Developing a Universally Accessible Web Portal for Traditional and Distance Learning Versions of a Computer Literacy Course: An Auburn University Case Study

Daniela Marghitu
Department of Computer Science and Software Engineering
109C Dunstan Hall
Auburn University, Auburn AL 36849 USA
(334) 844 – 6386
daniela@auburn.edu

Chris Harmon
Department of Computer Science and Software Engineering
104 Shop Building
Auburn University, Auburn AL 36849 USA
(334) 844 – 6333
harmoch@auburn.edu

Kai Chang
Department of Computer Science and Software Engineering
103C Dunstan Hall
Auburn University, Auburn AL 36849 USA
(334) 844 – 6310
kchang@auburn.edu

ABSTRACT

Information Technology (IT) offers a wide range of opportunities for education and career enhancement for those who have access to the technologies they employ. However, many people find themselves on the wrong side of the digital divide that separates those with access to new technologies and those without. Even if they have access to these technologies, some people with disabilities find themselves on the wrong side of a second digital divide that is caused by the inaccessible design of coursework. This paper is a report on the findings of the authors using IT tools for developing a Universal Accessible Web Portal for the traditional and distance learning versions of the COMP1000 Introduction to Personal Applications Computer (COMP1000) course.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – evaluation and methodology, interaction styles, screen design, standardization, and user-centered design.

General Terms

Design, Human Factors

Keywords

Distance Education, Assistive Technology, Accessible Web Design and Development.

43rd ACM Southeast Conference, March 18-20, 2005, Kennesaw, GA, USA. Copyright 2005 ACM 1-59593-059-0/05/0003…$5.00.

1. INTRODUCTION

Technology-enhanced education is becoming an increasingly important part of higher and professional education. One way IT tools can be successfully used in improving the education process is by making computers, computer software applications, and Web sites accessible to students with disabilities. It is true that educational institutions, as of yet, are not specifically required to comply with government's Section 508 of the Rehabilitation Act of 1973. It does seem logical, however, that public universities with government funding will one day be required to disseminate information in the same manner and with the same regard to those individuals with and without physical impairments. Auburn University has an enrollment population of more than twenty thousand students. Of these, there are currently more than a thousand students served by the Auburn University's Office of Students with Disabilities. Each year the student population includes approximately twelve visually impaired students and thirty-three students with a hearing impairment, as well as numerous students with various levels of motor-skill limitations. These are the impairments that are likely to affect the ability of a university student to effectively complete a computer literacy course. In this paper, we will discuss our project on developing a Universal Accessible Web Portal for our traditional and distance learning versions of COMP1000.

2. BRIEF HISTORY

2.1 Personal Computer Applications Course

Auburn University offers COMP1000, which is an introductory computer applications course taught by The Computer Science and Software Engineering Department. This course teaches students about the fundamentals of the Personal Computer (PC), Windows XP, Windows Office 2003, Windows FrontPage 2003, and the World Wide Web (WWW). Students who take this course are either seeking to enrich themselves by expanding their knowledge of the Windows application fundamentals that will help them with their jobs in the future, or to fulfill part of their graduation requirements [5].

2.2 Personal Computer Applications Computer Competency Test

2.2.1 Computer Competency Test

Auburn University offers the Computer Competency Test (COMP1@@0) as an alternative to COMP1000. The Competency Test is treated as a regular course, meaning that students must register for the test using the Auburn University Software Administrative System, OASIS. The test, which is taken on-line using WebCT, consists of fifty multiple-choice questions covering the COMP1000 Personal Computer Applications course material. Students that take COMP1000 as a graduation requirement are required to pass the Competency Test with a minimum of seventy percent to be exempt from taking COMP1000.

