Website Usability and Content Accessibility of the top USA Universities

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Abstract: This study investigates whether the websites of the top USA universities are ranked high in terms of accessibility and usability and if these two measures are correlated. The usability and accessibility of the top fifty USA universities (USNews, 2001) were measured using two automatic evaluation tools: Bobby and LIFT. The results show a low compliance (30%) with Web site Content Accessibility Guide and a low usability rating for most of the university websites. The accessibility approval was found to correlate significantly with overall usability ratings of the websites. The size (in Kb) of the website was found to be a driving variable both for usability and accessibility.

Introduction

Currently over 30 million people in the United States and many more millions worldwide have physical, sensory or cognitive limitations that make interacting with traditional monitor, keyboard and mouse configurations difficult (Laux, 1988). The number of people with disabilities is expected to increase significantly in the next decade as the United States' and world's population is rapidly growing older, and the number of World Wide Web (WWW) users of old age also increases exponentially (U.S. Census Bureau, 1999, Curry, 1999).

To make computer technology accessible to people with disabilities, companies provide specialized human computer interface devices (e.g. special mouse for people of age that have difficulty in motor movements, special magnification for monitors, special keyboards). However, although being able to interact with a computer is a necessary prerequisite to using the WWW, the web provides unique features (dynamic content, heavily graphical user interfaces, complicated navigation structures) that often make accessibility a more complicated challenge.

Definition of Web accessibility and Universal Design

Many people have been advocating a universal design strategy when designing web interfaces. Universal design refers to the design of products and environments that are usable by all people, to the greatest extent possible, without the need for case-by-case accommodation. If you adopt universal design when developing WWW pages, your pages will be more readily accessible to most people with disabilities who are already using computers (Laux, 1988).

Chuck Letoumeau (2001) defines web accessibility to mean that "anyone using any kind of web browsing technology must be able to visit any site and get a full and complete understanding of the information as well as have the full and complete ability to interact with the site if that is necessary".

Universities and Web accessibility

Apart from the many social and economic motivations for addressing Web accessibility, regulatory compliance is becoming an important factor.

More specifically (Laux, 1988):

1. When a web site is used in a job or in schools or universities, accessibility becomes an issue that may be addressed by the Americans with Disabilities Act of 1990 (ADA).
2. If employees need to use an outside Web site for a critical job function, the employer or institution may be responsible for providing adequate access.
3. If web sites are designed so that current adaptive equipment cannot make the pages accessible, employers and educational institutions may have difficulty providing acceptable accommodation (e.g. heavily graphic oriented web pages).
4. A service provided to the public via a web site or page that is not accessible to users with disabilities may be subject to an ADA claim; and more important, the service provider may loose market share because many potential customers are unable to access the service.

Also there are significant legal reasons for making sure that the university campus web pages are accessible. By failing to provide access to the internet, universities have been found in violation of Section 504 of the Rehabilitation Act of 1973 and Title II of the Americans with Disabilities Act of 1990 (Campbell & Waddell, 1997). Others (Margolin, 1998) advocate that inaccessible web pages are also in violation of Title III of ADA since the internet is a public space.

Usability and Accessibility Mandates, Guidelines and Tools

There are some encouraging signs that the accessibility of the Internet is taken into account by mainstream society (Newell & Gregor, 1997). Accessibility for information on the Web has been well regulated in the U.S. Some legal mandates regarding accessibility are Section 255 of the Telecommunications Act 1996 (http://www.fcc.gov/cib/dro/ section255.html), which regulates the accessibility of Internet Telephony, and Section 508 of the Rehabilitation Act Amendments of 1998 (http://www.ed.gov/offices/OSERS/ RSA/RehabAct.html), which requires that when Federal departments or agencies develop, procure, maintain, or use electronic and information technology, they shall ensure that the technology is accessible to people with disabilities, unless an undue burden would be imposed on the department or agency.

Sullivan and Matson (2000) compared 50 most popular web sites in terms of their usability and content accessibility and found a marginal correlation (ρ=0.23) between manually analyzed content accessibility in conformance to the Priority 1 of the WCAG and overall automated usability testing result provided by LIFT (http://www.usablenet.com/index.htm). The present study extends Sullivan and Mason's study in two ways: by automating the content accessibility testing using Bobby (http://www.cast.org/bobby), which performs the test based on all Priorities, and by performing group comparisons of university web sites in terms of their usability and content accessibility.

