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Abstract

This study investigates Website accessibility of university home pages in the public senior institutions in the state of South Carolina. The reasons for performing the study are twofold: first, to find the common accessibility problems among the institutions. Second, to find which institution has the highest number of accessibility problems. Thirteen universities were selected to be analyzed by **Cynthia Says** and **Section 508 Accessibility Checking Tool**. Each university home page was analyzed by each Web accessibility evaluation tool. The mean for both **Cynthia Says** and **Section 508 Accessibility Checking Tool** was 4.15 and the standard deviation of 9.71 and 12.03 respectively. However, **Cynthia Says** found 4 out of 13 Websites free of accessibility errors while **Section 508 Accessibility Checking Tool** found 8 Websites free of accessibility errors. The findings suggest that the different evaluation processes contributed to the difference in the number of university home pages free of accessibility errors. **WebEval** was used to evaluate the accessibility quality of the significant images. Out of 195 total images, 144 (74%) are significant images. Significant images with alt text was 114 (58%) of 195 total images. Challenges remain for university Web designers to provide university home pages completely free of accessibility errors. It is hoped that this study can provide insights for individuals developing university home pages.

Introduction

University or college Websites are the focus point for postsecondary students and others searching for information about the institution (e.g., student coursework requiring Internet access and admission requirements of a prospective university or college). A strong Web presence is essential to the entire university community. Each Website contains information about academic programs and resources, campus activities and the institution's administrative policies. An individual can access a variety of services (e.g., library holdings, campus bookstore, employment opportunities, ordering of transcript(s), Web-based courses and assignments) via the Web pages.

A university or college Website is not only an academic portal, but also a door to the institution's involvement in the local communities, state, country, and the world. It is important that the Websites are also accessible to individuals with disabilities. An inaccessible Website prevents an individual with disabilities from obtaining the information he or she needs from the university or college and may limit his or her participation in the institution's activities. According to **Kane** et al. an inaccessible university Web pages may also promote an educational divide in which people with disabilities are denied equal access to public education and other aspects of society.[1]

The research of **Lazar** et al. indicates that there are many resources (e.g., online, software tools and technical guides) available to Web designers to use to make a Website accessible. The research is inconclusive as to why Web designers do not use the tools and resources available to them to make Websites accessible.[2] **Lazar** and **Greenidge** found that guidelines exist for creating accessible Websites but are not followed. They also found that levels of Web accessibility are low in Websites.[3]

Literature Review

Awareness of Website accessibility started in the late 1990s and continues to grow.[4] Organizations, government agencies, and individuals (e.g., **Cynthia Waddell** and **Michael G. Paciello**) are working together to stress the importance of Website accessibility for all Websites. Each group discusses accessibility problems and encourages Web designers to include accessibility design practices in developing a Website. Standards (e.g., **Section 508** and **Web Content Accessibility Guideline 2.0**) have been developed to help guide the development of Websites because of the emerging technologies and the tremendous growth in the Web. Website test tools, such as **JCrawler**, **Pylot** and **WAVE 4.0 beta**, help to maintain Website accessibility. Many governments, such as Australia, New Zealand, Italy, United Kingdom, and Hong Kong have established Web accessibility legislation.[5]

Web accessibility guidelines explain how to make Web content accessible to people with disabilities. Also, the guidelines give guidance to Web designers on how to incorporate accessibility principles into their Website development practices. **Chisholm** et al. indicate that the **Web Content Accessibility Guidelines (WCAG) 1.0**, which was established by the **Web Accessibility Initiative (WAI)** of the **World Wide Web Consortium (W3C)**,[6] is one of the widely used set of guidelines to develop and evaluate Websites.

Seale highlights the **WCAG 1.0** consisting of 14 guidelines. For each guideline, there is a list of checkpoints and each checkpoint is given a priority level from one to three, with priority one providing a minimum level of accessibility,[7] while priorities 2 and 3 would increase the accessibility level of the Website.