2.2.2 Computer Competency Database Portal

Students are only allowed to take COMP1@@0 only one time; however, OASIS does not allow any option to restrict a student from registering or taking the Competency Test a second time. A few years ago, a graduate student created a database portal using PHP and MySQL that could be used to keep track of which students had taken the Competency Test and their score. Recently, several errors have been encountered with this database portal. Part of this project will be to create a new and improved Computer Competency Database Portal using ASP and SQL Server 2000. The user interface and navigation of the new Competency Database Portal will be consistent with the rest of the site and also conform to the Section 508 of the US Rehabilitation Act [8] and the W3C's Web Content Accessibility Guidelines (WCAG) [11].

3. SOFTWARE COMPONENTS FOR DEVELOPMENT

3.1 Accessibility and Evaluation Tools

Accessibility and Evaluation Tools refer to the tools used to make the World Wide Web accessible and available to everyone, including people with disabilities and senior citizens.

3.1.1 Watchfire Bobby

Bobby is a comprehensive web accessibility software tool designed to help expose and repair barriers to accessibility and encourage compliance with existing accessibility guidelines [10]. Bobby can be used to test for compliance with existing accessibility guidelines, including Section 508 of the US Rehabilitation Act and the W3C's Web Content Accessibility Guidelines (WCAG). The Bobby Watchfire website (http://bobby.watchfire.com) provides a free online version of Bobby that can be used to evaluate individual live web pages one at a time. The online version of Bobby was one of many evaluation tools used during this research.

3.1.2 aDesigner

The aDesigner developed by IBM is a disability simulator that allows web designers to test their pages for accessible and usability for the visually impaired. The aDesigner tool checks for compliance with existing guidelines such as Section 508 of the US Rehabilitation Act, the W3C WCAG, the Japan Industrial Standard (JIS), and IBM's checklist. There are two modes or settings in aDesigner: blind and low vision. The blind setting of aDesigner runs three types of tests on web pages: blind usability visualization, accessibility and usability checking, and compliance checking [3]. This setting helps web page designers understand how blind users who depend on voice browsers and screen readers experience a web page. In the low vision mode, the tool simulates how users with weak eyesight, color vision deficiencies, cataracts, and combinations of impairments perceive web pages [3]. In this project, both modes of aDesigner were used extensively to test the web portal for accessibility and usability problems.

3.1.3 W3C Validation Services

The World Wide Web Consortium (W3C) provides two online validation services: The Quality Assurance Markup Validation Service and The Cascading Style Sheet (CSS) Validation Service. The Markup Validation Service checks documents like (X)HTML for conformance to W3C Recommendations and other standards. The CSS Validation Service checks CSS in (X)HTML documents or standalone CSS documents for conformance to W3C recommendations. All of the web pages in the portal conform to the XHTML 1.0 Transitional and CSS Level 2 recommendations.

3.1.4 Lynx

Lynx (http://lynx.isc.org) is a text web browser available on UNIX, DOS, and Windows (through DOS emulation) that was developed by the Academic Computing Services at The University of Kansas. Lynx was used to test the linearization of an entire webpage, as well as the linearization of all tables used in developing the web portal. Lynx does not support graphics, plug-ins, JavaScript, Java, or CSS. Thus, it is an excellent test vehicle to evaluate whether or not your page is usable and readable with these technologies turned off [9]. There is a lynx Viewer available at http://www.delorie.com/web/lynxview.html where you can submit a URL in order to see what your page looks like when viewed in Lynx (See Figure 1).

