

School Websites: Are They Accessible to All?

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Abstract

There are thousands, perhaps millions, of elementary schools connected to the Internet in the United States. The purpose of this study was to examine accessibility issues on elementary school homepages. Using a random sample of elementary school websites, the researchers used WebXACT to document accessibility errors and warnings related to Section 508 of the American Rehabilitation Act and Priority 1, 2, and 3 of the Web Content Accessibility Guidelines checklist. Various content, media elements, and maintenance issues were noted for each website. In addition, functions on the Accessibility Toolbar that was developed by the Australian National Information and Library Service were used to examine additional features of the homepages. Findings indicate that the 91% of the websites had at least one accessibility error related to Section 508, and 84% of the websites had at least one Priority 1 error related to the Web Content Accessibility Guidelines. The major sources of these errors were related to text equivalents (alt tags) for images and imagemaps. Issues related to relative font sizes, screen resolutions, color contrast, style sheets, and access keys are also discussed. Recommendations are included for addressing website accessibility issues at schools and school districts.

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Introduction

Have you ever disconnected your computer speakers and tried to watch a video on the web? Can you navigate through your school's website without using a mouse? Could you fill out an online form if your computer monitor was turned off? Many people face situations similar to these every day. School websites will not be useful to everyone until webmasters and developers successfully address accessibility issues.

Accessibility focuses on providing "a high degree of usability for people with disabilities" (About WAI, 2003). The report by the U.S. Census Bureau in 2000 counted 49.7 million people with some type of long lasting condition or disability. This represents 19.3 percent of the 257.2 million people who were aged 5 and older in the civilian, non-institutionalized population - or nearly one person in five. Within this population, Census 2000 found:

- 9.3 million (3.6 percent) with a sensory disability involving sight or hearing.
- 21.2 million (8.2 percent) with a condition limiting basic physical activities, such as walking, climbing stairs, reaching, lifting, or carrying (U.S. Census Bureau, 2000).

There are countless disabilities that can make access to a school website difficult for students, parents, and community members. Everyone must be able to "see" what is on the webpages, "hear" essential audio, and navigate websites through the use of an input device, which might be a mouse, keyboard, or accessibility switch.

It is difficult for people to navigate and interact with websites if they cannot see or read the screen. Persons with low vision or complete vision loss may benefit from adaptations to hardware, software, and design. These adaptations can be as simple as increasing the font and character size through the accessibility features already installed on most PC's. Other adaptations can include screen readers, screen magnification software, speech synthesizers, refreshable Braille displays, and adapted keyboards/input devices. Design considerations for people with visual disabilities can include detailed descriptions of visuals, easy to follow text links, keyboard controls, a logical tab sequence, uncluttered displays, visually discriminating displays, and a consistent interface. People with "color blindness" also encounter barriers when color is used as a distinguishing factor for navigation or presentation of concepts. To increase visual discrimination when designing webpages, contrasting colors such as yellow and black versus milder differences such as green and purple should be used.

A person with low hearing or who is deaf may also have difficulty using the web. If a website relies heavily on sound to convey concepts, a person with hearing disabilities may require adaptations, such as headsets and captions for visual descriptions of the audio. If captions are not included for audio segments, a separate "text-only" version of the webpage should be available.

Mobility impairments can impact a person's access to computers in many ways. People with carpal tunnel syndrome, arthritis, congenital deformities, amputations, cerebral palsy, spinal cord injury, ambulation difficulties, wheelchair dependence, and/or cerebral vascular accidents (strokes) may be roughly defined as having mobility impairments. All of these disabilities impact a person's functioning in dramatically different ways and therefore must be overcome through a variety of hardware and software adaptations.

People may benefit from a mini-keyboard, a keyboard with a reduced number of keys, or a keyboard that enables on-screen scanning to decrease the distance and frequency of keystrokes needed to complete an activity. Designing a webpage with simple tab features between all options can also increase the ease of use for people with physical disabilities.

When investigating accessibility options for those with mobility impairments, it is important to examine not only the interfaces required with the computer, but also the environment in which a person will access the Internet. If a person has difficulty with ambulation or requires a wheelchair for mobility, an accessible location (room, desk, computer, etc.) must be available.

Accessibility Guidelines

More and more schools are using their websites to convey important information to parents, students, and the community (Barron, Hohlfeld, & Ivers, 2005). However, this avenue may be "closed" or "under construction" for millions of people with disabilities. For many years, the American Rehabilitation Act has helped to ensure that physical barriers have been removed (such as restrooms that are not accessible and curbs on streets). An important focus, at this point, is to remove the virtual barriers for many who access the web.

