

# **Building Accessible Educational Web Sites: The Law, Standards, Guidelines, Tools, and Lessons Learned**

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## **Abstract**

*Professional education is increasingly facing accessibility challenges with the emergence of web-based learning. This paper summarizes related U.S. legislation, standards, guidelines, and validation tools to make web-based learning accessible for all potential learners. We also present lessons learned during the implementation of web accessibility within an educational digital library tool called the Instructional Architect.*

## **Introduction**

E-learning is a rapidly growing trend that is providing increased educational opportunities for all learners. However, it also raises new concerns about how to accommodate students with disabilities. According to the United States Census Bureau (1997), 20 percent of the United States population has some kind of physical or cognitive disability, and one in ten has a severe disability. Moreover, 40 percent of college freshmen reported having some type of disability (Henderson, 2001). From an ethical perspective, these people deserve the same learning opportunities and ability to engage with web-based educational materials and resources.

One key concern is web accessibility. The Web Accessibility Initiative (WAI) defines web accessibility as access to the web by everyone, regardless of disability, so that (a) people with disabilities can perceive, understand, navigate, and interact with web sites and web applications; (b) people with disabilities can use web browsers and media players effectively, which should work well with all assistive technologies that some people with disabilities use to access the web; (c) web authoring tools, and evolving web technologies should support production of accessible web content and web sites, and that can be used effectively by people with disabilities (Brewer & EOWG Participants, 2003).

Designing accessible educational websites will make education available and meaningful to disabled people and help them communicate more effectively with the aid of information technology. Although the rapid development of assistive technology makes it more possible for individuals with a wide range of disabilities to gain access to computers and multi-media products (Carnevale, 1999; Closing the Gap, 2001), much web-based content with inaccessible design remains unavailable to disabled students (Waddell, 1998).

Web developers and instructional designers have the responsibility of making educational web sites accessible to everyone. Unfortunately many web developers and instructional designers just do not know how to make their sites universally accessible, or they choose to ignore the accessibility issue (Slatin & Rush, 2003).

The goal of this paper is to clarify web accessibility issues and to offer resources and lessons to assist others in successfully developing accessible educational web sites. In this paper, we outline relevant United States legislation, standards, guidelines, and validation tools for web accessibility. We then present lessons learned during the implementation of web accessibility within an educational digital library tool called the Instructional Architect (IA).

## **Relevant Legislation, Standards, Guidelines, and Validation tools**

### **Legislation**

Legislation in the United States that supports the development of accessible web sites includes the Rehabilitation Act of 1973 — specifically Section 504 and Section 508 (last amended in 1998), and the Americans with Disabilities Act of 1990 (ADA). The Acts are intended to protect the rights of disabled persons. According to Section 504 of the Rehabilitation Act, the federal statutes guarantee that disabled

learners will not be discriminated against because of their disability status, and all government agencies, fully or partially federally funded projects and schools will risk litigation if their web sites are not accessible to disabled students (Web Accessibility in Mind [WebAIM], 2003). As the ADA of cyberspace (Waddell, 1998), Section 508 of the Rehabilitation Act also provides the basis for the Electronic and Information Technology Accessibility Standards, which took effect in June 2001. Accordingly, accessible web design becomes a requirement for everyone — educators, web developers, and instructional designers — rather than an optional feature.

### **Standards**

Standards from the World Wide Web Consortium (W3C) for HyperText Markup Language (HTML) 4.01, Cascading Style Sheets (CSS) levels 1 (CSS1) and level 2 (CSS2) specify syntax and functionality of tags and styles used in web sites.

Some new structural elements and attributes has been added in HTML 4 to improve accessibility by enhancing highly structured documents, complementing non-textual contexts, and improving navigation. For example, the FIELDSET and LEGEND elements has been added to create form structure by organizing form controls into semantically related groups, and the new “title” attribute is provided to give a short description of any web element (for example, the “title” attribute can be used with the anchor <A> element to describe the nature of a link so that web users can decide whether to follow it.)