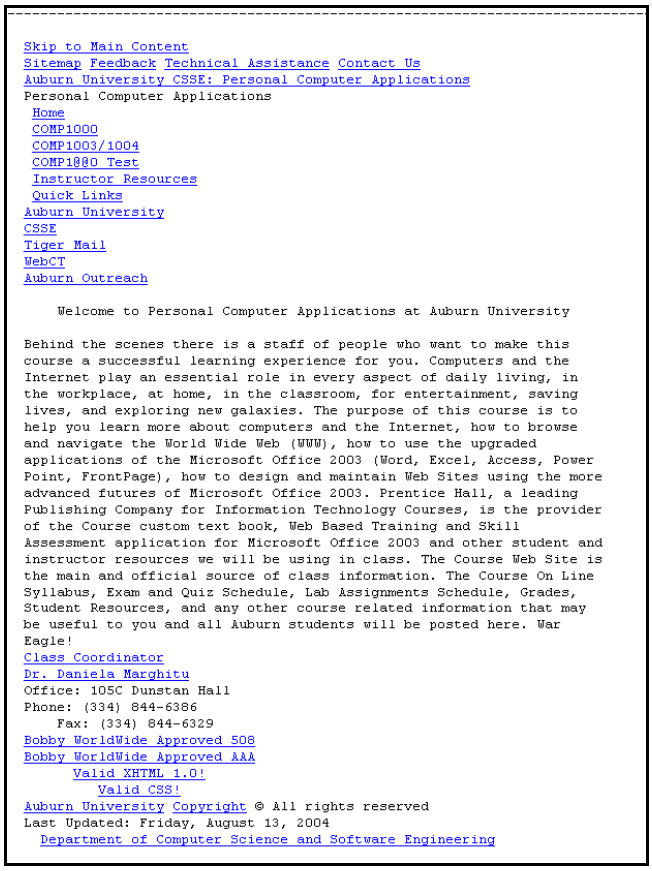

Figure 1. Sample Output from the Lynx Viewer

3.1.5 Accessible Web Publishing Wizard

The Accessible Web Publishing Wizard developed by The University of Illinois Center for Instructional Technology Accessibility, provides an alternative to the built-in web publishing features in Microsoft Office for Word, PowerPoint, and Excel. The Accessible Web Publishing Wizard can be used to convert Word documents, PowerPoint presentations, and Excel spreadsheets into accessible and valid HTML 4.01 with CSS through an easy-to-use interface. The HTML generated by the wizard meets Section 508 of the US Rehabilitation Act and the W3C's WCAG Double-A requirements.

3.2 Assistive Technology

3.2.1 JAWS

JAWS for Windows is the most popular screen reader worldwide. JAWS for Windows works with your PC to provide access to today's software applications and the Internet [2]. With JAWS, information on the screen is read aloud or outputted to refreshable Braille displays. This output will allow for testing and will be used to help understand how people who use assistive technology tools perceive the web portal.

3.2.2 Dragon Naturally Speaking

Dragon Naturally Speaking 7 (Dragon) can be used to help people with disabilities optimize the productivity of their PC. Dragon is the fast, easy and accurate way to turn speech into text [7].

3.3 Web and Database Development Tools

3.3.1 Microsoft FrontPage 2003

Microsoft FrontPage 2003 is Microsoft's program used to create and edit HTML documents. FrontPage is considered to be a What You See Is What You Get (WYSIWYG) editor, meaning that it allows you to view and edit a web page that looks exactly as it will look on the Web, rather than as HTML text, which is what a text editor does. The problem with this feature is that the HTML code generated does not conform to the existing accessibility guidelines. For the development of this project, the Microsoft FrontPage 2003 was used solely as a text editor. The advantage of using FrontPage was the feature of creating a dynamic template. This feature allows you to dynamically update common features of all the web pages by modifying one file, the dynamic template.

3.3.2 Cascading Style Sheets

Many web designers begin the designing work by thinking in terms of how something will look rather than how it will work. The framework of any product must be thoroughly thought out and constructed before designing its outward presentation. The lack of understanding this basic concept is the reason numerous web sites are difficult to use and are not easily accessible [9]. As you know, web pages themselves are constructed with a simple markup language called Extensible Hypertext Markup Language (XHTML) [1]. Traditionally, (X)HTML was designed to define the structure of documents in order to make web publishing simple. However, over several years bad practices have been formed by web designers; and HTML has been used for both structure and presentation. The idea of Cascading Style Sheets (CSS) is to separate content from presentation [9]. By using CSS to separate content from presentation it allows for web pages to load faster, and to be more usable and accessible in most web browsers, voice browsers, and screen readers. For the development of this web portal, (X)HTML was solely used for structure and CSS were used for presentation purposes.

