WBT, “Internet Programming” (IP). The
Appendix J: (Continued)

IP content was abridged in order to fit the design and time frame of this study, to the effect that only five of the IP’s 15 content sections made it into the final instantiation of the BWPP.

The tutorial was structured as a linear WBT, requiring participants to complete one section before moving on to the next. It was prefaced with a welcome and orientation segment, followed by five content sections, a review section, and a final exam. The tutorial’s content was organized as follows:

1. Welcome
2. Orientation (optional)
3. Section 1: Introduction to HTML
4. Section 2: The HTML Document Structure
5. Section 3: Logical and Physical Tags
6. Section 4: Lists
7. Section 5: Images
8. Section 6: Review
9. Section 7: Final Exam

Welcome and Orientation

The Welcome segment welcomed the participant and served as the program introduction. It provided a few informational pages regarding the tutorial’s origin, its purpose, and its organization and structure. It also segued into the optional Orientation
Appendix J: (Continued)

Segment (see Figure 26), which overviewed several functional and operational features of the program, including the layout of the program interface, how to navigate within the tutorial, the primary and supplemental features of the tutorial, the final exam, and conventions used in the program (e.g., glossary words, static and interactive examples). While strongly encouraged to complete the Orientation segment, participants could choose to skip it. Not only could participants come back to it at any time, but all the information in the Orientation segment was also available in the Program’s Help feature.

![Basic Web Page Programming]

**Figure 26. Segue From Welcome to Optional Orientation Segment**

*Section 1: Introduction to HTML*

In the first content section of the tutorial, the participant was given a brief overview of what HTML is and how it is used to create Web documents. Several HTML tags and tag attributes (e.g., `<B>`/`</B>`, `<HR>`, and `Size`) were introduced and
demonstrated through static and/or dynamic examples as a way of orienting the participant to HTML as a tag language and how elements of an HTML document are expressed. (Static and dynamic, as well as interactive examples are discussed later in this appendix.) Particular focus was given to the syntax by which these tags and their attributes are expressed. Figure 27 provides a sample page from Section 1.

Section 2: The HTML Document Structure

In this section, the participant was introduced to the structure of a basic HTML document. The structure was parsed out into its main elements (e.g., head, title, body, links, etc.), with each being discussed and demonstrated in examples. More tags and attributes were introduced for formatting text and links.
Appendix J: (Continued)

Whereas Section 1 dealt with tags isolated from the HTML document, here tags were discussed in relation to the main elements of an HTML document. Participants were taken step-by-step through the creation of a basic HTML document. In addition to static and dynamic examples, interactive examples were employed so that participants could begin to actually manipulate the attributes of certain HTML elements.

Section 3: Logical and Physical Tags

Here, participants were introduced to the concepts of logical and physical tags. The ramifications for employing each category of tags was impressed upon them through examples.

Section 4: Lists

In this brief section, participants were introduced to both ordered and unordered lists. The tags and attributes for defining and customizing both types were demonstrated by examples.

Section 5: Images

This was the last and longest content section. It was here that participants were instructed in how to include graphic images into an HTML document. Participants were first shown how to place a simple, static image into the document and introduced to some of the image tag’s attributes. Through interactive examples, they were also shown how to manipulate these attributes to alter how an image is displayed in a browser. Next,
Appendix J: (Continued)

participants were shown how to make an image interactive by mapping clickable areas to the image file using the image coordinate system. Figure 28 shows a page from Section 5.

![Image](attachment:Figure28.png)

Figure 28. Sample Page from Section 5: Images

**Section 6: Review**

This section was simply a condensed review of the previous five content sections. No images or examples were included.

**Section 7: Final Exam**

The final exam consisted of 18 multiple choice questions, each with four possible answers. The questions derived directly from the tutorial’s five content sections. The exam questions and answers can be found in Appendix K, but Figure 29 is a sample of an exam question page.
A score of 78% (14 out of 18 answered correctly) was considered passing. However, before receiving their exam results, participants were required to complete the 10-item Learner Satisfaction Survey. The Satisfaction Survey was discussed in Chapter Three and the survey items can be found in Appendix M.