The **WCAG 1.0** is one of three relevant sets of guidelines developed by the **WAI** which are universally accepted by Web designers[8]; however manually verifying a Web page for no accessibility barriers is time consuming for the Web designers. There are many different software tools (e.g., **InFocus**, **LIFT Machine**, and **Ramp Ascend**) that a Web designer may use to check the accessibility level of his or her Website pages. One such tool is the accessibility checker which analyzes the Web page to verify that there is no accessibility barrier. Two popular accessibility checkers are **WAVE 4.0** and **Cynthia Says**. The **Website Permanent Tangent** states that no automated checker alone can highlight all potential accessibility problems and some may highlight problems where none exist. Human intervention has to be included, as does a certain amount of user testing.[9]

The **Website Internet World Stats** indicates that the Internet is a worldwide experience in which its usage has grown 100 percent,[10] and that the Internet has influenced every society in the world. Governments are recognizing the importance of providing Internet access to everyone especially individuals with disabilities. Countries are approaching the problem of Web accessibility with different legislative approaches. Some countries approach the problem from a human, civil rights or technology procurement.

In the United States, **Section 508** of the **Rehabilitation Act of 1973** requires Federal agencies to provide access to the electronic information and data by individuals with disabilities regardless of if the person is a government employee or a member of the general public. **Section 508**, also, provides accessibility standards by which all federal Websites must adhere to.[11] **Johnson** et al. research found no federal law requiring public or private higher education institutions to make their Websites accessible.[12]

In England, the **Special Educational Needs and Disability Act of 2001 (SENDA)** protects students from discrimination when accessing educational resources on the Internet. The law applies to all educational institutions from primary to higher education. Other countries, such as Australia, New Zealand, France, Spain, Canada, and Hong Kong, have established laws dealing with Web accessibility.

With guidelines, tools and laws supporting
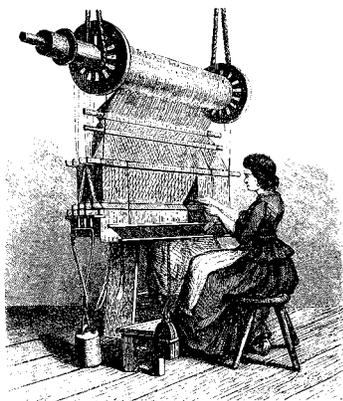
Web accessibility, research indicates that many university Websites are inaccessible to individuals with disabilities. **Rowland**[13] summarized six Website accessibility studies and found that one in four university home pages meets **Bobby's** minimum accessibility standard. **Bobby** was the best known accessibility evaluation tool/accessibility checker that tested a Web page for compliance with Web accessibility standards (e.g., **Section 508** and **WCAG 1.0**); however, **Bobby** is no longer publicly available as of February 2008. **Kane** et al.[1] analyzed 100 home pages of top international universities. Their findings indicate that a large portion of the universities home pages still have accessibility problems. The findings also indicate accessibility problems vary among the countries and geographical locations. Other accessibility problems include non-English language Websites and none or poor quality accessibility policies. **Sloan** et al.[14] analyzed 11 university Websites in the UK. The authors used **Bobby** and **W3C HTML Validation Tool** to review each Website. The authors also manually evaluate each Website according to the **WCAG 1.0** guidelines. The authors found that although the Websites included accessibility features; however, there were many accessibility barriers. The findings suggest to the authors that misunderstanding of accessibility design principles is common.

Other studies have analyzed other subject group Websites for Website accessibility. **Sloan** and **Sloan**[15] evaluated the Websites of each political party running in the 2003 Scottish Parliament elections. The authors used **Cynthia Says** to evaluate each Website. The authors state that the 2003 elections for the Scottish Parliament have been made more accessible for the electorate. The authors' findings indicate that regardless of Web accessibility awareness, laws, and the advantage of providing information to visitors, the findings are disappointing. Individuals with disabilities will continue to have problems accessing each party's Website for information. The researchers also found party information on the Internet to be inconsistent.

Loiacono [and] **McCoy**[16] analyzed 45 Websites in the product/service areas. **Bobby** was used to evaluate each Website for **WCAG 1.0** and **Section 508** standards. The research findings indicate that 91 percent of the Websites based on **Section 508** criteria did not provide fully accessible home pages. The findings also indicate that no Website was completely free of **WCAG 1.0** Priority 2 and 3 barriers. However, the Websites analyzed state **WCAG 1.0** Priority 1 barriers were comparable with **Section 508** barriers. The authors found that mandating Website accessibility will help increase Website accessibility. Also, the findings show that businesses that have inaccessible Websites will lose customers especially individuals with disabilities. Disabilities (e.g., visual, hearing, physical, speech and cognitive and neurological disabilities) can influence how an individual accesses the Internet. Therefore, companies may have to reconsider their Website designs to accommodate these limitations. Non-disabled individuals would benefit from adjustments made to Websites to increase accessibility. It is in the company's best interest to make their Websites accessible to avoid intervention from the government.