3.3.3 Active Server Pages and JavaScript

Active Server Pages (ASP) is a technology that enables you to make web pages that are truly dynamic, giving you the data you want, when you want it [6]. ASP pages can be written in VBScript, JavaScript, as well as PerlScript [4]. JavaScript was chosen for the development of this project because it is simple to comprehend, easy to use, and powerful. Also, JavaScript is the only practical language to use for client side programming, so this allowed for being able to use the same language for server side and client side programming.

3.3.4 SQL Server 2000

There are many different database platforms available in today's technology, such as Oracle, Microsoft SQL Server 2000, Sybase, and MySQL. SQL Server was selected for this project because all of the development and web hosting will be using the Microsoft Windows technology.

4. DESIGN AND IMPLEMENTATION OF THE ACCESSIBLE WEB PORTAL

4.1 Architectural Overview

This project produces a universally accessible web portal for the traditional and distance learning versions of COMP1000. This means that, for both versions of the course, all information may be found via the web and will be fully accessible for anyone, including people with disabilities (See Figure 2).

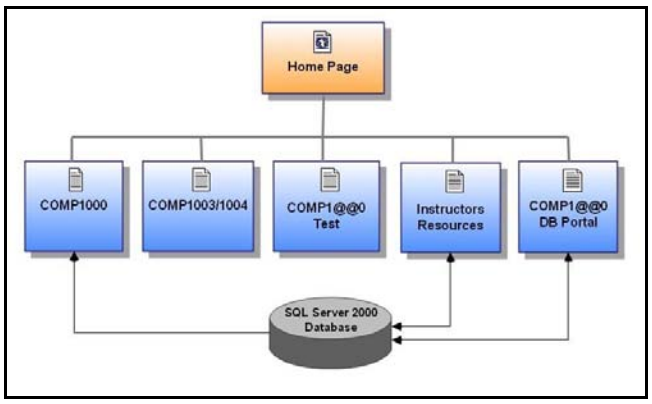

Figure 2. Architectural Overview of Web Portal

All of the source code and data files used for this web portal are stored on Auburn University's FrontPage server (hostname: frontpage.auburn.edu) (See Figure 3). This Windows-based FrontPage server is a secure server that is generally used to host task-specific web sites that require additional scripting and database interactivity such as applications and surveys. The following features of the server were used in this project and were taken into consideration when deciding to use this server: secure HTTPS, ASP, Microsoft SQL Server 2000, and nightly backups.

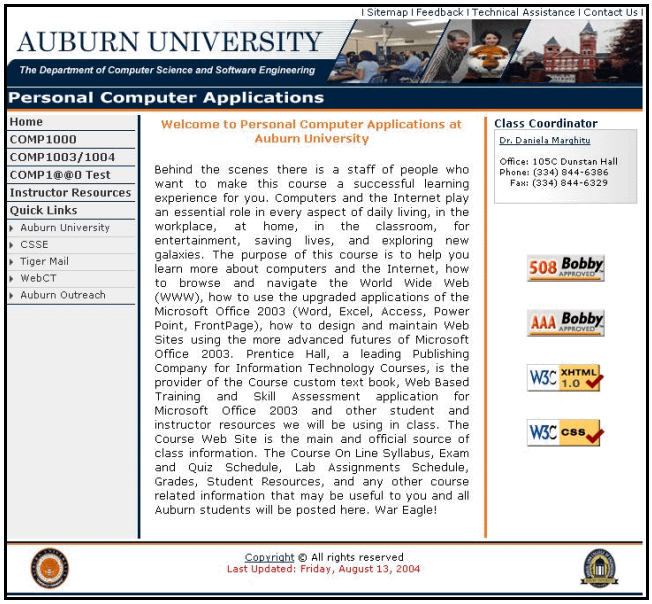

Figure 3. Home Page of Web Portal

4.2 Design and Implementation

4.2.1 Constructing the Dynamic Web Template

The Microsoft FrontPage 2003 dynamic web template feature was used in this project to help provide consistency of the user interface and to help make maintenance and additions to the web portal easy in the future. The template used throughout the web portal was fully tested to make sure that it passes all accessibility guidelines and recommendations. By doing this, it allows us to make additions to the web portal and maintain the accessibility (See Figure 4).

