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This chapter focuses on the user interface and instructional design of on-line materials: accessibility, aesthetic appeal, consistency and layout, customizability and maintainability, help and support documentation, intimacy and presence, metaphors and maps, and other items.

Assessing the Usability of On-Line Instructional Materials

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Although cognitive and educational psychologists have studied learning for decades, establishing just how moving conventional instruction on-line improves or detracts from learning continues to be hotly debated. And along with the fundamental challenge of defining learning and how we implement Web-based instruction (WBI), we also need to pay attention to the interface challenges posed by these evolving domains (Rappin, Guzdial, Realff, and Ludovice, 1997).

Research on user-centered design, usability, and human-computer interaction can provide instructors with numerous informal but powerful methods to help them design WBI that is functional and supports the range of activities that users are expected to perform and is aesthetically pleasing and supports user expectations, scanning, search, and reading goals.

A Sociocognitive Model of On-Line Instruction

Before describing methods that can help instructors understand user behavior and design usable WBI, it is important to acknowledge that all instruction, whether on-line or conventional, involves interaction. Moore's notion of transactional distance (1992) is critical to understanding how on-line or distance education interacts with and complements traditional definitions of education, focusing on the amount and types of interaction that occur between learners and instructors and among learners, instructors, and overall WBI design. Education therefore can be viewed as a continuum of transactional offerings, where the specifics of media and mediation are less

important than their variety and quality. In this light, it seems more appropriate to frame different educational approaches in terms of whether they are same time–same place instruction or same time–different place instruction.

As unpredictable as learners may be, it is still possible for instructors to develop an instructional plan that anticipates five critical dimensions of all instructional situations: learner background and knowledge, learner tasks, social dynamics, instructional objectives, and learning environment and tools.

Learner Background and Knowledge. Research on hard-copy and on-line documentation suggests that users do not read documentation (Rettig, 1991). This perspective toward users is only partly true: users do not read documentation unless they think they need it (motivation is a critical issue in all learning), and when they do read documentation, they do so strategically: satisficing, skipping, scanning, and skimming.

Human-computer interaction and usability researchers have spent considerable energy trying to anticipate user types, backgrounds, and behaviors. Kearsley (1988), for example, describes three levels or dimensions of user experience: expertise with the computer, the particular task domain, and the particular application software.

Another method of describing learners is in terms of their demographic characteristics, for example, their level of education, economic standing, geographical placement, subcultural values and expectations, or age. This perspective toward users finds its roots ultimately in the North American Industry Classification System (NAICS), produced by the U.S. Department of Commerce, which influences most contemporary marketing analyses of audiences' tastes and preferences.

Learning styles as well influence the way users access information (Kolb, 1984). Felder (1993) suggests that students can be characterized broadly in terms of the type of information they prefer (sights, sounds, or texts), their preferred modality (visual or verbal), their preferred organization of information (inferred or deductive), their approach to processing information (active versus reflective), and how they move toward understanding (sequentially or holistically). Mehlenbacher, Miller, Covington, and Larsen (2000), for example, found that reflective, global learners tended to perform better than hands-on, sequential learners in Web-based courses on communication for engineering and technology.

Finally, it is important to note that learners are subject to a host of particular emotional, motivation, and affective attributes (Mehlenbacher, 2000). User-learners often hold mistaken models of the problems they are working with, and these user misconceptions (Mirel, 1998) can produce "problem tangles" that lead to increasingly confusing mismatches between instruction and user representations of the original problem. These problematic user situations can generate serious errors unless instructors are able to anticipate them in advance to account for them in the WBI.

Learner Tasks and Activities. Users in general move recursively through six goal states as they attempt to work with any on-line environment (Duffy, Palmer, and Mehlenbacher, 1993):

1. Representing problems. Users, guided by prior experience and their ability to apply that experience to their particular situations, attempt to understand their situation or problem as they work through it.
2. Accessing information. Users identify instructional materials relevant to their problem representation and attempt to access them.
3. Navigating information. Users navigate to particular topics, a considerable challenge for many on-line learners.
4. Scanning information. Users search for particular headings, information items, or instructions related to their problem representation.
5. Understanding information. Users attempt to comprehend the instructional text and graphics, a process that is easier to summarize than to produce (Barker, 1998; Schriver, 1997).
6. Transferring information. Users take what they have learned back to the class assignments, discussion, and exercises.

