A Web Accessibility Report Card for Top International University Web Sites

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ABSTRACT
University web pages play a central role in the activities of current and prospective postsecondary students. University sites that are not accessible may exclude people with disabilities from participation in educational, social and professional activities. In order to assess the current state of university web site accessibility, we performed a multi-method analysis of the home pages of 100 top international universities. Each site was analyzed for compliance with accessibility standards, image accessibility, alternate-language and text-only content, and quality of web accessibility statements. Results showed that many top universities continue to have accessibility problems. University web site accessibility also varies greatly across different countries and geographic regions. Remaining obstacles to universal accessibility for universities include low accessibility in non-English-speaking countries and absent or low-quality accessibility policies.

Categories and Subject Descriptors
H.1.2 [**Models and Principles**]: User/Machine Systems – *human factors*. K.3.1 [**Computers and Education**]: Computers Uses in Education – *distance learning.* K.4.2 [**Computers and Society**]: Social Issues – *assistive technologies for persons with disabilities.*

General Terms
Design, Human Factors, Legal Aspects, Verification.

Keywords
Web, Accessibility, Evaluation, Education, WCAG, Section 508

1. INTRODUCTION
University web sites play a crucial role in the day-to-day lives of postsecondary students. Use of the Web is quickly becoming a required part of university life. University web pages often contain important information about academic resources, campus events, and administrative policies. These pages may also provide access to university services such as the library, campus bookstore, and course registration system.

A 2002 survey from the Pew Internet and American Life Project found that 48% of university students had participated in courses that required use of the Internet [17]. In addition to serving current students, university web pages may also provide information for prospective students and their families. A 2005 survey of American teenagers and their parents found that 42% of prospective university students used the Internet as a primary resource when choosing a university program [14].

As university web sites take on an increasingly role, it is important that these sites be accessible to users with disabilities. Web sites that are not accessible may prevent users with disabilities from accessing the information that they contain, and may prevent those users from participating in university activities. 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.

Web developers who wish to create accessible web pages may draw from a wide variety of helpful online resources such as technical documentation and software tools. Many of these resources are available online for free. Despite the availability of these resources, many web developers continue to produce web sites that are inaccessible [19]. Recent studies suggest that many existing web sites are even becoming less accessible over time [13,20].

In order to improve the accessibility of university web sites worldwide, we must identify those areas in which accessibility issues are most severe. To this end, we executed a multi-method accessibility evaluation of 100 top international university web pages. This evaluation was designed to identify ongoing accessibility issues affecting university pages, and to isolate groups of web sites that suffer from serious accessibility problems. Our evaluation considered how factors such as geographic location, language, university ranking, and public funding status might impact a university's level of web accessibility. We found that while many worldwide university web pages contain accessibility errors, there were significant geographical variations in web site accessibility. We also found that many sites lack accessibility policies or other documentation, which may prevent users with disabilities from effectively using those sites.

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2. BACKGROUND

2.1 Support for accessible university sites

Concern about web site accessibility has been growing steadily since the mid-1990s [31]. The cause of web site accessibility has been supported by researchers, community organizations, web standards bodies, and governmental agencies. These groups have attempted to raise awareness of accessibility issues and to encourage accessible design practices through a number of different methods. Web developers and web standards organizations have developed technical guidelines that attempt to codify accessible design techniques. Researchers and software developers have created software tools to assist everyday web developers in creating accessible web sites. In some countries, government organizations have begun to implement legal requirements for accessible web pages.

Web standards and guidelines are intended to provide web developers with information about how to create accessible web sites and evaluate the accessibility of existing sites. Although there are a number of accessibility guidelines in existence, the most commonly followed guidelines are the Web Content Accessibility Guidelines (WCAG), developed in 1999 by the World Wide Web Consortium's Web Accessibility Initiative [7]. WCAG provides a set of checkpoints that web developers may follow to ensure that their sites are accessible to a wide variety of users. WCAG defines three levels of web accessibility, and provides a set of checkpoints for each level. A web page must satisfy all Priority 1 checkpoints to be considered minimally accessible. Web developers may implement Priority 2 and Priority 3 checkpoints to provide increased accessibility for users. While WCAG is intended to apply to all web sites, the WCAG standard has also been used to develop a specialized set of checkpoints targeted at educational sites [27]. WCAG has also been used as a model for accessibility legislation, such as in the Section 508 guidelines for US government web sites [34].