Kelly's[17] Web accessibility study focused on university Websites entry points [home pages] in the United Kingdom after the **Special Educational Needs and Disability Act (SENDA)** became law in 2002. The **SENDA** removes the exemption of educational institutions from the **Disability Discrimination Act** and states that discrimination against individuals with disabilities is against the law. The author used **Bobby** to evaluate 162 educational institutions home pages to see if the Websites were in compliances with **Bobby's A**, **AA**, and **WCAG**. The research found 90 university Websites with **WCAG 1.0** Priority 1 errors and 152 university Websites with Priority 2 errors. The findings presented suggest that many universities' home pages have accessibility problems that must be addressed by the institutions.

Research Method
Sample

Websites were selected from the **South Carolina Commission on Higher Education (SCCHE)** Website. This list consists of public senior institutions as determined by the **SCCHE**. A public senior institution is defined "as an institution that offers the bachelor's and higher degrees are often called 'senior' colleges and universities, to distinguish them from 'junior' colleges and other institutions offering the associate degree as their highest qualification."[18] I focused on the home page of each institution because the home page is the main access point for visitors, students, faculty, and staff.

These abbreviations represent the following universities:

MUSC — Medical University of South Carolina

USC-Aiken — University of South Carolina, Aiken campus

USC-Beaufort — University of South Carolina, Beaufort campus

USC-Columbia — University of South Carolina, Columbia campus

USC-Upstate — University of South Carolina, Upstate campus

Instruments

Many research studies (**Kane** et al., **Kelly**, **Loiacono** [and] **McCoy**) have used **Bobby** to evaluate Website home pages. The researchers understand the strengths (e.g., snapshot of accessibility) and weakness (e.g., can not automatically determine the accessibility of a Website) of the accessibility checking tool. Nevertheless, Web accessibility evaluation tools help to determine if the Web page is in compliance of accessibility standards and reduce time and work correcting accessibility problems on a Web page. Therefore, I used two accessibility evaluation/accessibility checking tools to evaluate Websites to avoid bias from using one accessibility checking tool.

I conducted a multi-method Website accessibility test/survey of 13 public senior institution's home pages in the state of South Carolina. The main purpose is to find common accessibility problems among the educational institution Website home pages and identify which institutions have the highest number of accessibility problems.

The study focused on automated testing for accessibility problems. I used automated accessibility evaluation tools to evaluate each Website home page for compliance with **Section 508** standards. **Section 508** standards are the federal law of the United States and are recognized by the postsecondary institutions of higher education. The data was collected in February 2009. Each Website home page was evaluated by both automatic accessibility checking tools. Data was collected and analyzed by each automatic accessibility checking tool and presented in different Web accessibility report forms.

Procedures

Each Website was analyzed using two automated accessibility evaluation tools: **Cynthia Says**[28] and **Section 508 Accessibility Checking Tool**.[29] Both **Cynthia Says** and **Section 508 Accessibility Checking Tool** are Web based packages and free. **Cynthia Says** can check one Web page at a time for **Section 508** or **WCAG 1.0** guidelines. The user may select multiple priority levels of **WCAG 1.0**, alternative text quality report, or file source on accessibility failures to be included in the accessibility report for an institution or company Web page. However, **Section 508 Accessibility Checking Tool** will compare html code against **Section 508** checklist. The user may select either Web page URL or source code to be evaluated by the accessibility tool.

For each page, I recorded the number of **Section 508** violations found by each tool. For example, an image does not include an alternative text (alt text) or a description of the image is counted once by each tool. Then I calculated the mean and the standard deviation for each tool. **Excel** was used to calculate the standard deviation for both **Cynthia Says** and **Section 508 Accessibility Checking Tool**. I wanted to find the statistical significance between **Cynthia Says** and **Section 508 Accessibility Checking Tool** findings. I did a manual check of each university home page to verify accessibility errors found on each by both evaluation tools. In addition, I used **WebEval**[19] created by WebInSight to analyze each university home page to assess the quality of images with alternative text or alt text. A significant image with alt text indicates that the alt text is relevant and describes the purpose of the image. One can consider an insignificant image to be either decorative or spacer image (i.e., img src="spacer.gif" alt=" ") which is used to control the layout of the Web page in visual browers.[20]

Limitations of the Study

Limitations do exist in this research. This study used a small sample. The dynamic nature of the Internet and the accuracy of Web accessibility testing tools may result in an overstating or understating the accessibility test results. The study does not address disability law or other legal aspects of accessibility, a possible area for future study.