Section 508

In order to ensure equitable access to the Internet, the U.S. government and other entities have issued mandates and policies relative to accessibility. In 1998, Section 508 of the American Rehabilitation Act went into effect requiring all electronic and information technologies (including websites) that are developed or purchased by the federal government be accessible by people with disabilities (U.S. General Services Administration, 2005). Although this does not apply directly to the private sector, it may impact schools because many of the federal grants (awarded to schools, universities, and other agencies) require that all products comply with Section 508. Coombs (2000) points out that even if your institution is not affected by accessibility mandates, it is ethically and economically the "right thing to do."

The subpart of the 508 Standards that focuses on web-based intranet and Internet information and applications defines criteria for accessibility. The criteria are intended to ensure that the access and use of the web is comparable for everyone – with or without disabilities. The criteria are lettered a-p, as indicated on the following list (U.S. General Services Administration, 2005):

- a) A text equivalent for every non-text element shall be provided (e.g., via "alt", "longdesc", or in element content).
- b) Equivalent alternatives for any multimedia presentation shall be synchronized with the presentation.
- c) Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup.
- d) Documents shall be organized so they are readable without requiring an associated style sheet.
- e) Redundant text links shall be provided for each active region of a server-side image map.
- f) Client-side image maps shall be provided instead of server-side image maps except where the regions cannot be defined with an available geometric shape.
- g) Row and column headers shall be identified for data tables.
- h) Markup shall be used to associate data cells and header cells for data tables that have two or more logical levels of row or column headers.
- i) Frames shall be titled with text that facilitates frame identification and navigation.
- j) Pages shall be designed to avoid causing the screen to flicker with a frequency greater than 2 Hz and lower than 55 Hz.
- k) A text-only page, with equivalent information or functionality, shall be provided to make a web site comply with the provisions of this part, when compliance cannot be accomplished in any other way. The content of the text-only page shall be updated whenever the primary page changes.
- l) When pages utilize scripting languages to display content, or to create interface elements, the information provided by the script shall be identified with functional text that can be read by assistive technology.
- m) When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l).
- n) When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.
- o) A method shall be provided that permits users to skip repetitive navigation links.
- p) When a timed response is required, the user shall be alerted and given sufficient time to indicate more time is required.

Web Content Accessibility Guidelines

The requirements in Section 508 are very similar to the Web Content Accessibility Guidelines (WCAG) that were developed by the World Wide Web Consortium for international use in 1999 (W3C, 1999). The WCAG define three levels – Priority 1, Priority 2, and Priority 3. Priority 1 contains the basic requirements and **must** be implemented for a website to be considered accessible; Priority 2 **should** be implemented to remove significant barriers; and Priority 3 **may** be implemented to improve access to web documents. The Web Content Accessibility Guidelines have 14 checkpoints (W3C, 1999):

1. Provide equivalent alternatives to auditory and visual content
2. Do not rely on color alone
3. Use markup and style sheets and do so properly
4. Clarify natural language usage
5. Create tables that transform gracefully
6. Ensure that pages featuring new technology transform gracefully
7. Ensure user control of time-sensitive content changes
8. Ensure direct accessibility of embedded user interfaces
9. Design for device independence
10. Use interim solution
11. Use W3C technologies and guidelines
12. Provide context and orientation information
13. Provide clear navigation mechanisms
14. Ensure that documents are clear and simple

“While Section 508 standards are mandatory for the US public sector, there is currently a global movement in Web-based applications and content towards the adoption of WCAG 1.0 Priority 1 checkpoints, and in some case Priority 2 checkpoints “(Carignan, 2004). There is a strong correlation between Section 508 Guidelines and Priority 1 Checkpoints. In fact, the US Government interprets paragraphs (a) through (k) of Section 508 as consistent with the Priority 1 levels displayed in Table 1 (U.S. General Services Administration, 2005). Web pages that conform to all of the WCAG checkpoints for Priority 1.0, must also meet paragraphs (l), (m), (n), (o), and (p) of Section 508 to comply with the federal law.

Table 1. Correlation of Section 508 and WCAG Level 1.

Section 508 Guideline	WCAG 1.0 Checkpoint
(a)	1.1
(b)	1.4
(c)	2.1
(d)	6.1
(e)	1.2
(f)	9.1
(g)	5.1
(h)	5.2
(i)	12.1
(j)	7.1
(k)	11.4

A side-by-side comparison of Section 508 Web standards and WCAG Priority 1 checkpoints can be found at <http://jimthatcher.com/sidebyside.htm> (Thatcher, 2001).