Although web accessibility guidelines such as WCAG are designed to be easy to follow, verifying a site's accessibility can be a time-consuming task. Software developers have created a number of tools to simplify this process. One common form of accessibility tool is the automated accessibility evaluator, which scans a set of web pages and automatically evaluates their compliance with guidelines such as WCAG [1]. WebXACT (http://webxact.watchfire.com), formerly known as Bobby, and Cynthia Says (http://www.contentquality.com) are two popular accessibility evaluators that utilize WCAG and Section 508 accessibility guidelines. The Functional Accessibility Evaluator (FAE) evaluates web sites and provides authors with directed feedback about accessibility in several categories [12]. These tools may assist developers in the creation of accessible web sites, but may not be able to identify all accessibility issues. For this reason, automated tools are often used in combination with some type of manual evaluation or checklist [22,32].

Governments worldwide have also begun to consider the problem of web accessibility. Laws that were originally intended to ensure the accessibility of physical spaces and work environments are now being extended to provide equal access for electronic materials. Laws governing web accessibility are beginning to appear, but may lag behind technological advancements. As a result, legal support for web accessibility varies widely. In the United States, Section 508 of the Rehabilitation Act of 1973 [34] stipulates that all electronic information produced by federal agencies must be accessible to people with disabilities. Section 508 also provides a set of mandatory accessibility checkpoints for federal government web sites. While Section 508 mandates the accessibility of US government web sites, there are currently no legal accessibility requirements for university sites [16].

The United Kingdom has recently adopted legislation that requires educational materials to be made accessible to people with disabilities. The Special Educational Needs and Disability Act (SENDA) of 2001 protects primary, secondary and university students from discrimination in accessing educational resources, and may be applied to web accessibility at universities and other educational institutions [30]. Other nations, including Australia, Japan and Canada, have created best practices guidelines for web accessibility, but have not yet developed legal accessibility requirements [35].

2.2 Prior studies of university accessibility

Despite the prevalence of standards, tools, and legislation supporting accessible web development, a number of previous studies have shown that many university web pages remain inaccessible to users with disabilities.

Rowland [25] summarized a number of early web accessibility studies, and found that fewer than 25 percent of university home pages met the minimum accessibility criteria established by Bobby. In another study, Schmetzke evaluated the web sites of the top 24 library and information science programs as ranked by US News and World Report [26]. Schmetzke used Bobby to evaluate departmental home pages and second-level pages linked from the home page. He found that only one web site was free of accessibility errors on all pages, and that 77 percent of university web pages contained at least one accessibility error. Zaphiris and Ellis used automatic evaluation tools to examine the usability and accessibility of the top 50 universities in the United States. They found that only 15 of the 50 university sites were free of WCAG Priority 1 accessibility errors, and only 7 sites passed both usability and accessibility tests [38].

Other studies have examined the accessibility of university web sites relative to other groups of web sites. These studies have typically found government sites to be the most accessible, with university sites trailing behind. In 2002, Jackson-Sanborn and her colleagues examined between 50 and 100 popular sites in six categories: clothing, international sites, jobs, universities, government, and general popular sites [15]. Bobby was used to analyze the accessibility of sites. No Priority 1 errors were found on 43 of the 100 university sites, second only to the government sites, of which 60 of 100 were free of Priority 1 errors. Bailey and Burd analyzed corporate, government, and university web sites in the UK every year between 2000 and 2004 [2]. They found that university web sites were the most accessible in 2000, but were overtaken by corporate sites by 2004.