Importantly, these six goals of the general learner orientation, “How do I . . . ?” are usually framed by cognitive dissonance: “What is due next? Where are the examples of this exercise? What do I need to read to prepare for the next assignment?” and so on.

Social Dynamics. Stelzer and Vogelzangs (1995) stress that the greatest challenge facing on-line instructors is how to generate a high level of student-faculty interaction, given that the greatest difficulty that on-line students experience is feeling isolated and keeping their motivation high. For this reason, carefully anticipating how Web pages, bulletin boards, chat environments, whiteboards, commenting and annotation tools, and e-mail or listservs will work together can allow instructors to anticipate some of the general problems their on-line students are likely to encounter. Limiting the number of tools that instructors integrate into their WBI is one way of decreasing up front the user problems that can occur.

Instructional Objectives. Savery and Duffy (1995) define problem-based learning (PBL) as learner understanding based on experiences with content, context, and the learner’s goals, where meaning is not transmitted but contextualized, puzzlement motivates learning, and social negotiation and trial and error are important aspects of all learning situations.

Instructors should therefore operate as coaches or facilitators, an orientation that for many requires a significant reorientation. Rather than focusing on the one-way communication of course content, instructors need to communicate instructional objects through discussion, elaboration, confirmation, sharing, questioning, introducing, and adapting. As much as possible, on-line students need to be able to take an active role in the learning process, not only for motivational reasons but also for practical ones:

instructors cannot possibly hope to keep up with the incoming requests for their direction if their students default to them as the single authority for the class content.

Learning Environment and Tools. Moore (1992) suggests that as more instructors move their classrooms on-line, another type of interaction will become increasingly important: student-environment interaction (see Khan, 1997, for numerous chapters that focus specifically on this dimension). The environment in general refers to the physical or Web-based location for learning, which may include specific on-line tools that students interact with, such as e-mail, listserv programs, MOOs (multi-user domains, object-oriented), chatrooms, network file exchange platforms, forums, and computer-conferencing software (Eldred and Hawisher, 1995). Environments may be well designed and easy to navigate, convenient, reliable, accurate, and comprehensive, or they may be the opposite.

Usability Testing WBI

Instructors and information developers interested in learning more about usability testing should acquaint themselves with the numerous resources available on the subject (Alder and Winograd, 1992; Dumas and Redish, 1993; Hackos and Redish, 1998; Nielsen, 1997; Nielsen and Mack, 1994; Rubin, 1994).

Many different approaches to usability testing exist, ranging from contextual inquiry to interviews and surveying to focus groups and market analyses to direct user observation.¹ Importantly, every method has its strengths and weaknesses, and readers interested in learning more about the details of usability approaches should consult Mehlenbacher (1993).

For the purposes of this chapter, I recommend that observation-based usability testing combined with the talk-aloud protocol method is probably the least expensive and most rewarding data-collection approach for instructors to take. To run an observation-based usability test and talk-aloud protocol, instructors simply ask users (representative of their intended audience) to perform four or five tasks with the WBI while talking aloud. The usual test duration is thirty minutes to one hour and includes having users sign consent forms that allow the instructor to analyze the data collected from their audiotaped or videotaped session, demographic information surveys, and posttest questionnaires that focus on quantitative reactions to the WBI.

Heuristic Evaluation of WBI

Mack and Nielsen (1994) warn that “usability inspection methods are well suited as part of an iterative design process where they can be combined with other usability evaluation methods like user testing” (p. 19). Heuristic procedures, unlike rule-governed procedures, gain their strength from their

flexibility, allowance for intuition and judgment, and general goal of problem solving (see Table 11.1 for an extensive list of heuristic questions for evaluators to consider as they design WBI).

Table 11.1. Usability Design Principles for WBI

Usability Design Principles for Web-Based Instruction (WBI), 1 of 2 (cf. Najjar, 1998; Nielsen, 1994; Selber, Johnson-Eilola, and Mehlenbacher, 1997)