After completing the Satisfaction Survey, participants were given their exam results (see Figure 30). They were given their score, and told which questions they answered correctly and those answered incorrectly. A link was provided if they wished to see the correct answers to the questions they missed.
Participants were thanked for their participation and instructed to quit the program. Those participants who were randomly selected for the post-session interview were also reminded of that.

**Main Menu**

The Main Menu was accessed through its button located in the menu bar at the bottom right of the tutorial interface. It shared the same interface as the rest of the tutorial and listed all sections of the tutorial, including the Welcome and Orientation segments. Figure 31 shows the Main Menu of the BWPP tutorial. A checkbox preceded each section, but only those that had been completed were checked. Those sections already completed and the next in line for completion were accessible (a section did not become accessible until the previous section was completed). Participants
Appendix J: (Continued)

could review any section they had already completed as many times as they wished. Thus, the Main Menu served both an informational and a navigational purpose, providing a means for the participant to keep track of their progress in the tutorial, as well as a means of navigating among the sections of the program they either had already completed or section next in line for them to complete.

![Figure 31. The Main Menu](image)

**Additional Features of the Program**

The BWPP also offered several other features: Help, Glossary, Resources, and Send Email. The Help, Glossary, and Resources buttons were all located in the menu bar at the bottom right of the tutorial interface, and the Send Email button was located below the menu bar. Clicking on the buttons for any of these features, displayed that feature in its own window.
Appendix J: (Continued)

The Help button provided explanations and/or tips on a number of topics, such as navigating within the program, instructions for completing the program, and program features. All the information in the optional Orientation could also be found there. Figure 32 shows the Help window.

![The Help Window](image)

*Figure 32. The Help Window*

Clicking on the Glossary button opened a glossary of terms found in the BWPP tutorial. All terms found in the glossary were also in the body of the tutorial, appearing in bold, blue and underlined. Clicking on these “hot words” opened up the program’s Glossary to that specific term. Figure 33 shows the Glossary window.
Appendix J: (Continued)

The Resources button provided access to the other resources related to the topics in this program. Specifically, it provided extended information on HTML tags and Web character entities. Figure 34 shows the Resources window.

Figure 33. The Glossary Window
Appendix J: (Continued)

![Figure 34. The Resources Window](image)

The Send Email button brought up a short form in a new window. The form allowed participants to send a question, comment or suggestion to the study’ principal investigator from any page in the program. However, as mentioned earlier the Send Email operation was used for a more clandestine purpose, which will be discussed later in this appendix. Figure 35 shows the Send Email window.
Appendix J: (Continued)

Static, Dynamic and Interactive Examples

The BWPP tutorial provided frequent examples of three types throughout the content sections: static examples, dynamic examples, and interactive examples. The type of example employed for a particular concept or topic depending on the nature of that concept/topic and how much screen real estate the example needed. While all static and some dynamic examples displayed entirely within the tutorial’s content area, some dynamic and all interactive examples opened a new window that displayed the results of the example code.

Static examples, like the one depicted in Figure 36, were not dynamic or interactive in any way. They illustrated a point via simple text or graphics and required no action by the participant.
Dynamic examples illustrated a point in a two-part fashion. First, when the page loaded, it displayed the example’s code view; that is, how the particular HTML element being discussed was written as source code. Participants would click the code view’s “Let’s See It” button to display the results view, which showed how the code would display in a browser.

Sometimes the dynamic examples were constructed to display both the code view and results view entirely within the tutorial’s content area. Figures 37 and 38 depict this type of dynamic example, with Figure 37 showing the code view and Figure 38 showing the results view. Clicking the “Let’s See It” button in the code view toggled to the results view and clicking on the “View Code” button in the results view toggled back to the code view.
Appendix J: (Continued)

Figure 37. Dynamic Example: Code View

Figure 38. Dynamic Example: Results View in Content Area
Appendix J: (Continued)

Some dynamic examples, however, did not display the result code in the tutorial’s content area, but rather displayed the results view in its own window (see Figure 39).

