Universal Design & The Web: Techniques, Problems, and Solutions

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Abstract: Universal web design is the practice of designing and developing web content that is accessible to the broadest possible audience, including people with disabilities. The World Wide Web Consortium (W3C) published its Web Content Accessibility Guidelines 1.0 in May 1999. More recently, Adobe has built accessibility features into its Portable Document Format (PDF) and Macromedia has similarly equipped its Flash platform with accessibility features. However, research continues to show that few web authors are using the available tools to create accessible content. Solutions include authoring tools more assertively prompting authors regarding accessibility, and widespread efforts to promote universal web design through polices, best practices, and advocacy.

Purpose

The World Wide Web is ubiquitous. All sectors of developed society, including education, depend increasingly on the web for delivery of programs and services. This can be liberating for many individuals with disabilities, who have historically depended on others to assist them in reading educational materials, completing exams, and other activities related to their education. By receiving and interacting with their educational content electronically, students with disabilities can learn more independently than was previously possible. The web also has the potential to eliminate the often lengthy delays students face when having to wait for traditional print materials to be converted into accessible formats such as Braille, large print, or audio cassette. An original document that is created using accessible design techniques requires no conversion: Students with disabilities can access it simultaneously with their non-disabled peers.

However, the web's potential as a liberating medium for persons with disabilities depends on web content being accessible. The purpose of the present paper is to explore the issue of universal design and web accessibility by addressing each of the following questions: What are universal design and web accessibility, considering both technical and legal perspectives? What are effective strategies and techniques for creating web content that is accessible to all users? What does the research literature reveal about the accessibility of current websites? Finally, what are the implications of these findings for individuals and organizations that are using the web to facilitate delivery of educational programs and/or services?

Universal Design and Web Accessibility

Universal design is "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (Center for Universal Design). This practice, when applied to the web, results in web content that is accessible to the broadest possible audience, including people with a wide range of abilities and disabilities who access the web using a wide variety of input and output technologies. The phrase "web accessibility" is typically used in reference to individuals with disabilities' access to web content. However, the phrase can refer more broadly to all users' access, taking into consideration the broad spectrum of user characteristics and the increasing variety of web-enabled devices in use today. Generally web access can be defined in terms of two human behaviors: perceiving and operating. Users perceive and operate web content in a wide variety of ways.

The most common means by which users perceive web content is visually, through a computer monitor, although there are differences in screen size, resolution, preferred browser, font and style settings, and other interface characteristics. A growing number of users perceive web content audibly, including screen reader users such as

those with blindness or learning disabilities, wireless phone users who subscribe to audible web services, and commuters with web-enabled vehicles that rely on speech input and output. Some blind users perceive web content via a tactile interface using a refreshable Braille output device.

The most common means by which users operate web content (i.e., navigate links, select menu items, press form buttons and other controls) is by keyboard and/or mouse. Some individuals, particularly those with certain mobility or visual impairments, are unable to use a mouse, and might operate the computer exclusively using keyboard. Also, a growing number of individuals with and without disabilities operate the computer using speech recognition technology.

Designing and developing web content that is perceivable and operable by all of these individuals requires sensitivity to the fact that this spectrum of diverse users exists. This sensitivity to technological diversity is the cornerstone of universal design for the web. Fortunately, universal design for the web can be practiced without the author's having an exhaustive knowledge of the myriad interfaces possible within his or her audience. Instead, universal design for the web can be practiced through knowledge of and compliance with web design standards, including the World Wide Web Consortium's (W3C's) Web Content Accessibility Guidelines (WCAG). WCAG 1.0 became a W3C Recommendation in May 1999, and thereby became the first formal standard by which web accessibility could be defined and measured.

The WCAG has been embraced internationally: Laws, policies, standards and guidelines covering government web sites have been implemented by many nations throughout North America, Europe, and Asia (WAI, 2005). In the United States, recent amendments to Section 508 of the Rehabilitation Act require that electronic and information technologies procured, developed, maintained, or used by federal agencies must be accessible. As charged by this law, the U.S. Architectural and Transportation Barriers Compliance Board (Access Board) developed accessibility standards (Office of the Federal Register, 2000) which address the accessibility of "Web-based intranet and internet information and applications." The Access Board standards are based in part on the WCAG 1.0, specifically on checkpoints labeled by W3C as Priority 1, those checkpoints that are most critical for avoiding exclusion of entire groups of people.

Although Section 508 specifically applies to the federal government, a number of U.S. state governments have adopted its standards.

With web accessibility clearly defined by standards and guidelines such as WCAG 1.0 and Section 508, web accessibility becomes as simple as all players complying with the standards. Thompson (2003) identifies the specific responsibilities of consumers, technology developers (including developers of assistive technology, operating systems, software applications, user agents, and authoring tools), standards organizations, K-12 and postsecondary schools, employers, advocates and legislators who play critical roles in making technology accessible, both individually and through relationships with one another.

The responsibilities of all players become increasingly evident as the web evolves from its HTML beginnings and embraces a growing array of file formats and technologies. Vendors of these emerging technologies bear the responsibility of assuring that their technologies support accessibility, just as HTML does. Given this assurance, developers of authoring tools must support the accessibility features that are available, web design trainers must educate content authors and developers on how to create accessible content, content authors and developers must apply this knowledge, and assistive technologies must support it.