CSS enables web authors and users to style HTML from document structure. For example, CSS allows web authors to achieve visual effects by using CSS spacing, alignment, and positioning properties. By using CSS, web authors can write simpler HTML and eliminate the use of meaningless images and non-breaking spaces (&nbsp;), which is non-standard mark-up, to create space around an element. Removing the CSS layout information in case browsers do not support them or users who deactivate them results in cleaner, more concise documents. Reference information and tutorials on standards-based web development can be found at <http://www.w3schools.com/>. Most recent browsers support most of CSS1 and much of CSS2.

### **Guidelines**

Guidelines for web accessibility are coordinated and established by the Web Accessibility Initiative (WAI). The current version of the guidelines is the Web Content Accessibility Guidelines (WCAG) 1.0 (<http://www.w3.org/TR/WCAG10/>), which provides web developers with guidelines and a prioritized list of checkpoints for how to write HTML and other authoring languages to make web sites accessible. Among the prioritized list, Priority 1 checkpoints must definitely be adhered to, Priority 2 checkpoints should be satisfied, and Priority 3 checkpoints may be addressed to achieve web accessibility. Currently WCAG 2.0 is still a W3C working draft.

Working with the above web accessibility standards and guidelines will help designers develop predictable, reliable, and accessible web sites.

### **Validation Tools**

Validation tools check web sites for compliance with web accessibility standards and guidelines, summarize potential accessibility concerns, and provide links to information about potential accessibility problems identified. Some examples of free online validation tools include: the W3C HTML Validation Service (<http://validator.w3.org>), Bobby (<http://www.cast.org/bobby>), Cynthia™ Says (<http://www.contentquality.com/>), and WAVE (<http://www.wave.webaim.org/index.jsp>).

## **Lessons Learned During the Implementation of Web Accessibility within the IA**

The Instructional Architect (IA) (<http://ia.usu.edu/>) is an Internet portal designed for use with digital libraries of educational resources. It provides a tool for creating instructional materials using online resources (Recker, Dorward, & Nelson, 2004). To provide the same learning opportunities to all users, an accessible version of the IA was released at the end of 2003. The following summarizes lessons learned during the process of becoming aware of, obtaining training in, developing within, and testing against the standards and guidelines for accessible web sites.

### **Awareness of Web Accessibility**

Instructional designers and web developers cannot afford to not know or ignore accessibility issue, both from ethical perspectives and according to law mandates. Consider the form shown in Figure 1, which ignores web accessibility issues and is supposed to function as the form in Figure 2.

Because the form fields and button in Figure 1 are not labeled following web accessibility guidelines, blind users who use assistive technology devices such as screen readers will have an experience similar to non-blind users accessing the form with the monitor turned off.

Planning for accessibility in the outset avoids wasting resources during subsequent conversions of inaccessible applications. If instructional designers and web developers keep accessibility in mind and build an accessible site from the beginning, it becomes much simpler to develop and maintain the site cost-effectively.

In addition, web developers and instructional designers should be aware that accessibility means accommodating a broad range of users, including visual impairment users such as low vision, blind, and color-blind users, hearing impairment users such as deaf users, motor impairment users, and cognitive disabled users. Cognitive disabilities remains the least understood and least discussed type of disability among web developers and instructional designers (Bohman, 2004). As a result, more research is needed to better understand and improve learning opportunities for such learners.

### **Professional Training and Learning Community**

Currently many developers and designers are neither aware of the need for accessibility, nor know how to achieve it. Training programs with complete and well-organized web accessibility tutorials help with both of these issues. For example, the IA team benefited from comprehensive web accessibility training offered by WebAIM (<http://www.webaim.org>).

Besides professional training, web developers and designers should participate in online web accessibility learning communities to update techniques and share experiences. Along with the evolution of web technologies, new accessibility issues will emerge. The IA team found it helpful to participate in the Accessify Forum (<http://www.accessifyforum.com/>). This provides a forum for sharing lessons and experiences among web accessibility experts, and for being informed about the latest technology and applicable resources.