![Figure 39. Dynamic Example: Results View in New Window](image)

Interactive examples employed text areas for the code view, allowing participants to change the code information (e.g., size attribute values). When the “Let's See It” button was clicked, the results view was displayed in a new window. However, the if the participant changed any of the information in the code view, the results view reflect the changes made by the participant. Figures 40 and 41 depict an interactive example, with Figure 40 showing the code view and Figure 41 showing the results view.
Appendix J: (Continued)

Figure 40. Interactive Example: Code View

Figure 41. Interactive Example: Results View
Appendix J: (Continued)

Most of the interactive examples provided some level of help. Participants could access this help by clicking the “Click here for help” link that was located somewhere on the page (see Figure 42). When this link was clicked, the contents of the example box essentially did what the participant was being instructed to do (see Figure 43). Clicking on the “Hide Help” link toggled the code view back to its initial state.

![Figure 42. Interactive Example: Help Link](image)

<table>
<thead>
<tr>
<th>Try changing the width in the example below to “30,” then click &quot;Let's See It&quot; to see what happens. Feel free to experiment. Click here for help.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;IMG SRC=&quot;happy.gif&quot; ALT=&quot;Smiley Face&quot; WIDTH=&quot;67&quot; HEIGHT=&quot;66&quot;&gt;</td>
</tr>
<tr>
<td>Let's See It</td>
</tr>
</tbody>
</table>

| Figure 42. Interactive Example: Help Link |

<table>
<thead>
<tr>
<th>Try changing the width in the example below to “30,” then click &quot;Let's See It&quot; to see what happens. Feel free to experiment. Hide Help.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;IMG SRC=&quot;happy.gif&quot; ALT=&quot;Smiley Face&quot; WIDTH=&quot;30&quot; HEIGHT=&quot;66&quot;&gt;</td>
</tr>
<tr>
<td>Let's See It</td>
</tr>
</tbody>
</table>

| Figure 43. Interactive Example: Help View |

**Intentional Program Errors**

During the design process of the BWPP tutorial, there was a concern that participants might not take the opportunity to engage in any of these activities on their
own, resulting in a very limited experience of the tutorial interface. The decision was
made, therefore, to induce participants to engage in some of these tasks by introducing a
limited number of artificial program errors into the tutorial. Of course there was also the
concern that such errors would artificially skew participants’ satisfaction level. It was
decided the risk of negatively impacting participants’ satisfaction level was outweighed
by the potential benefits of participants having a fuller experience with the program
interface.

In the end, four such errors were embedded in the tutorial, one each in content
sections 1, 3, and 5, as well as in the Final Exam instructions. When a participant landed
on a page containing one of these errors, an error message and instructions for correcting
the error were displayed (see Figure 44 for one of these error messages). After following
the instructions, the error would be “corrected” and the participant would be able to
continue with the tutorial. Once corrected, the error would never reappear again no matter
how many times the participant viewed that page (e.g., during a review of a section).

The error introduced in Section 1 instructed the participant to click the “Previous”
button at the bottom of the screen, then when he or she was on the previous page, to click
the “Next” button again. The section 3 error had the participant click the “Restart” button
at the bottom of the screen, then when the restart options appeared, the participant was to
click the “Restart Section 3: Logical and Physical Tags” option. The error in Section 5
told the participant that an image on the page could not be found and instructed him or
her to notify system administrator by clicking on the “Send Email” button at the bottom
of the page. The last error message, displayed during the instructions for the final exam, told the participant to click the “Main Menu” button at the bottom of the screen, then when the Main Menu appeared, to click the “Section 7: Final Exam” option. These four errors were designed to force the participant to make use of the “Previous,” “Restart,” “Send Email,” and “Main Menu” buttons, respectively, at least once during the tutorial.

![Figure 44. Example of an Artificially Introduced Program Error](image)
Appendix K: The *Basic Web Page Programming* Exam Items

Note: asterisks indicate the correct response.