Research on Web Accessibility

Several studies have focused on the accessibility of websites. Using an online tool (called Bobby), Schmetzke completed several web accessibility studies. An analysis of 1051 community colleges showed that only 29% of the websites were free of major accessibility barriers (Schmetzke, 2001a). He also examined 24 highly ranked library and information science schools at major universities. His results showed “cause for concern” because the majority of the websites were not accessible to people with disabilities (2001b, p. 35).

Bray, Flowers, and other researchers have also examined school websites (see Table 2). Using Bobby, they checked for compliance with the three levels of the WCAG checklists. For each level, they reported the mean and standard deviations of the numbers of accessibility errors.

Table 2. Research studies related to school websites.

Area of Study/Researchers	Year	N	Priority	Mean	SD
Community college websites			1	1.01	0.71
			2	3.02	1.57
Flowers, Bray, Algozzine	2001	253	3	1.80	0.43
School districts' websites			1	0.91	0.67
			2	2.33	1.57
Bray, Flowers, Gibson	2003	567	3	1.64	0.57
Elementary schools' websites for students with disabilities	2003	244	1	0.70	0.71
			2	1.69	1.44
			3	1.48	0.62
Bray, Flowers, Smith, Algozzine					

All of the studies listed in Table 2 found accessibility issues on the school websites. “Only 23% of the community college home pages evaluated were determined to be accessible to individuals with disabilities” (Flowers, Bray, & Algozzine, 2001, p. 475). The other two studies found 74.3% of the school districts' websites had accessibility problems, and 57.4% of the elementary school home pages issues, many of which were severe (Bray, Flowers, & Gibson, 2003; Bray, Flowers, Smith & Algozzine, 2003). Academic sites typically have been found to have low levels of accessibility, “in spite of the fact that they were created by organizations most likely to have access to current knowledge on the subject as well as an understanding of the need for accessible Web sites for students, faculty, and staff” (Ellison, 2004, p. 2).

Research Methods

The data set includes 147 randomly selected U.S. elementary school websites from Yahoo's K-12 School Directory. This data set represents a 3 percent random sample of the 4900 elementary school sites that were listed in the Spring of 2005.

Watchfire WebXACT

There are several online tools that can be used to automatically evaluate the accessibility of webpages. Many of the previous studies used a tool called Bobby. The same company, Watchfire, has released another tool (WebXACT) that “can be used to test single Web pages for adherence to privacy and quality guidelines, in addition to accessibility issues” (Donston, 2003, p. 1). The researchers of this study used WebXACT (<http://www.webxact.com/>) to assess the homepages of elementary schools according to the U.S. Section 508 guidelines, the Web Content Accessibility checkpoints, and other factors (see Figure 1).



Figure 1. WebXACT features.

Using WebXACT, the following information was recorded for each school’s homepage:

- General features, such as last update, download filesize, etc.
- Quality issues, such as number of broken links, number of missing ALT tags, etc.
- WACG priority 1, 2, and 3 errors and warnings related to accessibility
- Section 508 errors and warnings related to accessibility

Although tools such as Bobby and WebXACT are great for quickly assessing the objective aspects of a website, they are not capable of assessing subjective features. In fact, the

“results” from a WebXACT report on a website will include both Errors and Warnings (see Figure 2). Errors are issues that can be determined by electronically reviewing the code, and can result in a statement such as “Provide alternative text for all images.” Warnings, however, are much more subjective, and may include issues such as “If you use color to convey information, make sure the information is also represented another way.” To make the final judgment on a Warning – a manual check must be conducted.