According to **W3C**,[21] "there is as yet no tool that can perform a completely automatic assessment on the checkpoints in the guidelines, and fully automatic testing may remain difficult or impossible. For instance, some checkpoints rely on an interpretation of what 'important' information is, or whether the text equivalent for a non-text element is accurate. It is also possible for automated accessibility checkers to register 'false negatives' or 'false positives' due to the type of mark-up on a page." I used two evaluation tools to avoid bias in test results and to see how each tool presents its findings. **WebAIM** points out that when content changes dynamically within a Web page, it may cause accessibility problems.[22] The viewer may not be able to access information on Web pages that were previously available to him or her.

Findings and Discussion
Summary of Web page Errors

The results of this study reveal many things about Website accessibility of the university Web pages from the sample institutions across the state of South Carolina. The 13 university home pages that were analyzed using **Cynthia Says** contained 54 errors while **Section 508 Accessibility Checking Tool** found 54 errors. After averaging the results of **Cynthia Says** and **Section 508 Accessibility Checking Tool**, the mean number of errors per page was 4.15. **Cynthia Says** found 4 of the 13 Websites tested contained no errors while **Section 508 Accessibility Checking Tool** found 8 of the 13 Websites free of errors. One Website contained the highest number of errors, 36 and 44 errors respectively, found from this set of data. Also, one Website received a warning from **Cynthia Says** test results. **Table 1** shows the frequency of errors found using both tools for 13 universities in South Carolina. The standard deviation for **Cynthia Says** and **Section 508 Accessibility Checking Tool** is slightly different. The standard deviation for **Cynthia Says** is 9.71 and the standard deviation for **Section 508 Accessibility Checking Tool** is 12.03.

Although there is no difference between the means of both tools, the result suggests that there is a difference in the processes used by the Web accessibility evaluation tools. The difference can be seen by how many Websites were free of errors by both tools. Both tools evaluated each Website for **Section 508** standards. However, one Website results are suspicious which may suggest that the findings may be inappropriate and that the home page has been unintentionally blocked by accessibility problems. This result confirms the point made by the **W3C**[23] and **Permanent Tangent**[9] that no

accessibility evaluation tool can automatically determine the accessibility of a Website. A manual check of the Web page is needed to ensure accessibility of the Web page and the accuracy of the evaluation tool. The evaluation tools help to save work time because it indicates errors found on the Web page.

Analysis of Image Accessibility Quality

WebEval[19] was used to evaluate Web page accessibility to determine if images have alternative text (alt text). A significant image provides information pertinent to the Web page. An effective alt text provides a description of an image for its target audiences for alt text as follows: sighted readers who browse non-graphically, blind and sighted readers alike who access a page using audio-based browser technologies, or automated indexing programs that recognized and utilize alt text as part of the page's contents.[27] On the other hand, an image can be used as a spacer image which is used for decorative or layout purpose and should contain an empty alt (e.g., alt=" ") or a css background image so that reading browsers do not bother users by uttering things like "spacer image."[26] 6 out of 13 university home pages had all images accessible. Out of 195 total images, 144 (74%) are significant images. Significant images with alt text were 114 (58%) of 195 total images or each university home page has on average 9 images with alt text.

Section 508 Accessibility Checking Tool Summary

According to **Section 508 Accessibility Checking Tool**, **Citadel**, **Clemson**, **College of Charleston**, **Lander**, **South Carolina State University**, **USC-Aiken**, **USC-Columbia** and **USC-Upstate** Websites were free of automatic violations. Numerous missing alt text or long descriptions (longdesc) were found on the **Coastal Carolina**, **Francis Marion**, **MUSC**, **USC-Beaufort**, and **Winthrop** home pages. **USC-Beaufort** used spacer.gifs on its home page. Alt text provides individuals using software (e.g., **JAWS** and **Thunder** screen reader) the ability to read the page. Fixing an alt text/longdesc error is easy, when adding an image to a Web page add an alt text or long description describing the image. **USC-Beaufort** needed to add an alt text or longdesc to one map image.