Accessibility	<p>Has the WBI been viewed on different platforms, browsers, modem speeds?</p> <p>Is the WBI ADA compliant (e.g., have you avoided the use of colors such as red and yellow which are problematic for visually challenged users)?</p> <p>Have you consulted the Center for Applied Special Technology's Bobby (http://www.cast.org/bobby) or W3C's Web Assessibility Initiative (http://www.w3.org/WAI)?</p>
Aesthetic appeal	<p>Does the design appear minimalist (uncluttered, readable, memorable)?</p> <p>Are graphics or colors employed aesthetically?</p> <p>Are distractions minimized (e.g., movement, blinking, scrolling, animation, etc.)?</p>
Authority and authenticity	<p>Does the WBI establish a serious tone or presence?</p> <p>Are humor or anthropomorphic expressions used minimally?</p> <p>Is direction given for further assistance if necessary?</p>
Completeness	<p>Are levels clear and explicit about the "end" or parameters of the Web-based course?</p> <p>Are there different "levels" of use and, if so, are they clearly distinguishable?</p>
Consistency and layout	<p>Does every page begin with a title/subject heading that describes the contents?</p> <p>Is there a consistent icon design and graphic display across pages or screens?</p> <p>Are the layout, font choices, terminology use, colors, and positioning of items the same throughout the WBI (<4 of any of the above is usually recommended)?</p>
Customizability and maintainability	<p>Does printing of the WBI require special configuration to optimize presentation and, if so, is this indicated in the documentation?</p> <p>Are individual preferences/sections clearly distinguishable from one another?</p> <p>Is manipulation of the WBI possible and easy to achieve?</p>
Error support and feedback	<p>When users scan or select something does it differentiate itself from other information chunks or unselected items?</p> <p>Do cross-references, menu instructions, prompts, and error messages (if necessary) appear in the same place on each page or screen?</p>
Examples and case studies	<p>Are examples, demonstrations, case studies, or problem-based situations available to facilitate learning?</p> <p>Are examples divided into meaningful sections (e.g., overview, demonstration, explanation, and so on)?</p>
Genre representation	<p>Is task-oriented help or support materials easy to locate and access?</p> <p>Is the WBI's "table of contents" or main menu organized functionally, according to user tasks and not according to instructional jargon or generic "topics"?</p>

Table 11.1. (Continued)

Usability Design Principles for Web-Based Instruction (WBI), 2 of 2

Intimacy and presence	Is an overall tone of the WBI present, active, and engaging? Does the WBI act as a learning environment for users, and not simply as a warehouse of unrelated topics or links?
Metaphors and maps	Does the WBI establish an easily recognizable metaphor that helps users identify additional instructional materials in relation to each other, their state in the system, and options available to them?
Navigability and user movement	Does the WBI clearly separate navigation from content? How many levels down can users traverse and, if more than three, is returning to their initial state easy to accomplish? Can users see where they are in the overall WBI at all times? Do the locations of navigational elements remain consistent (e.g., tabs or menus)? Is the need to scroll or traverse multiple pages for a single topic minimized across screens or pages?
Organization and information relevance	Is a site map or comprehensive index available? Is the overall organization of the WBI clear from the majority of pages or screens? Are primary options emphasized in favor of secondary and tertiary ones?
Readability and quality of writing	Is the text in active voice and concisely written (>4 <15 words/sentence)? Are terms consistently plural, verb + object or noun + verb, avoiding unnecessarily redundant words? Does white space highlight a modular text design that separates information chunks from each other? Are bold and color texts used sparingly to identify important text (limiting use of all capitals and italics to improve readability)? Can users understand the content of the information presented easily?
Relationship with real-world tasks	Are terminology and labeling meaningful, concrete, and familiar to the target audience? Do related and interdependent WBI functions appear on the same screen or page? Is sequencing used naturally, if sequences of common events are expected? Does the WBI allow users to easily complete their transactions or tasks on-line?
Reliability and functionality	Do all the titles, menus, icons, links, and opening windows work predictably across the WBI?
Typographic cues and structuring	Does the text employ meaningful discourse cues, modularization, chunking? Is information structured by meaningful labeling, bulleted lists, or iconic markers? Are legible fonts and colors employed? Is the principle of left-to-right placement linked to most-important to least-important information?

Conclusion

On-line learning environments are still very much in their infancy, and despite enthusiastic claims that such teaching and learning environments readily exist, instructors and students are still faced with a significant learning curve. Integrating usability testing approaches into the design process

can help instructors anticipate some of the problems their students are bound to encounter in providing on-line learning materials that are engaging, memorable, and easy to read and use.

Note

1. See Horn, "The Usability Methods Toolbox," <http://jthom.best.vwh.net/usability/usable.htm>; Instone, "Usable Web," <http://usableWeb.com>; and Nielsen, "Usable Information Technology," <http://www.useit.com>.

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