Recent examples of vendors who have responded to this need include Adobe and Macromedia. Adobe, with the release of Acrobat 5.0, introduced a new type of PDF called "tagged PDF", which allows PDF documents to be marked up with an underlying tagged structure that is similar to HTML. This advancement allows images to be described for blind users who navigate the web using an audible screen reader or tactile Braille output device. Tagged PDF also allows document structure to be explicitly communicated to these users, which facilitates navigation. There are many additional accessibility benefits of the improved PDF format. However, despite the accessibility that is now inherent to the tagged PDF format, assistive technologies and PDF creation tools both fall short of full support for the accessibility features, and few PDF authors have been educated on the techniques for creating accessible PDF documents.

Similarly, Macromedia, with the release of Flash MX, has integrated accessibility into its Flash development environment. Flash developers can now provide audible access to animation components, and can silence those components that have no informative value. However, in practice few developers who use Flash are actually utilizing these accessibility features.

Literature Review

Despite the existence of clearly defined web accessibility standards and recent accessibility advances from product vendors such as Adobe and Macromedia, accessibility across all file formats, including HTML, PDF, and Flash, requires knowledge and effort on the part of content authors, designers, and developers. Research has shown, and continues to show, that few web authors are creating content that is accessible to all users.

Many published studies have compared the accessibility of web pages. Schmetzke has conducted several web accessibility benchmark studies (Schmetzke, 2002a), including evaluations of the University of Wisconsin's 13 four-year campuses (Schmetzke, 2002b), the 56 North American colleges that offer ALA-accredited programs in library and information science (Schmetzke, 2002c), and the home pages of 1051 community colleges (Schmetzke, 2001). Jackson-Sandborn and Odess-Harnish (2001) evaluated the home pages of the 100 most visited sites in several categories, including colleges. Rowland and Smith (1999) evaluated a random sample of 400 U.S. prominent colleges, universities, and online learning institutions. A follow-up study by Walden, Rowland, & Bohman (2000) evaluated a similar sample of 518 U.S. institutions. Rowland (1999) also evaluated 47 University Affiliated Program (UAP) websites. The National Center for the Dissemination of Disability Research (1998) evaluated the websites from 213 programs that received funding from the agency, most of which were postsecondary educational institutions. Flowers, Bray, & Algozzine (1999) evaluated departmental websites from 89 departments of special education. Jackson (1999) evaluated three genres of websites, including education, on a variety of design elements, including accessibility. Kelly (2002) evaluated the entry points of 162 universities in the United Kingdom. Opitz, Savenye, & Rowland (2003) evaluated the Department of Education and corresponding special education home pages for each state in the United States. McMullin (2002) evaluated a sample of 200 Irish websites across various sectors and service types, including government and other public sector sites, political parties, educational institutions, and agencies (state or voluntary) with particular responsibilities for services to users with disabilities. Thompson, Burgstahler, & Comden (2003) manually evaluated "critical" web pages of 102 public research universities using a 5-point rating scale.

All of the above studies found similar results: In each study, a significant majority of websites evaluated was not conformant to web accessibility standards, and was therefore not accessible to all users.

Implications for Practice

A World Wide Web that is accessible to all possible users requires effort from a variety of constituents, including vendors such as Adobe and Macromedia, plus web authors, designers, and developers. Research shows that current accessibility practices have not resulted in a universally accessible web. In contrast, the web is still a largely inaccessible medium to many individuals with disabilities. In order to move forward in improving the accessibility of the web, additional efforts are required beyond those currently in place.

For example, developers of authoring tools could go beyond supporting accessibility and could take the added step of requiring it, or at a minimum prompting authors if content appears to be inaccessible. Some tools have already taken this step. For example, the web authoring tool Composer, which is bundled with Mozilla-based browsers including Firefox and Netscape, requires that authors address the need for alternate text for images. When authors insert an image into a web document, they must either enter alternate text or select a box indicating that alternate text is not required (for images that are solely decorative). Adobe Acrobat 7.0 Professional provides similar prompts, alerting authors to possible accessibility problems in their PDF documents, and providing specific steps for implementing solutions. For most other web authoring applications, authors are not prompted for accessibility; they must seek it out, and few authors are aware enough to do so.

Until authoring tools more proactively inform authors about accessibility and universal design, the message will continue to spread via polices, best practices, and advocacy. Policies can be issued from the top, as in the U.S. congress passing Section 508, or from the bottom, as in an individual web designer pledging their personal commitment to practice universal web design. Anecdotally, both approaches have attained some success, as have the wide variety of departmental and organizational policies that fall somewhere between these two extremes. One accessible web page and/or one accessibility-conscious web designer can have a significant impact as others model their exemplary efforts.

Conclusion

Designing web content that is accessible to all users is a shared responsibility among many constituents, including developers of file formats and markup languages, developers of web authoring tools, and web authors, designers, and developers. While promising practices exist among each of these constituent groups, research shows that current accessibility efforts are not enough to allow the web to meet its potential as a liberating medium for individuals with disabilities. Additional effort among all constituents is required in order to assure that web content can be effectively delivered to all users.

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