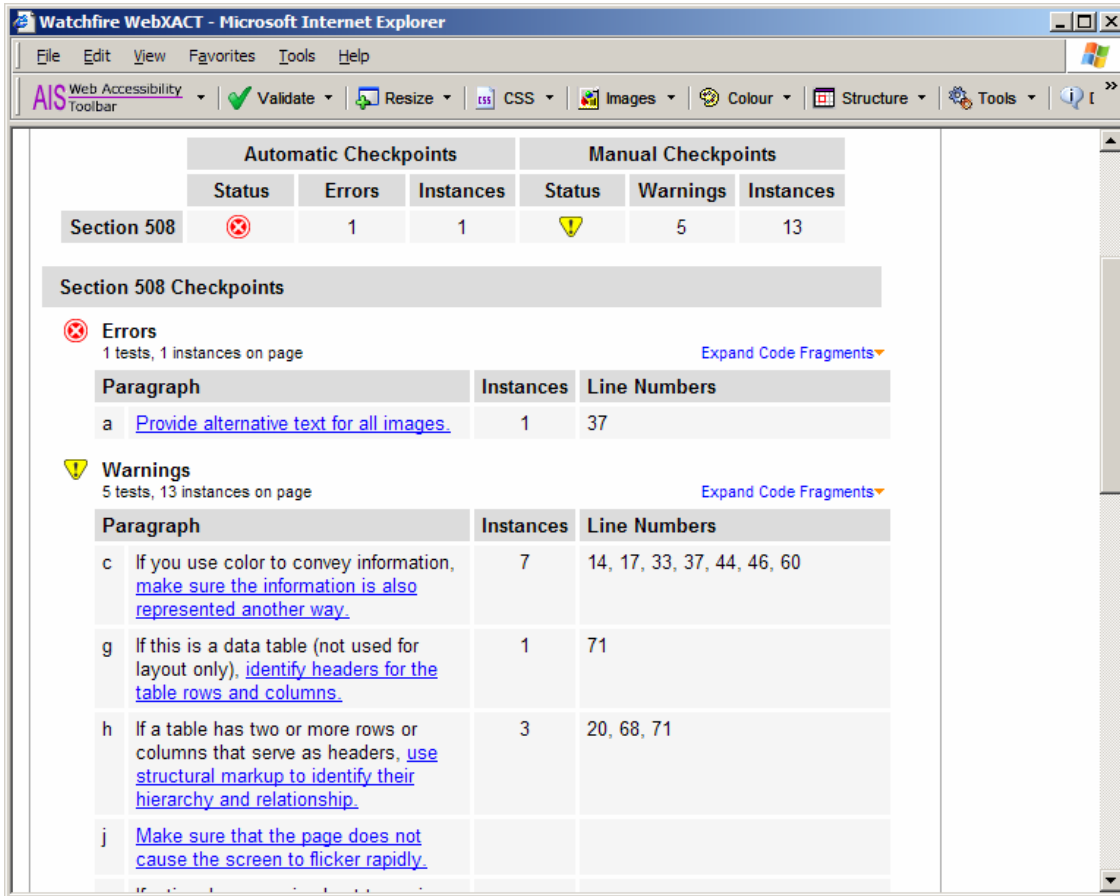


Figure 2. WebXACT Errors and Warnings for Section 508.

Web Accessibility Toolbar

The Web Accessibility Toolbar is a very useful tool that was created to assist in the manual assessment of web pages (National Information and Library Service, 2005). It can be freely downloaded from <http://www.nils.org.au/ais/web/resources/toolbar/> and provides a multitude of features to test web pages (see Figure 3).

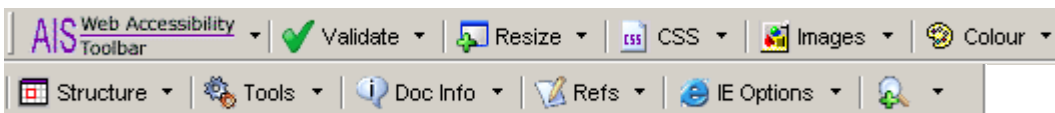


Figure 3. Web Accessibility Toolbar by the National Information and Library Service

For the purposes of this study the following features were used:

- Resize – test the page in 640x480 and 800x600 resolutions
- CSS – disable the style sheets
- Colour – convert the page to grayscale
- Structure – determine if the code for AccessKeys is included on the web page, and, where appropriate, to check the titles of data tables
- Tools – quick links to WebXACT

Results

The results show that the majority of sites surveyed did not meet the U.S. Section 508 Guidelines. The accessibility errors for Section 508, as well as the priority levels of the WCAG are listed in Table 3. Note that the mean for the Section 508 errors is slightly higher than the mean for the Priority 1 errors. A total of 91% of the websites had at least one Section 508 error, and 84% of the websites had at least one Priority 1 error.

Table 3. Accessibility Errors (N=147)

Checkpoint	Minimum	Maximum	Mean	SD
Section 508	0	5	1.49	.93
Priority 1	0	3	1.03	.64
Priority 2	0	6	2.85	1.19
Priority 3	0	5	2.77	.83

The most common issue of non-compliance for Section 508 was the lack of Alt tags for images (see Table 4).

Table 4. Section 508 errors.

Pages with Errors	Section 508	Paragraph Description
78%	a	A text equivalent for every non-text element shall be provided (e.g., via "alt", "longdesc", or in element content).
10%	i	Frames shall be titled with text that facilitates frame identification and navigation.
31%	m	When a web page requires that an applet, plug-in or other application be present on the client system to interpret page content, the page must provide a link to a plug-in or applet that complies with §1194.21(a) through (l).
13%	n	When electronic forms are designed to be completed on-line, the form shall allow people using assistive technology to access the information, field elements, and functionality required for completion and submission of the form, including all directions and cues.