1. Which tag is used to create a bulleted list?
   * A. UL
   B. OL
   C. LI
   D. BI

2. Which tag causes the browser to display a bullet or number (depending on the kind of list in which it is used)?
   A. OL
   B. UL
   * C. LI
   D. TYPE

3. Which tag allows you to specify either an exact or a relative size for text?
   A. SMALL
   * B. FONT
   C. BIG
   D. REL

4. What is the minimum number of opening LI tags required for a list with 3 bullets?
   A. 1
   B. 2
   * C. 3
   D. 4
Appendix K: (Continued)

5. Which tag is used to mark text as bold?

* A. B
B. D
C. BOLD
D. DARK

6. Which tag must all browsers render the same?

A. STRONG
B. EM
* C. I
D. KBD

7. Different browsers may render which of the following tags as they see fit?

A. I
B. IT
* C. EM
D. U

8. In general, what will a browser do with a tag it does not recognize?

A. report an error
* B. ignore it
C. replace it with a close match
D. fix it
9. Which attribute of the image tag must be set to 0 (zero) to disable the box that appears around a clickable image?
   * A. BORDER
   B. BOX
   C. SUBJECT
   D. ALT

10. Given the tag specification <I></I>, which of the following would be valid ways to use this tag?
    A. more than one of the following
    B. <I>text</I>
    * C. <I>text</I></I>
    D. </I>text<I>

11. Which heading level tag will be displayed most prominently?
    A. HR
    B. H0
    * C. H2
    D. H6

12. Which attribute is used to change the look of a bullet?
    A. VALUE
    * B. TYPE
    C. LOOK
    D. NAME
Appendix K: (Continued)

13. Which attribute of the image tag is used to specify what nongraphical browsers will see and what graphical browsers see while waiting for the image to download?

A. BORDER
B. BOX
C. SUBJECT
D. ALT

14. Given the start tag <FONT SIZE="+1">, what should the end tag look like?

A. more than one of the following
B. </FONT SIZE="+1">
C. </FONT SIZE="-1">
D. </FONT>

15. In the image coordinate system, where is the origin (0,0) for the image?

A. center
B. top, left
C. top, right
D. bottom, left

16. What is the minimum number of opening UL tags required for a list with 3 bullets?

A. 1
B. 2
C. 3
D. 4
Appendix K: (Continued)

17. On a page that includes an image with text following it, the text that follows may or may not appear to download at a different rate of speed when the width and height of the image are specified. Will that rate be faster, slower, the same, or depend on the size of the image?

* A. faster
B. slower
C. same
D. depends on image size

18. Which tag is used to create a numbered list?

A. LI
B. LN
C. NL
* D. OL
My Opinion on the Courseware and Exam

Dear Philip,

I did not compare your adaptation with my content, side by side. However, I carefully read through all of your material and found it to reflect well the information I covered in my courseware, with the exception of the sections on the Internet, Development/Design, Frames, and some information that would have been gleaned by the students when completing the assignments. I agree with the items you chose to eliminate from the posttest. I would add that questions 2 (refers to frames) and 11 (refers to information learned when completing the table assignment) should also be eliminated.

I feel that the course is reasonable as you have rendered it. The sections and questions eliminated are reasonable ways to reduce the length of the courseware for the purposes of your study. The content is viable and of interest in its reduced state. I would recommend that you check the Cronbach's alpha based on my data for the reduced question set represented in your exam in order to estimate the possible reliability of your instrument and to make sure it is high enough for your purposes.

I find your adaptation to be of the highest quality.

Happy Data Collecting,

Tina L. Majchrzak, Ph.D.
Appendix M: Learner Satisfaction Survey Questions

The following are the satisfaction survey questions that were presented to all study participants immediately following the submission of their individual final exam answers for scoring, but before they receive their score. The response to each survey item was on a five-point Likert scale, where 1 was *strongly disagree* and 5 was *strongly agree*.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I liked the way the program was designed.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>2.</td>
<td>The program was easy to navigate.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>3.</td>
<td>Working with the program was satisfying.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>4.</td>
<td>All features of the program were easily accessible.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>5.</td>
<td>The program design was efficient.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>6.</td>
<td>The program design was pleasing.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>7.</td>
<td>The program design was user-friendly.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>8.</td>
<td>The program design was effective.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>9.</td>
<td>The program design was intuitive.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>10.</td>
<td>The program design was easy to work with.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>
Appendix N: Web Form for Entering Post-Session Interview Data Into Database