This study aims to answer two research questions:
1. Are top university web sites rated highly in terms of accessibility and usability?
2. Is the result of accessibility evaluation of university web sites related to the result of their usability evaluation?

The two automatic evaluation tools used in this study are LIFT and Bobby. LIFT was chosen because it is the only automatic tool that performs usability evaluation. Bobby was one of the most widely used automatic accessibility evaluation tool.

LIFT provides a report of the number of catastrophic errors (errors that disable users to complete tasks), major errors (errors that cause users to face major impediments), minor errors (errors that are really a nuisance for users) and cosmetic errors (low priority materials). In addition, as a general rating, LIFT assigns a rating of excellent, good, fair or poor.

Bobby recommends effective Web page authoring for special Web browsers (e.g. the one which reads text out loud using a speech synthesizer for blind users). Bobby divides the accessibility errors into 4 sections to be tested:
1. *Priority 1 Errors* are problems that seriously affect the page's usability by people with disabilities, in accordance with Priority 1 of WCAG. A Bobby Approved rating can only be granted to a site with no Priority 1 errors. Bobby Approved status is equivalent to Conformance Level A for the WCAG.
2. *Priority 2 Errors* are secondary access problems. If all items in this section including relevant User Checks passed the test, it meets Conformance Level AA for the WCAG.

3. *Priority 3 Errors* are third-tier access problems. If all items in this section including relevant User Checks passed the test, it meets Conformance Level AAA for the WCAG.
4. *The Browser Compatibility Errors* are HTML elements and element attributes that are used on the page which are not valid for particular browsers. These elements do not necessarily cause accessibility problems, but users should be aware that the page may not be rendered as expected which may impact usability and accessibility.

As a general rating, Bobby gives the rating with the picture of "Bobby-hats". Hats with wheelchairs indicate Priority 1 accessibility errors that are automatically detectable. A question mark identifies a possible Priority 1 error that cannot be fully automatically checked, indicating that the user will need to address that question manually.

Methodology

Data Collection Method and Analysis

The websites of the top fifty (based on the 2001 college rankings of US-News (2001)) universities were collected and their accessibility and usability evaluated using the two automatic tools (Bobby and Lift respectively). Furthermore, two other performance measures, size and download speed, were determined using Web Site Garage (websitegarage.netscape.com) automatic tool.

To answer the aforementioned two research questions, several statistical analysis techniques are employed. For the first research question, the means and standard deviations of the accessibility and usability ratings of the fifty top university web sites were calculated. To investigate whether, in general, the accessibility and usability are related, bivariate correlation for all analyzed web sites was calculated.

Results and Discussions

Table 1 and 2 list the mean and standard deviation of the usability and accessibility ratings for the fifty top USA universities. Bobby's approval rating is converted into a binary variable with '0' representing 'Not Approved' and '1' representing 'Approved' status. The Usability rating is also converted into an ordinal scale with '1' representing 'Fair', '2' 'Good', and '3' 'Excellent'. The results for web page sizes and download times obtained from web site garage automatic tool are presented in Table 3.

From Table 1 and 2 it is apparent that the web sites of the top USA universities are ranked very low in terms of accessibility (less than 1/3 of them are bobby approved) and low in terms of usability (a rating of 2.16 on a 1 to 3 scale). Table 1 also shows high browser compatibility errors for the university websites. One possible reason for this might be that web site designers tend to rely on web design tools that are compatible with only one particular type of browser.

Nielsen (1997), suggests web sites to have sizes of 8 K for optimum response times (1 second response time) with ISDN connection speeds. From the results on table 3 it can be observed that web sites of the top USA universities on average are more than eight times too big for optimal response time for ISDN users.

	Approval	Priority 1	Priority 2	Priority 3	Browser Errors
Accessibility (Bobby) N=50	0.30 (0.46)	1.00 (0.83)	3.96 (1.11)	1.88 (0.33)	11.84 (5.82)

Table 1: Mean Accessibility Ratings (standard deviations in parenthesis)

	Usability Rating	Catastrophic	Major	Minor
Usability (Lift) N=50	2.16 (0.68)	0.62 (0.81)	2.56 (1.45)	3.44 (1.80)

Table 2: Mean Usability Ratings (standard deviations in parenthesis)

To answer the second research question, bivariate correlation of different usability and accessibility measures were observed. The accessibility approval correlates significantly with the overall usability rating ($\rho=0.298$, $p<0.05$). Furthermore, the size of the website was found to correlate highly with usability ($\rho=0.442$, $p<0.01$) but not the accessibility ratings. No correlation between the university ranking (USNews, 2001) and either accessibility or usability was found.