Several studies have attempted to measure the impact of legislation on web page accessibility. Kelly examined the home pages of 162 universities in the United Kingdom in 2002, shortly after the accessibility law known as SENDA came into effect [18]. Of the sites surveyed, less than half passed all Priority 1 checkpoints, and only four passed both Priority 1 and Priority 2 checkpoints. Willison performed a similar analysis of UK university sites after SENDA. He found that 14 of 19 sites were free of Priority 1 errors, but that all of the surveyed sites had Priority 2 or Priority 3 errors [36]. Bailey and Burd [2] analyzed university sites before and after SENDA, and found that the new law did not significantly affect levels of accessibility on university web sites.

Each of the studies described here presents only a "snapshot of access" [25], as web pages can change rapidly. When taken together, however, these studies reveal significant ongoing accessibility problems that affect university web sites in multiple countries.

2.3 Evaluation methods

Many of the large-scale accessibility analyses to date have relied upon a single evaluation tool such as Bobby. Recognizing the limitations of automated tools, some researchers have combined multiple methods to achieve more robust accessibility measurements. Researchers have combined the results of multiple automated tools [9,10] and have compared automated tools to human evaluators [20,29,36]. In 1999, Sloan and his colleagues [29] performed a comprehensive analysis of 11 university web sites in the United Kingdom using a number of measures, including automated analysis with Bobby, a manual evaluation of WCAG guidelines, a heuristic evaluation with a screen reader and text-only browser, and a heuristic usability evaluation. The researchers found that only 2 of 11 sites met all Priority 1 checkpoints.

Thompson and his colleagues analyzed the accessibility of 102 public research university web sites with Bobby and a human evaluator [32]. The evaluator viewed each page using a standard browser and screen reader, and rated the page on a scale of 0 to 5. The pages that were evaluated received a mean rating of 2.26, and the majority of sites were rated between 1 and 3. The authors found that the ratings of the human evaluators and Bobby were correlated (r = .595).

3. METHODS

We conducted a multi-method accessibility survey of 100 top international university web sites. Our primary goals were to identify common accessibility issues affecting university web pages and to identify groups of universities with the greatest accessibility issues. We selected a large set of international sites in order to examine the effects of geographical region, language, and other factors on web site accessibility.

Our study utilized both automated and manual tests in order to capture a broad range of accessibility issues. We used automated accessibility evaluation tools to measure compliance with accessibility standards and image accessibility. Manual tests were used to evaluate aspects of accessibility that cannot easily be tested automatically, such as the presence of accessibility policies and alternate languages.

Data collection and analysis took place in January 2007. Automated analyses were performed using web-based evaluation tools. Pages used in the manual tests were downloaded by the research team and analyzed offline in order to eliminate the possibility of pages changing during analysis.

3.1 Selection of web sites

Web sites were chosen from the Times Higher Education Supplement's 2006 World University Rankings [33]. This list consists of top-rated international universities as determined by a number of factors including peer review, research productivity, graduate employability, teacher-student ratio, and international outlook. We chose this list because of its emphasis on peer review and because of its popularity. The World Rankings List is well known internationally and is likely to be consulted by many prospective students when choosing a university.

We selected the top 100 universities from this list and analyzed the home page of each university. When the list referenced a university system rather than an individual campus, we chose the campus with the largest number of students. We felt that focusing on home pages was appropriate because home pages are viewed by many current and prospective students and because the home page is a consistent feature across sites. All of the sites that we analyzed featured an English-language version of the home page. Additionally, 39 out of 100 sites featured a version of the home page in at least one additional language. Our analysis focused primarily upon English-language home pages, but also compared non-English to English pages.

3.2 Automated tests

Each web site was analyzed using four automated evaluation tools: WebXACT/Bobby (referred to here as Bobby), Cynthia Says (Cynthia), Functional Accessibility Evaluator (FAE), and WebInSight. We used multiple tools in order to provide a robust set of accessibility measures.

3.2.1 Web accessibility standards compliance

WebXACT/Bobby and Cynthia Says are designed to measure a web site's compliance with accessibility standards. For this study we used the desktop application version of Bobby and the web-based version of Cynthia. To minimize the impact of false positives or false negatives from a single tool [5], we combined scores from Bobby and Cynthia. Both tools evaluated web pages using the WCAG 1.0 standard, which is recognized worldwide.