### **Development**

During the development of web accessibility for the IA, we experienced that to create an accessible web sites is not more difficult and time-consuming if it is properly planned for at the outset. In addition, we found that the following approaches very helpful in the development of the accessible IA.

*Use of Cascading Style Sheets (CSS).* The use of CSS enables accessibility primarily by separating document structure and content from layout and presentation. For example, CSS can help avoid "tag misuse". In our case, we initially used TABLE elements in every web page to align content. We later learned that disabled users would be confused and misled by this kind of tag misuse. One example of such confusion happened when blind users access web pages using a screen reader. Because a screen reader will read the table content in a linear way, complicated table structures used just for alignment purpose (embedded with rich COLSPAN and ROWSPAN attributes or nested TABLE elements) will disassociate the real data. As a result, it becomes impossible for blind users to understand the web pages effectively. Furthermore, because accessibility causes the HTML to be more completely defined, separating style from markup with CSS will cause web documents to be loaded more quickly and maintained more easily. In addition, web developers can verify that the simplified structure works effectively when CSS is not applied. Using the simplified structure, web developers only need to make changes to the CSS file to adjust the layout of the web site, rather than changing every page on the site.

Creating an accessible web site doesn't mean that the web site must be boring and graphics-free. Graphics increase accessibility by providing visual cues to help people to understand the content and navigation of the web site better. Following the CSS standards and web accessibility guidelines, the visible aspects of graphics will not pose inaccessible problems to blind users because web developers can provide equivalent alternative text (via the "alt" attribute) that allows blind users to access the content of graphics with their screen reader software. In short, web developers can build accessible web site with an attractive design by following web accessibility guidelines. For example, the CSS Zen Garden site (<http://www.csszengarden.com>) demonstrates how attractive web sites with different visual appeals based on the same web content can be built with the power of standardized HTML and CSS. In designing the

accessible IA site, we also benefited from using CSS by creating nine alternative PowerPoint-like background templates to provide useful feature for the IA users. With this enhanced feature, IA users have the opportunity to choose different fonts and backgrounds when creating instruction using the IA to match their subject and grade level. And as a result, their instruction is also accessible.

There is one caveat we would like to share when using CSS during web accessibility implementation. CSS support differs between web browsers, even within different versions of the same web browser. Web developers should test the web site in as many browsers as possible and need to master commonly implemented CSS features to find the best CSS solution for the widest variety of browsers.

*Use of templates.* The use of templates helped the IA web developers separate the HTML from the scripting code, which makes changing and maintaining both the code and HTML files much easier. This separation also prevents interface and web designers from breaking scripting code. Furthermore, accessible templates improved our efficiency in implementing accessibility in two ways: (1) by making the several general templates accessible, most of our work was vastly simplified; and (2) improvements to the accessibility of each page can be made by simply maintaining a few page-specific template files.

*There is no need to create a separate, text-only version.* During the early stage of web accessibility implementation, there were some discussions about whether providing a separate text-only version would help meet the blind learners’ needs. In the end, we found it is unnecessary to maintain two versions concurrently. Not only it is hard to maintain two parallel versions, but we found that web developers can meet the needs of blind users by providing equivalent alternative text for all visual elements. In our approach, the web site has an inherent text version already because embedded alternative text will allow blind users to access the content of graphics and other visual materials. Here we want to point out again that it is a misunderstanding that web accessibility implementation means a "text only" approach for blind users. "Text only" practices may remove visual materials which blind users can not view, but also potentially reduce the accessibility of the site for the people with a cognitive disability as the visual materials will help sighted users, especially users with cognitive disabilities, to better understand the meaning and organization of the content.

### User Testing

Validation tools are only computer programs, and cannot capture all potential problems with regard to the accessibility of a web site for disabled users. For example, W3C CSS validation tools can help check whether the correct syntax was followed, but they cannot check if CSS actually makes sense or if the resulting layout is actually what was intended. In the same way, Bobby or WAVE can only check whether the web site meet technical requirements; they cannot guarantee that disabled users’ experiences regarding web accessibility is equivalent or satisfying.