Size (KB)	68.34 (26.67)
Download Time (with a 56K modem) in Seconds	18.44 (6.89)

Table 3: Mean web page size and download times (standard deviations in parenthesis)

From the individual university web site evaluations it was possible to segregate sites into three broad accessibility categories

1. High-Accessibility: Sites with no detected Priority 1 accessibility problems. These sites are BOBBY approved.
2. Medium-Accessibility: Sites with one Priority 1 accessibility problem. These sites are not BOBBY approved.
3. Inaccessible: Sites with 2 and above Priority 1 accessibility problems.

Table 4 lists the fifty universities terms of their accessibility rankings based on the three categories defined above.

A qualitative representation of the obtained significant correlation between accessibility and usability is provided in Table 6 Sites listed in Table 5 include only those sites that ranked in the top or bottom tier (Tier 1 or Tier 3, respectively) both in terms of usability and accessibility.

Tier 1 Highly Accessible (Approved)	Tier 2 (Not Approved: 1 P1 error)	Tier 3 (Not Approved: 2 or more P1 errors)
University of California Irvine	Wake Forest University	California Institute of Technology
Univ. of Wisconsin Madison	University of Pennsylvania	College of William and Mary
Massachusetts Inst. of Technology	Stanford University	Yeshiva University
Northwestern University	Georgetown University	Brandeis University
Dartmouth College	Brown University	Georgia Institute of Technology
University of Michigan Ann Arbor	Duke University	Cornell University
Yale University	University of Rochester	U. of North Carolina Chapel Hill
University of Texas Austin	Washington University in St. Louis	Vanderbilt University
University of Washington	Univ. of California Santa Barbara	Carnegie Mellon University
Harvard University	Columbia University	University of California Davis
Boston College	Emory University	University of Chicago
Tufts University	Princeton University	Pepperdine University
University of California Berkeley	New York University	Univ. of Southern California
Univ. of California Los Angeles	University of Notre Dame	
Univ. of California San Diego	Rensselaer Polytechnic Inst.	
	Rice University	
	Johns Hopkins University	
	Pennsylvania State University	
	Lehigh University	
	U. of Illinois Urbana Champaign	
	Tulane University	
	University of Virginia	
	Case Western Reserve Univ.	

Table 4: Three-Tiered Accessibility Ranking of Popular Web Sites

Conclusions

This study aimed to answer two research questions:

1. Are top university web sites rated highly in terms of accessibility and usability?
2. Is the result of accessibility evaluation of university web sites related to the result of their usability evaluation?

The analysis revealed that the web sites of the top 50 USA universities are ranked very low in terms of accessibility (only 30% of them are Bobby approved) and low in terms of usability (a rating of 2.16 on a 1 to 3 scale). The accessibility approval was found to correlate significantly with overall usability ratings for the university web sites.

The legal dimension of making universities (and thus their websites) accessible to people with disabilities should alert the academic community for more careful consideration of incorporating accessibility guidelines in the web site development of their campus websites.

The present study brings about several implications for the practitioners. First, because some web sites' accessibility and usability measures are not predictive of each other, it opens a door into exploring the possibility of developing an integrated automated accessibility and usability evaluation tool. Second, the finding that most web sites did not receive the approved status from Bobby could be used to motivate web site designers to improve the accessibility and usability of web sites.

Further research could be conducted in several areas. First, in this study, only simple correlation and descriptive statistics were employed. Advanced statistical analysis such as structural equation modeling would be fruitful to explore the underlying relationship between different measures of usability and accessibility evaluation.