For each page, we recorded the number of Priority 1, 2, and 3 violations produced by each of the tools. We measured the number of guidelines that were violated, rather than the number of individual violations. In other words, each type of accessibility violation, such as image content without alternate text, is counted only once [20]. Using Bobby and Cynthia, we calculated the number of violations for WCAG Priority 1, 2 and 3 errors.

After calculating scores using each tool, we added these scores together to produce combined Priority 1, 2, and 3 scores. We also computed a combined total P1-P3 score consisting of every Priority 1, 2 and 3 violation from both tools. These combined scores represent the scores from both Bobby and Cynthia, and thus overestimate the number of accessibility violations on each page. These scores were divided by 2 to calculate the average Priority 1, 2, and 3 scores, and the average P1-P3 score. These average scores provide an accurate estimate of the number of accessibility violations on each page.

3.2.2 Functional analysis

Each page was also analyzed using the Functional Accessibility Evaluator (FAE) from the University of Illinois [12]. FAE analyzes sites using the DRES/CITES best practices [8], which draw from both WCAG and Section 508 guidelines. FAE provides a detailed analysis of accessibility issues in five categories: navigation and orientation, text equivalents, scripting and automation, styling, and standards. FAE generates a score between 0% and 100% for each category. FAE also reports a qualitative status code based on the percentage of passed tests: Complete (100% of tests passed), Almost Complete (85-100%), Partially Implemented (40-94%), Not Implemented (0-39%), and Not Applicable.

Because FAE uses a different scoring system than Bobby and Cynthia, we did not combine scores from FAE with scores from Bobby and Cynthia.

3.2.3 Alternate text

Lack of alternate text for images is one of the most common accessibility errors. A number of prior studies have found that missing alternate text was the most common accessibility error [11,26,29]. Missing alternate text is also one of the easiest accessibility problems to solve, as web developers need only include an alternate text tag when inserting an image.

While most accessibility tools can test for the presence of alternate text, these tools may inaccurately estimatte the severity of problem. For example, many pages contain images used for decoration or visual spacing only. These decorative images should not be considered to be inaccessible, as they have no meaningful text equivalent. We used the classifier developed by the WebInSight [3] project to provide a more accurate assessment of alternate text quality. WebInSight analyzes the quality of alternate image text by identifying significant and insignificant accessible images. A significant image is one that is intended to convey page content, while an insignificant image is one that is used for page decoration or spacing.

3.3 Manual tests

We performed a number of manual tests in order to analyze potential accessibility issues that that cannot be evaluated by current software. Our manual tests included analysis of web site accessibility policies, text-only versions of the home page, and alternate language versions of the home page.

3.3.1 Accessibility policies

Accessibility policies and related documents may play an important role in how people with disabilities use a web site. These documents may describe the site's compliance with accessibility standards, may provide users with instructions on accessing accessibility features such as keyboard shortcuts, and may provide contact information for resolving accessibility issues. University web accessibility policies have not been extensively studied. An exploratory study by Bohman [4] found that many universities either lacked public accessibility policies or featured unclear and incomplete policies.

We manually searched each English-language web site for accessibility statements. Our search procedure was based on steps that a user might follow in trying to find such a policy. We first contacted the webmaster for each site and requested a link to their web site's accessibility policy documentation. Next, we manually examined the home page for each university and attempted to find a policy document either on the front page, or linked to a page labeled "Help" or "About this site". Next, we searched for the terms "accessibility" and "accessibility policy" on the web site's search engine and manually examined each link on the first page of results. If we could not find an accessibility statement on any of these pages, we labeled the site as not having a reachable accessibility statement.

Once we collected accessibility statements from each site, we analyzed each statement for the presence of technical specifications, contact information and other features. When a site contained multiple accessibility policy documents, the documents were analyzed as a single policy.