Figure 45 shows part of the Web form for entering the post-session interview data into the database. For each question, the radio button for the participant’s discrete response to that question is selected. The transcription of the interview interaction between the interviewer and study participant is entered in the pop-up Transcription Window, which is opened by clicking on the “Transcribe” link for that particular question.

![Web Form for Entering Post-Session Interview Data in Database](image)

*Figure 45. Web Form for Entering Post-Session Interview Data in Database*
The following is a transcript from a post-session interview conducted on May 5, 2005 with participant number 311425. Please note that “I” refers to the questions and comments of the interviewer (also italicized), and “P” refers to the responses of the study participant being interviewed. Also, ellipses within the text indicate unfinished statements.

I:  [Question 1] Overall, did you like the program interface of this instructional program?

P:  I did. It was really easy to navigate. You know, it helped me out.

I:  So, it was easy to function within?

P:  Right.

I:  [Question 2] Did the design of program interface influence whether or not you felt satisfied with (or liked) this instructional experience?

P:  Yeah, I think it did in a way because if it was hard for me navigate thru it, it would have taken me more time to kind of figure out what exactly I needed to do to get to the next page or what I needed to do to, you know, finish the section or things like that. So I think it did, you know, help me a little bit.

I:  If any aspect would have been aversive, would it have had an effect?

P:  Yeah. I think so.

I:  [Question 3] Do you think that how an instructional program’s interface is constructed has an impact on how well people like the program?
Appendix O: (Continued)

P: I think it does because that's partly also what grabs their attention and keeps them, you know, motivated - interested - in the program itself. So I think it does effect how they feel about it.

I: [Question 4] Do you think that how an instructional program’s interface is constructed has an impact on how well people learn the material?

P: No, I don't think so. How well they learn it? no. Because the navigation has nothing to do with the actual topic or whatever you're reading. The information is still going to be there. Whether you get to it or not, you're still going to have the opportunity to learn. Navigating thru it is just kind of keeping yourself there and being able to get there.

I: So you see the two as being distinct?

P: Right.

I: So learning can exist outside how that learning is facilitated?

P: Right.

I: [Question 5] Do you prefer to have an idea of how much text is on a Web page at the start before you start reading it?

P: Yeah. I think too much text will kind of lead the reader off in a way that you kinda get, you know, its too much text, you're reading your eyes. It's a computer, so you're looking at a screen already as it is. I wouldn't put that much text on a page.

I: Why? Do you think it's harder to read on a computer screen?

P: It's not harder to read, but it just gets kinda... you're looking at words on a computer screen, it gets kinda tiring after a while just looking at the words.
Appendix O: (Continued)

I: *Do you get as tired reading as much text in a book?*

P: I think a book is more tiring than reading it on a computer.

I: *So if you see a page that you realize scrolls off the page, you prefer to gauge how much you're going to have to put into this?*

P: Yeah. To see how much...

I: [Question 6] *How do you prefer to have instructional text presented to you on a Web page: in relatively small chunks or in longer passages?*

P: Small chunks. For the same reason as on the previous question; too much text on a page will kinda just bore me or I wouldn't really be interested, you know. Getting small chunks, I also learn it a lot easier than taking it all at once. Little by little, I'll learn it a lot better.

I: [Question 7] *Do you find it easier to read, understand, and remember new material on a Web page if there is a limited amount of text on the page?*

P: Yeah, you know, the same thing. If I take it smaller, taking than more at a time, then I know that I'll actually comprehend it, learn it, than actually just reading it, not knowing what I'm reading.