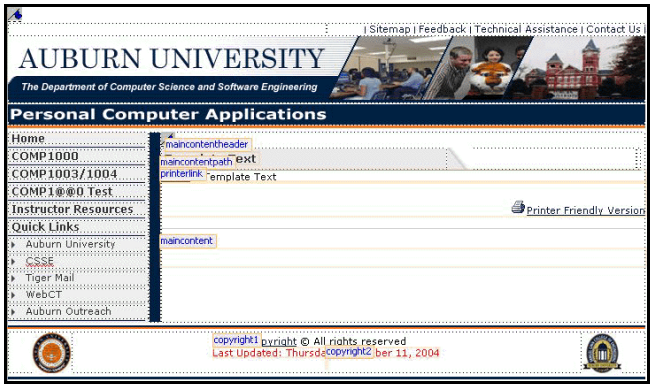

Figure 4. Basic Dynamic Web Template

4.2.2 Main Accessibility Features

There are many accessibility features that have been implemented into this web based portal in order to conform to all of the major guidelines and recommendations. Below is a list of some of the major accessibility features that the entire portal follows:

- All images have text alternatives (ALT attributes), unless they are purely decorative.
- Text uses relative font size so it can be enlarged or reduced using the text size options available in visual browsers.
- Pages are organized to be fully functional, even with JavaScript turned off.
- Pages are designed to maintain good contrast, even without cascading style sheets.
- Pages use flexible formats so they can be automatically resized for different window sizes and screen resolutions.
- Pages are designed with separate cascading style sheets, so they can be replaced by user-defined style sheets.
- Pages validate to a maximum amount, making exceptions only to aid users with older browsers.
- The web portal uses Access Keys, meaning that someone can navigate throughout the portal without a mouse.
- The web portal follows World Wide Web Consortium (W3C) and Section 508 guidelines.

4.2.3 COMP1000 and COMP1@@0

The COMP1000 portion of the web portal provides the students with all of the information needed for the course. The course syllabus, class schedule, lecture slides, and all assignment files are made fully accessible to all of the students. There is even a

frequently asked question page for the site that provides answers to all of the questions commonly asked during a typical semester. The COMP1@@0 pages provide students that are registered for the Competency Test information on how to prepare for the test. Step by step directions are provided to the students to help ensure that all students will be properly registered for the Competency Test when test time comes around. There is also a link and directions on how to use Auburn University's Open WebCT account to take a practice test.

4.2.4 COMP1003 and COMP1004

Over the last several years distance education or outreach classes have become more in demand for several reasons: computers are no longer a luxury so more and more people can own a home computer, the need for computer literacy in all competitive types of jobs, and people's busy lives. Outreach courses are extremely convenient and can be worked into people's schedules very easily, whether they are working full time or have other obligations. By making the on-campus version (COMP1000) fully accessible, an excellent opportunity was provided to create a fully accessible distance course. There will be a credit and noncredit version of the outreach course, COMP1003 and COMP1004 respectively. These outreach courses will cover the exact material as the on campus course. There will be prerecorded lectures with closed captioning and slides for each major topic of the course. With these outreach courses being fully accessible, we hope to be able to provide everyone an opportunity to learn about the personal computer applications of today's technology.

4.2.5 Instructors Resources

The Instructors Resources are password protected pages that provide the Graduate Teaching Assistants the information and guidelines that they need in order to be successful at teaching the computer literacy course. The most important feature of the Instructor Resources is the Makeup List. It is very difficult to keep track of which students are entitled to makeup a quiz or exam, based on University policy, because there are usually over a thousand students registered each semester. The Makeup List allows the GTAs to submit to a centralized database the information of their students who are entitled for a makeup. By having this centralized list, it is easy to track which students are entitled for makeup work (See Figure 5).