3.3.2 Alternate languages and text-only

Sites that are designed to be accessible to an international audience may benefit from providing content in multiple languages and formats. Shneiderman [28] and Richards and Hanson [24] have suggested that practitioners of universal accessibility should consider the needs of people from different cultures and of non-native language speakers.

We manually searched each home page for the presence of an alternate language version of the home page. For those pages that contained more than one language, we performed our automated accessibility tests on the English-language page and the native-language page separately.

Providing a text-only version of a web site may provide usability benefits for people that use screen readers or other alternative browsers [6]. We manually searched each home page and accessibility statement page for a link to a text-only version of the web site.

3.4 Limitations of the methods

The dynamic nature of the Web and the precision of automated testing tools may introduce some potential errors to our accessibility measurements. Where possible, we have attempted to account for these errors.

First, automated evaluation tools such as Bobby and Cynthia may underestimate or overestimate the number of accessibility errors on a web page [5]. We used multiple evaluation tools to minimize the error introduced by any single tool.

Second, the content displayed on a web page may change from visit to visit [36]. This is a concern for web pages with dynamic page content, which may appear to become more or less accessible between visits even if the underlying web page has not changed. When permitted by the analysis method, we analyzed offline copies of web pages rather than the original dynamic page.

4. RESULTS

4.1 Web accessibility standards compliance

4.1.1 Total number of errors

We combined the number of Priority 1, 2 and 3 violations recorded by Bobby and Cynthia. The 100 university web pages that we analyzed contained a total of 937 accessibility errors. After averaging the results of Bobby and Cynthia, the mean number of errors per page was 4.68. Of the 100 sites we tested, 36 contained no Priority 1 errors in either evaluation tool. Only 2 universities, the University of Michigan and the University of Queensland, were free of all Priority 1, 2 and 3 errors. Two web sites had an average P1-3 score of 9, the highest number of errors found in this data set. Figure 1 shows the distribution of accessibility errors in the data set.

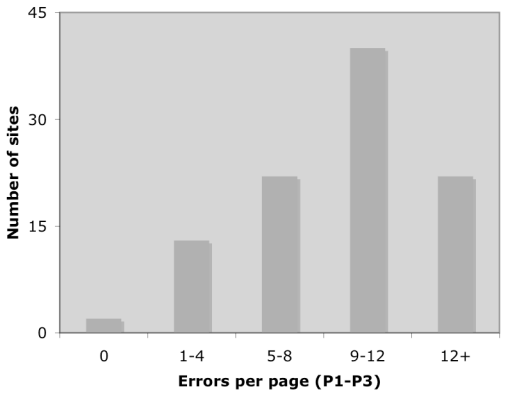

Figure 1. Distribution of total accessibility errors (combination of Bobby and Cynthia errors)

4.1.2 Geographical differences

The World University Ranking contains universities from 21 countries. Out of the 100 universities on the list, 48 universities are located in the United States or the United Kingdom. The top 10 universities in this list are all located in either the US or UK.

In order to examine international differences in accessibility, web sites were grouped by country of origin. We then compared the average total number of errors for universities in each group. Table 1 summarizes the differences in number of accessibility errors for all countries with 5 or more universities in the top 100.

Among those countries with 5 or more ranked universities, universities in Australia contain the fewest average accessibility errors, followed by the United Kingdom, the United States, the Netherlands and France (tie), and Switzerland. A two-way ANOVA was performed using the total number of accessibility errors, and revealed that differences in accessibility between the top 6 countries are statistically significant ($p < .05$).

In order to examine accessibility differences based on geographic region, we performed another comparative analysis, this time grouping universities by continent. Table 2 contains summary results from the comparison between continents.

Table 1. Average errors/page in highest ranked countries.