I: *Do you get a better sense of progress with smaller chunks? Do you get a sense of accomplishment by having finished three smaller paragraphs as opposed to one longer paragraph?*

P: Oh yeah. I think that definitely that way because you've finished one and in your mind your understand that there's two more to accomplish, so you've already accomplished
Appendix O: (Continued)

one thing. But by knowing that you have a one whole section to complete then you
don't have anything... there's no progression there. You've just completed one section.

I:  *Do you think it may be easier to find primary points in smaller paragraphs?*

P:  No I think it's easier knowing the primary point of the paragraph. Like I said, that way
you can comprehend the information and actually learn it than just trying to find the
topics or trying to find the points.

I:  *And it's easier to do that in smaller chunks?*

P:  Yeah.

I:  *[Question 8] Do you think the amount of scrolling involved in an online instructional
   program has any effect on your satisfaction level regarding the instructional
   experience*

P:  No, I don't think the scrolling had anything... no effect.

I:  *So, is that because your used to scrolling?*

P:  Yeah.

I:  *[Question 9] Do you think the amount of scrolling involved in an online instructional
   program has any effect on how well you learn the material?*

P:  No, I don’t think so at all.

I:  *[Question 10] If you wanted to find some information in the program you had read
   previously, would you prefer to have to scroll back up a page to find it, or to click
   back through the previous pages where scrolling is not required to see the pages’
   content?*
Appendix O: (Continued)

P: No, I think it's easier to just scroll up and see the information than having to go back and having to, you know, regress – is that what it is? – to go back, and so I think it's easier scrolling up.

I: So you have no problem orienting yourself to where that previous information was scrolling up?

P: No, not at all.

I: [Question 11] Do think having to scroll down a page to view more content and/or to get to some features of an instructional program distracts you from focusing on the material?

P: No, I don't it did at all. No. it didn’t distract me at all.

I: [Question 12] Given the choice in an online instructional program, do you have a preference between having to scroll down each page to view more instructional information or having to click a button to move between pages where you can see all of the page’s information at once?

P: I think it's be better to actually click, that way you could see the whole information on the page, rather than actually scrolling down and seeing that information because it puts less information on one page. That way, like I said, too much information pushes the reader away. I think that having them on separate page gives the reader the option to look at it or not if he or she wants to. If not, it's on the page; they have to look at it, you know.

I: So do you think its easier to digest if you’ve got that little amount of information?
Appendix O: (Continued)

P: Right. Yeah.

I: In a scrolling version, do you think that it’s a temptation just to scroll down – you see a lot of text on a page, do you think it’s a temptation just to scroll past some of this stuff? Are you more likely to read all the information if it’s in smaller chunks, like where it’s kind of like a book – you see the entire thing or if the text is scrolling off the page?

P: Yeah, I think with the scroll, you get tempted to just like scroll and you skip thru it and not really read it. But if it's there and it's set and you cannot scroll, then I think that you would actually read all of it and not miss anything.

I: Do you agree with this statement: that if it's in smaller chunks and you see all of the page’s content that it's more acceptable, in terms of “I can accept having to expend effort to read this, as opposed to “Good God, look at what’s all down here. I don’t want to read all this stuff?”

P: Yeah, I do agree with that. I did, it is.

I: Alright. Do you have any general comments about the interface or any part of this study? [The participant asked what was going to be done with the study once it was complete, but I redirected him back to the last question.]

P: No.
About the Author

Phillip E. Grace has 23 years of experience in instructional design, training, and training event coordination at the University of South Florida’s (USF) Louis de la Parte Florida Mental Health Institute in Tampa. His last job title at the Institute was Coordinator of Education and Training Programs.

Phillip has developed live, Web-based and CD-ROM instruction. From 1999 to 2005, he developed a ColdFusion-based Web learning site for mental health care providers that served 6,000 individual and group contract customers. For this Web-learning initiative, he designed, programmed, evaluated, managed, and provided technical support for a number of fee-based and free instructional programs covering a variety of mental health related topics.

Phillip is scheduled to receive his doctorate in Instructional Technology at USF in spring 2006. He also holds a B.A. in anthropology and an M.A. in applied medical anthropology, both from USF.

Phillip now resides in Chapel Hill, North Carolina.