The warnings for each website were also recorded (see Table 5). Note that in all cases, the number of Warnings in Table 5 is higher than the number of Errors listed in Table 3. Warnings are subjective issues that must be examined manually.

Table 5. Accessibility Warnings (N=148)

Checkpoint	Minimum	Maximum	Mean	SD
Section 508	2	8	5.78	1.43
Priority 1	3	13	8.50	2.87
Priority 2	8	23	15.77	2.55
Priority 3	5	13	9.10	1.40

Using the Accessibility Toolbar and other tools, the researchers manually examined several of the issues that issued warning, such as the use of color, flicker, screen size, and table headings.

Font Size - Many people need to adjust the size of text in order to be able to read the content on the screen; yet some designers use absolute font sizes that cannot be adjusted. In this study, 37 of the 147 websites (25%) were designed with absolute font sizes.

Screen Display Size – The display should also be fluid, allowing webpages to be viewed at different resolutions, without scrolling. In this case, 134 of the websites (91%) were viewable, without scrolling, at 800X600 resolution; only 78 (53%) were viewable in 640X480.

Color Considerations – Colorblindness is an accessibility issue that impacts many people. Paragraph (c) of Section 508 states: Web pages shall be designed so that all information conveyed with color is also available without color, for example from context or markup. The amount of contrast (between text and backgrounds) was judged to be sufficient in 119 of the websites (81%), and almost all of the websites (97%) were legible in grayscale. Flickering images or text were only seen on 3 of the websites (2%).

Style Sheets – Checkpoint 6.1 of Priority 1 states: “Organize documents so they may be read without style sheets. For example, when an HTML document is rendered without associated style sheets, it must still be possible to read the document” (W3C, 1999). To test this condition, the Disable CSS feature on the Accessibility Toolbar was used. More than 86% of the websites (n=127) did not use style sheets and/or maintained their format when the styles sheets were disabled.

Access Keys – The HTML tag, ACCESSKEY, can be used to provide keyboard alternatives for hyperlinks. Accesskeys can be used to allow users with limited physical capabilities to navigate a website using keyboard or switch input. Only 4 of the 147 websites (3%) included this tag on the schools’ website.

Discussion

Recent research suggests that more and more schools are using their websites to provide information to parents and other members of the community (Barron, Hohlfeld & Ivers, 2005). As school websites take on the role of major communication tools, it is more important than ever to ensure that they are accessible to everyone.

Similar to previous research, this study found that very few school websites meet all of the guidelines for accessibility. In their analysis of school district websites, Bray, Flowers & Gibson (2003) found that 74.3% of the webpages had at least one accessibility error. The present study showed errors on 91% of the websites (as measured by Section 508) and on 84% of the websites, as measured by WCAG's Priority 1. Most of the errors were related to text equivalents, frame titles, links to plug-ins, and the format of forms.

Contrary to most previous studies that were conducted with an accessibility tool, called Bobby, this study used WebXACT and differentiated between accessibility errors (which can be analyzed automatically by the computers) and accessibility warnings (which require manual verification). Given that accessibility warnings must be verified, the number of warnings is considered to provide less direct evidence of the severity of accessibility issues.

This study also differed from previous research in that it reported errors and warnings related to both Section 508 and the Priority levels of the Web Content Accessibility Guidelines. Although the results were similar between the two sets of guidelines, there were more errors related to Section 508 than to Priority 1. This is probably due to the fact that web pages that conform to all Priority 1 checkpoints must meet additional criteria to comply with Section 508. Some of the manual checks for this study were conducted using the Web Accessibility Toolbar. The features on this toolbar are very extensive and easy to use. Most of the homepages incorporated appropriate style sheets and color considerations; however, very few sites incorporated keyboard alternatives or were adjustable to smaller screen sizes.

Although testing websites with automatic tools such as WebXACT and manual tools such as the Web Accessibility Toolbar provide valuable information, "it is highly recommended that an accessibility evaluation be conducted with assistive technologies ... to ensure accessibility" (Carignan, 2004). If members of the target population (with disabilities) are not available, the tests can be simulated by turning the monitor off while using a screen reader (such as JAWS by Freedom Scientific), turning the speakers off, or disabling the mouse.

Conclusion

Having a disability should not prevent a person from accessing a school website. As more and more schools rely on their websites as a communication tool, they must implement the design techniques that will make the sites accessible to all -- including students and parents with disabilities. Research such as this can help to point out the deficiencies in existing design approaches and build an awareness of issues related to accessibility.

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