Country	Universities in top 100	Average P1 errors/page	Average P1-3 errors/page
Australia	7	0.07	2.71
UK	17	0.33	3.17
USA	33	0.5	4.61
Netherlands	7	0.78	5.5
France	5	0.8	5.5
Switzerland	5	0.6	5.6

University web sites in Oceania (Australia and New Zealand) were significantly more accessible than sites on other continents. Sites in Europe and North America trail behind, while sites in Asia contained significantly more accessibility errors. We performed a two-way ANOVA on the total number of accessibility errors, and found differences in accessibility errors between continents to be statistically significant ($p < .05$).

Table 2. Accessibility errors grouped by continent.

Continent	Universities in top 100	Average P1 errors/page	Average P1-3 errors/page
Australia/NZ	9	0.17	3.28
Europe	40	0.53	4.45
N America	37	0.55	4.81
Asia	14	1.11	5.93

4.1.3 Public and private universities in the US

The World University Ranking lists both public and private universities in the United States. The list contains 25 private US universities. Although neither public nor private universities are legally required to be accessible, one might expect that public universities would more closely follow local, state or national accessibility guidelines.

We placed the 25 US private universities and 8 public universities from the ranking list into separate groups. We then calculated the average total number of errors for sites in each group. Public universities had a mean error count of 4.61, while private universities had a mean error count of 4.90. We compared the total number of errors using a two-tailed t-test, but found no statistically significant difference in the number of errors.

4.1.4 University ranking

Prior studies of top-ranked university web pages did not show a strong correlation between university ranking and accessibility [21, 26].

We computed an accessibility ranking for each page using the total number of errors. We then computed the Spearman rank order correlation test to measure the relationship between total number of accessibility errors and university ranking. The relationship between these values was non-significant, supporting the assertion that there is no strong link between university standing and web site accessibility.

4.1.5 Non-English pages

In addition to 100 English-language sites, we collected 39 alternate-language versions of sites in the collection. In some cases, these sites represented additional languages intended to increase accessibility and usability of the site. For example, the University of Michigan provides a version of its site in Spanish. In other cases English was the secondary language of a web site in a non-English-speaking country.

We compared the total accessibility errors of non-English pages to the corresponding set of English pages. Differences between English and non-English versions seem to vary widely by the individual page. Error counts were identical for English and non-English pages for 16 of 39 bilingual universities. In one case, however, the non-English version of a page generated an additional 10 accessibility errors. In some cases the English page was more accessible, while in other cases the non-English page was more accessible.

We performed a two-tailed t-test to analyze the differences between non-English pages and the corresponding English versions of those sites. The difference in total errors between English and non-English pages was not statistically significant. However, we observed an increased likelihood of error for sites that were translated versions of Asian-language sites. We isolated those sites that featured an Asian language (Chinese, Japanese,

and Korean) and calculated the difference in error between the English and non-English versions. We calculated the same difference for all other sites that contained non-Asian alternate languages. We performed a t-test on these values, and found that accessibility errors varied more on sites featuring Asian languages ($p < 0.05$). This indicates that sites that are translated to or from Asian languages may have an increased likelihood of developing accessibility errors.

4.2 Functional analysis

FAE provides accessibility evaluations in five categories, and reports both a percent-based score and a qualitative status code in each category.

Table 3. Functional accessibility of top 100 university sites.

Functional category	Average error (%)	Accessibility status
Navigation & Orientation	36.07	Not Implemented
Text Equivalents	51.24	Partially Implemented
Scripting	54.00	Partially Implemented
Styling	50.95	Partially Implemented
HTML Standards	69.74	Partially Implemented

Overall FAE scores ranged from 100%, a perfect score, to 0.2% for the least accessible site. The mean accessibility score for all sites in this study was 52.4%.

Table 3 contains a summary of the data provided by FAE for all of the 100 top university sites. The university web sites achieved low scores in most categories, but scored slightly higher in the "HTML Standards" category. These sites fared especially poorly in the "Navigation & Orientation" category, suggesting that they might benefit from more navigation assistance and structural markup.

4.3 Comparing automatic evaluation tools

We elected to use multiple evaluation tools in order to minimize the bias of any single tool. While Bobby and Cynthia perform similar tests, their results are not always identical. FAE also provides information about sites that cannot be accessed through the other tools. Because each tool is using a similar set of accessibility guidelines, we should expect that scores from each tool will be similar.