As such, it is important to find disabled users to test the web site and make sure it is accessible for the widest possible range of disabilities—we recommend that this user testing occurs throughout the development process (Nielsen, 2000).

The design of the accessible IA web site benefited from the suggestions of two blind users. Although we followed the WAI guidelines, these two blind users still encountered small accessibility barriers that did not trigger warnings from the validation tools. For example, the IA has a search function in which users type in keywords and are shown 20 hits at a time. For each hit on an online resource, the IA provides a link called "more info" showing its metadata. Although this page passed Bobby validation, one blind user was confused about the 20 "more info" links read by the screen reader. There was no way for him to figure out which "more info" link was associated with the specific online educational resource. With his feedback, we appended each resource’s title to each "more info" link. But in order to not impact on the original visual appearance of the page content, we implemented CSS to hide each appended resource’s title.

Table 1 summarizes the key lessons the IA team learned during implementation of web accessibility, along with each lesson’s benefits and difficulties.

| Lessons Learned    | Benefits  | Difficulties |
|--------------------|---|--------------|
| Awareness of Issue | From ethical perspectives and according to law mandates<br>Avoid wasting resources during later conversions | None         |

|   |   |  |
|---|---|--|
| Participation in Professional Training and Learning Community | Become knowledgeable web developer quickly  | Cost and Time  |
| Development:<br>Use of CSS                                    | By separating document structure and content from layout and presentation, simplify HTML structure<br>Web documents can be loaded more quickly and maintained more easily | CSS support differs between web browsers, thoroughly testing is needed |
| Development:<br>Use of Template                               | By separate the HTML from the scripting code, changing and maintaining both the code and HTML files are much easier   | Need to learn specific template syntax                                 |
| Development:<br>No Separate Text Version                      | No need to maintain two parallel versions<br>The web site will have an inherent text version already if alternative text is provided for all visual elements              | Provide equivalent alternative text properly for all visual elements   |
| Iterative User Testing  | Only real disabled users' experiences can ensure web accessibility, which no validation tool can guarantee  | It is difficult to find the widest range of disabled users             |

Table 1. *Lessons Learned in Implementing Web Accessibility.*

### Discussion

The IA development team made efforts to design a digital library tool accessible to all users, yet we are still facing web accessibility challenges when using online resources from digital libraries. We find that many of these online resources are inaccessible. For example, some video clips, audio files, images, or flash files don't have equivalent text elements. Since online learning resources are the centerpieces of the IA, how do we continue to make the IA accessible if the resources that IA collects are not accessible? We realize that a good educational web environment can only be built with the cooperation of all instructional designers and web developers. It is the responsibility of instructional designers to initiate and raise awareness that all learning resources need to be created in accessible way. As such, instructional designers must become the change agents to disseminate web accessibility innovation.

Furthermore, as the World Wide Web is global, web accessibility issues should be coordinated at an international level. We hope that countries all over the world consider web accessibility as an important endeavor, and that every country will commit to working cooperatively.

### Conclusion

Web accessibility is not always easy to implement, often because many web developers and instructional designers simply do not know enough about the issue. Even some of the more informed developers and designers minimize its importance, or even ignore it altogether (Slatin & Rush, 2003). Because approximately one in five people has a disability affecting the quality of their web experience (Waddell & Thomason, 1998), implementing web accessibility must become a fundamental consideration in the design and development of web-based learning resources and instruction.

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The screenshot shows a web form titled "Create New Account". It contains several input fields without text labels: a text box for the first name, a text box for the last name, a dropdown menu for a title (with "Do Not Use Title" selected), a text box for an email address, a text box for a password, and another text box for a confirm password. A "Create New Account" button is at the bottom.

Figure 1: Form with unlabeled input fields.

The screenshot shows a web form titled "Create New Account" with labeled input fields. The labels are "First Name", "Last Name", "Title", "Email Address", "Password", and "Confirm Password". Each label is followed by its corresponding input field. The "Title" field is a dropdown menu with "Do Not Use Title" selected. A "Create New Account" button is at the bottom.

Figure 2: Form with labeled input fields.