Tier 1 Highly Usable (LIFT: Good)	Tier 2 (LIFT: Fair)	Tier 3 Least Usable (LIFT: Poor)
Pennsylvania State University	Univ. of California Santa Barbara	Brandeis University
Yale University	University of Rochester	Univ. of Southern California
Harvard University	Tulane University	University of California Davis
Boston College	Dartmouth College	U. of Illinois Urbana Champaign
Georgetown University	Carnegie Mellon University	Pepperdine University
Lehigh University	Brown University	Yeshiva University
California Institute of Technology	Stanford University	Emory University
Case Western Reserve Univ.	Rensselaer Polytechnic Inst.	Cornell University
University of California Irvine	Duke University	
University of Texas Austin	New York University	
Wake Forest University	Princeton University	
University of Notre Dame	Massachusetts Inst. of Technology	
Rice University	Tufts University	
Columbia University	Northwestern University	
University of Michigan Ann Arbor	University of Pennsylvania	
Johns Hopkins University	University of California Berkeley	
Univ. of California Los Angeles	University of Washington	
	U. of North Carolina Chapel Hill	
	Washington University in St. Louis	
	College of William and Mary	
	Univ. of California San Diego	
	Georgia Institute of Technology	
	Univ. of Wisconsin Madison	
	University of Chicago	
	University of Virginia	
	Vanderbilt University	

Table 5: Three-Tiered Usability Ranking of Popular Web Sites

Second, in the present study, the topic of interest is university web sites. However, the methodology used in this paper could be applied in any area of interest (e.g. entertainment, e-commerce or, services).

Some limitations of using automatic evaluation tools need to be recognized:

1. There are important elements (such as the web navigation structure, the information's layout, the value of information, or various aesthetic aspects) which are not evaluated by the automatic tools.
2. The meaning/significance/appearance of graphics is not evaluated, only the inclusion of ALT tags are taken into consideration by Bobby and LIFT and only the number (higher number of graphics correlates to lower rating) of graphics is considered in LIFT.
3. Text-only web sites will get high ranking with both tools regardless of the quality of information or the readability of the fonts.

These limitations might imply that, although automatic evaluation tools provide a quick reference of the web site's accessibility and usability, formal usability evaluation involving user testing combined with a series of other non-empirical methods (such as cognitive walkthroughs or GOMS) still hold a major importance in the thoroughness of web site evaluation.

High Usability/Accessibility	Low Usability/Accessibility
University of California Irvine University of Michigan Ann Arbor Yale University University of Texas Austin Harvard University Boston College Univ. of California Los Angeles	Brandeis University Univ. of Southern California University of California Davis Pepperdine University Yeshiva University Cornell University

Table 6: Concordance/Discordance Summary of Sites on Usability and Accessibility

References

Laux, L. (1988). Designing Web Pages and Applications for People with Disabilities. In E. Grose & C. Forsythe (Eds.), *Human factors and Web development*. (pp. 87-95). Lawrence Erlbaum Associates, Inc., Publishers Mahwah NJ USA.

Cury, J.O. (2001). *Young at heart, and online: The over-50 crowd finds empowerment, community and new friends on the Web* [On-Line]. Available: http://www.buyingarizona.com/senior_source.html.

U.S. Census Bureau. (2000). *Projections of the Total Resident Population by 5-Year Age Groups, and Sex with Special Age Categories: Middle Series, 2025 to 2045* [On-Line]. Available: http://www.census.gov/population/projections/nation/summary/np-t3-f.txt.

Letourneau, C. (2001) *Accessible Web Design – a Definitiion.* [On-Line]. Available: http://www.starlingweb.com/webac.htm

Campbell, L., Waddell, C. (1997). *Electronic Curbcuts: How to Build an Accessible Web Site*. [On-Line]. Available: http://www.prodworks.com/ilf/ecc.htm

Margolin, M. (1998). *The Web Isn't for Everyone...Yet – Day 1*. [On-Line]. Available: http://www.hotwired.com/webmonkey/98/21/index2a.html

Newell, A.F. and Gregor, P. (1997). Human Computer Interfaces for People with Disabilities. In *M. Helander, T.K. Landauer and P. Prabhu (Eds.) Handbook of Human-Computer Interaction, 2 nd ed*. Elsevier Science B.V, 813-826.

Nielsen, J. (1997). Size Limits For Web Sites. [On-Line] Available: http://www.useit.com/alertbox/sizelimits.html

Sullivan, T. & Matson, R. (2000). Barriers to Use: Usability and Content Accessibility on the Web's Most Popular Sites. *Proceedings of the Conference of Universal Usability*. Arlington, VA: ACM.