Combined P1-P3 error counts for Bobby and Cynthia are very highly correlated ($r^2 = 0.94$), with an average variance of 0.05. This is not surprising as each tool uses the same WCAG guidelines. In general, Bobby found approximately 2.65 more errors per site than Cynthia.

We also compared the total number of errors recorded by Bobby to the total number of errors recorded by FAE. We found a positive correlation between Bobby and FAE ($r^2 = 0.69$) although this is weaker than the correlation between Bobby and Cynthia. Figures 2 and 3 illustrate the correlation between Bobby and Cynthia and Bobby and FAE, respectively.

Given that each of the three scores correlates well with the others, it seems unnecessary to use all three tools together in future studies. However, since FAE produces detailed results about the types of accessibility errors encountered, it may be worth including in future studies.

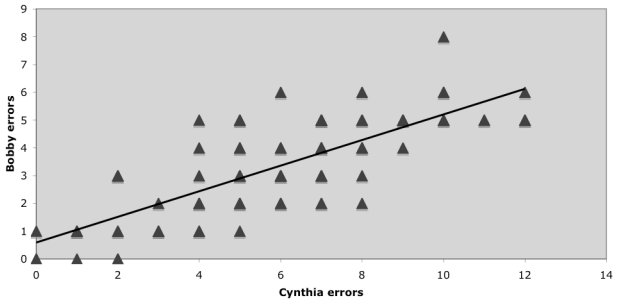

Figure 2. Comparison of Bobby and Cynthia total errors.

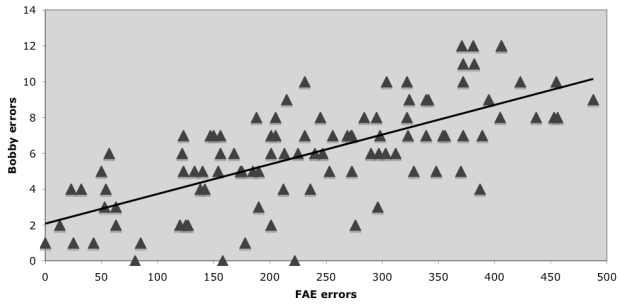

Figure 3. Comparison of Bobby and FAE total errors.

4.4 Alternate text

We used WebInSight [3] to analyze web images and their alternate text on each of the English-language home pages. Images that contained alternate text were considered to be accessible. Out of 3155 total images, 1112 images (35%) contained alternate text. On average, each web page had 57% accessible images. There were 24 web pages out of 100 for which all images were accessible.

We also used WebInSight to assess the accessibility of significant images. Significant images are assumed to contain relevant content, while insignificant images may have been used for layout or decoration only. WebInSight classifies significant images based on size, color, and whether or not the image is attached to a link or button. By counting only significant images, we found that web sites often provided alternate text for significant images. Out of 3155 total images, 1334 (42%) were found to be significant images. Of these, 945 images (71%) contained alternate text. On average, each page had 77% accessible significant images. There were 45 pages out of 100 for which all significant images were accessible. If we assume that WebInSight's classifier is accurate in identifying important images, then we have shown that university web sites provide significantly better accessibility for images than a basic image quality analysis would predict.

From the sample collection, 8 of the 100 sites had no accessible images on their home page. Of these sites, 6 sites were universities for which English is not the native language, and the other 2 sites were private universities in the United States.

4.5 Accessibility policies

In December of 2006 we contacted the webmaster of each university web site to request the URLs of any accessibility policies at that university. Webmasters were contacted via publicly posted e-mail addresses or contact forms on the university web site. We received responses from 39 of 100 webmasters within 30 days of the request. We located additional

accessibility policy documents through manual scanning of the home pages.

We located web accessibility policies on 46 of 100 pages. Of these, 21 of the policies were linked directly from the home page. Others were found through site information pages, help pages, and through on-site search. Every university web site in the United Kingdom and Ireland featured an accessibility statement.