Cynthia Says Summary

Cynthia Says found the **Coastal Carolina**, **South Carolina State University**, **USC-Aiken**, and **USC-Columbia** Websites were free of automatic violations. **USC-Upstate** received a warning for its test results. **USC-Upstate** results support the need for human evaluation of the Website to verify the test results.

Francis Marion, **Winthrop**, **Lander**, **MUSC**, **USC-Beaufort** and the **College of Charleston** were found to need to add alt text or long description to images on each home page. As mentioned above the alt text/longdesc errors are easy to fix by the Web designer. However, the **College of Charleston** needs to add an alt text description to their application form because the file is a shockwave flash file.

Several institutions, **Francis Marion**, **Clemson**, **Citadel** and **USC-Beaufort** needed to add labels to form elements. Form elements are elements that allow the user to enter information in (e.g., text fields, textarea fields, drop-down menus, radio buttons, checkboxes, etc.) in a form.[24] A label explains the purpose and function of each form element.[25] For example, when using a screen reader, an individual can tab through the form and understand each element of the form.

Critique of Tools

Based on the research, both **Cynthia Says** and **Section 508 Accessibility Checking Tool** provided different accessibility reports based on report formats. In the case of **Cynthia Says**, the report format is errors listed by line number. The benefit for the user is to be able to quickly read and find the errors and warnings

Table 1

Frequency Table of Errors (n = 13)

University	Errors	
	Cynthia Says	**Section 508**
Citadel	1	0
Clemson	2	0
Coastal Carolina	0	2
College of Charleston	2	0
Francis Marion	4	3
Lander	1	0
MUSC	3	3
South Carolina State	0	0
USC-Aiken	0	0
USC-Beaufort	36	44
USC-Columbia	0	0
USC-Upstate	0	0
Winthrop	5	2
Mean	**4.15**	**4.15**
Standard Deviation	**9.71**	**12.03**

on the report. However, finding errors in the html or source code takes time. **Cynthia Says** helps the reader by listing line and column numbers of failures and warnings on the report.

The **Section 508 Accessibility Checking Tool** used an evaluation and report language report format to present its test results. The evaluation and report language report provides an easy reading of the report on the Web page accessibility standard validation, highlights accessibility errors and warnings which must be manually checked by the Web designer. However, if the user does not understand html coding then he or she cannot go into the Web page source code to make corrections whereby the summary report has no value to the user. The **Section 508 Accessibility Checking Tool** Website did provide limited instructions but did not provide instructions to interpret the test results.

I believe that the different Web-based evaluation processes contributed to the differences in the accessibility report findings. However, there are two constant factors which remain the same with the usage of both tools: knowledge of both html coding and **Section 508** Web standards which are based on the 1998 amendment to **Section 508** of the **Rehabilitation Act**.

Both **Cynthia Says** and **Section 508 Accessibility Checking Tool** can be helpful to anyone developing a Website. Although both tools quickly point out accessibility problems and warnings which needed to be addressed in a timely manner to ensure accessibility for individuals with disabilities viewing the Website. However, errors are always transparent regardless of the efforts put into it.

Conclusion

The results presented in this study clearly indicate that accessibility problems are a challenge for many institutions in the state of South Carolina. However, images with alt text findings suggest that a majority of images on Web pages of postsecondary educational institutions are accessible. The study represents the beginning of Web accessibility problem research focusing on educational institutions in the state of South Carolina. The project may be expanded to cover the different classification of educational institutions that the South Carolina Commission on Higher Education has developed for the state (e.g., public technical colleges, independent senior institutions, private for-profit colleges, etc.) As mentioned already about the limitation to this study, future research must pursue the law concerning or governing Website accessibility of educational institutions and other legality issues involved, such as implementing **Section 508** of the **Rehabilitation Act of 1973**, amended 1998 by the **Work Force Investment Act** and **Web Content Accessibility Guidelines 2.0**. Meanwhile, this paper is directly concerned with Website accessibility of public senior institutions in South Carolina rather than dwelling on its implications. 🪶

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