

User-centered Design for Informational Websites

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The Web has become an enormous information source. The Google.com search engine claims to search over one billion Web pages, and current estimates say that the Web contains about 2.5 billion pages. As the Web continues to grow, it becomes more and more important for us to focus on user-centered design issues such as information accessibility and availability. This paper explains how user needs and goals determine accessibility and how CLR (cross-language retrieval) can increase availability.

As researchers, students, and the general public begin to use the Web as an information tool, we should consider their differing needs and goals. The Web has become one of our largest information resources. Digital library initiatives are providing a range of Web-based services, from current holding searches to actual content. There are also over 700 electronic journals being produced, and the number continues to grow. (Jul, 1992). Informational Websites offer numerous advantages: multiple users can simultaneously use the same resources from often prohibitively large distances. However, placing information on the Web does not guarantee that it will be usable.

User Needs and Goals

Dreyfus has identified five stages of use that define user needs: Novices, advanced beginners, competent performers, proficient performers, and expert performers (Dreyfus 1986). In Dreyfus' model, only 1-2% of users ever reach the expert performer stage. However, these users make up a large percentage of the informational Website development community. As a result, many of the design approaches and features seen in informational Websites are designed by and for only 1-2% of users.

Most users are classified as advanced beginners. Unlike novices, the advanced beginner is interested in learning and has a basic conceptual model of how the Web works. Advanced beginners require overview information to manage their cognitive overhead (Hammond and Allinson, 1989). Without overviews and help systems, advanced beginners become disoriented in hypertext systems and their actions are likely to be unsuccessful (see Conklin, 1987 for a discussion of cognitive overhead and disorientation). As they explore, advanced beginners need to know where to go next, how they arrived at a particular page, and how to return to the "beginning."

Informational Websites such as digital libraries normally focus on query-based navigation (see figure 1). Individual information resources are not linked together, so the main navigation is through a query and its results list rather than through a typical hypertext structure. Query-based navigation often provides very powerful Boolean searching and pattern matching and searches that can be filtered by field, author, or even media type. These options are very useful to expert users, who have experience with advanced search features. However, the majority of users do not know how to use advanced search features (Liebscher and Marchionini, 1988; Marchionini, Dwiggins, Katz, 1993). Without this knowledge, they have trouble using search facilities and are often unable to find their desired information.

If available, advanced beginners rely on other users to answer their questions. In a traditional library, they would ask the librarians for assistance. In one survey, 35% of traditional library users responded that they have never searched the library catalog (Kim and Little, 1987). For the advanced beginner, information retrieval and research is a collaborative activity (Ehrlich and Cash, 1994; King, *et. al.*, 1994; Marshall, *et. al.*, 1990; Schnase, *et. al.*, 1994). They are more successful when paired with a more experienced user who has more knowledge of their subject domain and/or the information retrieval facilities. Unfortunately, they do not have access to a librarian in an information Website. Experts, with their enhanced knowledge of their subject and the information retrieval facilities, are comfortable with iterative and exploratory querying (Bates, 1989; Morris, 1994). They do not need assistance, so they are often as successful and efficient with a digital library as with a traditional library.

The screenshot shows the ACM Digital Library search page. At the top, there is a navigation bar with links: library home, list alphabetically, list by SIG, search library, register DL, subscribe DL, and feedback. Below the navigation bar is the ACM logo and the text "ACM Digital Library search". The main area is titled "Search the Digital Library". It contains several search fields and options:

- Search Articles:**
 - Terms:** A text input field with search operators: all words, any words, exact phrase, subject, expression, stem.
 - In Fields:** A list of search categories with counts:
 - Title (64,016) Reviews (2,654)
 - Full-Text (56,926) Index Terms (52,428)
 - Abstract (18,175) (Number of articles)
- Authors:** A text input field with search operators: all names, any name, expression, soundex.
- Limit Your Search To:**
 - Publication:** A dropdown menu set to "All Journals and Proceedings".
 - Published Since:** Month and Year dropdown menus.
 - Published Before:** Month and Year dropdown menus.

At the bottom left is a "search" button.

Figure 1. ACM's Digital Library (acm.org)

Designing for Accessibility

Since advanced beginners have trouble with query-based navigation, we must provide alternate navigational tools. Online documentation systems typically provide a table of contents (TOC) and index. Research has shown that users prefer and are more successful using a TOC and index than using a search facility (Soderson, 1987; Gordon, *et. al.* 1988). In a study comparing indices to TOCs, users were found to prefer the index (Nichols, 1996). These studies suggest that most users would benefit from TOCs and indices in informational Websites. They also suggest that most users would use a TOC and index more often than a search facility.

Current research in the design of TOCs suggests that users feel overwhelmed by deep menus. Less experienced users expect online TOCs to mimic print TOCs: they want to start with broad, generic categories and then drill down to more specific categories (Marchionini, 1989). Search time and errors have been shown to increase with depth, and user preference has been shown to decrease with depth (Kiger, 1984; Jacko, and Salvendy, 1996). Obviously, informational Websites will require large TOC hierarchies. Based on this research, informational Websites should provide TOCs that are narrow at the top and bottom and wide in the middle. This combination has been shown to be most effective among a wide range of users (Lee and MacGregor, 1985; Norman, 1991).

An index is a highly successful navigation tool when it includes the user's search term. In one study with print indices, users were 75% successful when their term appeared in the index. When their term did not appear in the

index, the users' success rate dropped to 4% (Yussen, *et. al.*, 1993). This research suggests that standardized keyword lists and synonyms are extremely valuable in index development.

Increasing Availability

With the growing popularity of Spanish and Chinese on the Web, English will soon be displaced as the Web's most popular language. Cross-language retrieval (CLR) research seeks to provide accessibility across multiple languages. This research is focused on a number of solutions, including interactive query formulation, query enrichment, and cognate matching (Ballesteros and Croft, 1997; Buckley, *et. al.*, 1997; Davis, *et. al.*, 1997; Jordan, *et. al.*, 1993; Hayaski, *et. al.*, 1997; Resnik, 1997). Current CLR projects include SPIRIT (English, French, and German), CRISTAL (English, French, and Italian), TransLib (English, French, German, Spanish, and Greek). Altavista's BabelFish supports English, Spanish, German, Portuguese, French, Italian, Russian, Japanese, Korean, and Chinese. Although CLR approaches are still prone to errors and decrease search efficiency, they are increasing availability of non-English documents. Unlike other approaches, such as Unicode, CLR is a query-based approach and does not require changes to the information. It remains to be seen how CLR approaches might be applied to TOCs and indices, but CLR is definitely increasing availability.

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