Four sites contained a general non-discrimination policy that did not explicitly address accessibility. As these policies did not reference web accessibility, they were not counted as accessibility policies. We also received four links to accessibility policies in languages other than English. These documents were counted, but their content was not analyzed.

We analyzed each policy to determine its official status and to determine whether the policy referenced technical standards or provided instructions for resolving accessibility issues. Of the 46 statements found, only 14 stated that the policy was required or currently implemented, while 9 statements were labeled as suggestions only. An additional 20 statements were labeled as drafts or works in progress.

Technical details were included in 36 of 46 statements. These details either described specific technical actions taken to improve accessibility, such as adding alternate image text or keyboard shortcuts, or described compliance with a specific set of accessibility guidelines. Only 12 statements contained instructions or contact information for resolving accessibility issues on the site.

Web sites that featured accessibility policies had statistically fewer accessibility violations than sites that did not have policies ($p < .01$) Sites without policies averaged 5.36 P1-P3 violations, while sites with policies averaged 3.98 P1-3 violations.

4.6 Alternate languages and text-only

We manually examined each site in order to identify pages that contained alternate language content. Each university we tested had an English language page, and 39 pages had versions in at least one other language. Of these sites, 12 used English as the default language, 22 used some other language as the default, and 5 used different URLs for English and non-English versions. Only three sites in North America featured an alternate language link: McGill University (French), the National Autonomous University of Mexico (Spanish), and the University of Michigan (Spanish).

We also manually searched each page for the presence of a text-only option. We found that 14 sites out of 100 provided a link to a text-only version. Of these sites, 6 were located in the United States and 6 were located in the United Kingdom. One university in Ireland and one university in Hong Kong also provided text-only versions of their sites. One additional site featured a version for mobile phones that provided text-only access to the site. A number of these sites used text transcoder software to automatically generate a text-only version of the site. Unfortunately, technical restrictions prevent an accurate count of sites using transcoders, as not all text-only web pages contained information about how they were generated.

5. DISCUSSION

The results of this study present a mixed view of university web site accessibility. While some sites approach full accessibility, a large number of still suffer from accessibility problems.

The results also highlight several larger trends affecting web accessibility. One such issue is the accessibility of international university web sites. The issue of web accessibility has received a fair amount of attention in English-speaking countries such as the United States, Canada, the United Kingdom, and Australia. These sites tend to have a somewhat higher level of accessibility. However, universities in some non-English-speaking countries have significantly less accessible web pages. It is not clear from the present research what factors may cause this discrepancy in web site accessibility. It seems that legislation may have a limited positive effect on accessibility. For example, web sites in the United Kingdom, where university web site accessibility is regulated, have some of the highest levels of accessibility.

Another issue raised by the results of this study concerns the presence and quality of web accessibility policy statements. When available, web accessibility policies enable users to verify the accessibility of a web site and to more easily use accessibility features of that site. Less than half of the surveyed sites featured a findable accessibility policy, and the policies that were found differed significantly in the types of information that they provided. Few of the policies contained specific information about the web site's accessibility features, and fewer still provided a mechanism for users to notify the webmaster about accessibility problems. While the World Wide Web Consortium provides guidelines for producing web accessibility policies [37], these guidelines are not part of the WCAG technical guidelines and may be overlooked by web developers. Integrating web accessibility policy creation into the process of web site development might increase the quality and quantity of these policies, resulting in an improved user experience for users with disabilities.

6. CONCLUSION

In this paper we described a comprehensive, multi-method accessibility analysis of top university web sites. We have shown that accessibility is still a problem for many of the top universities worldwide, and that there remain significant hurdles to universal web accessibility for universities. In particular, we have found significant problems related to the accessibility of international web pages. We have also found that many sites lack clear web accessibility statements and documentation.

The results presented here may provide some preliminary directions for addressing international web accessibility issues. However, we have yet to explore the deeper social and cultural issues underlying these issues. Furthermore, we do not yet know what impact web accessibility might have on university enrollment and on participation in education by students with disabilities.

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