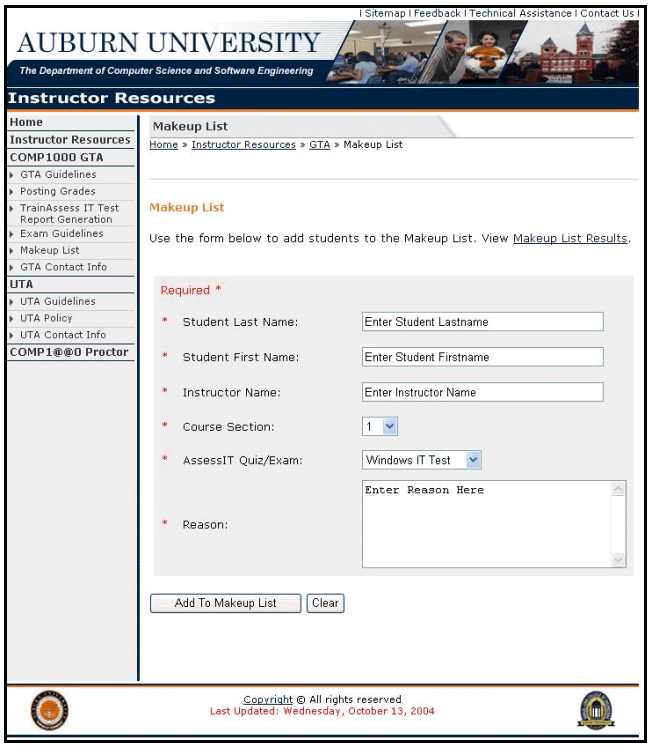

Figure 5. Makeup List Form

4.2.6 Competency DB Portal

For this portion of the project, a Database Portal was developed to keep track of all Auburn University students who have registered to take the Competency Test (COMP1@@0). This system will allow us to prevent students from trying to retake the exam more that once.

There were three database tables used for storing student information, test data, and for managing the security of the information. This information must be password protected, since the information being stored in this portal contains student personal information and test scores.

For security purposes there was one database table used to store information about the users of the system. This table contains the name of the individual, their contact information, their username and their password. Each user is also specified as being a user or an administrator. The only difference between a user and an administrator of the system is that an administrator can create new users and backup and purge the database. All other functions will be available to both users. The two types of users were created so that the graduate students in the future who proctor the test will be allowed to update the database without administrative rights. This will help prevent any accidental deletion of data.

The Competency Test is administered in WebCT, which is in compliance with the Section 508 and W3C standards. After the Competency Test has been proctored for the current semester, the results in WebCT are downloaded into a text delimited file. This text delimited file contains the first name, last name, username, and test scores of each student who was registered for the exam. These results can then be uploaded into the database portal. Once

the test results have been uploaded successfully, you can choose to query the database to view the test results based on a particular student, test date, test score, or by all students listed twice in the database. There are also options that allow you to print out a detailed report for a particular student and to view the overall statistics of all test scores (See Figure 6 and Figure 7).

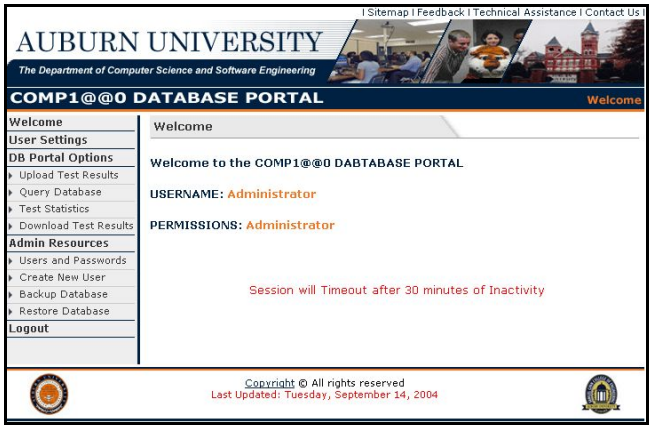

Figure 6. Administrators View

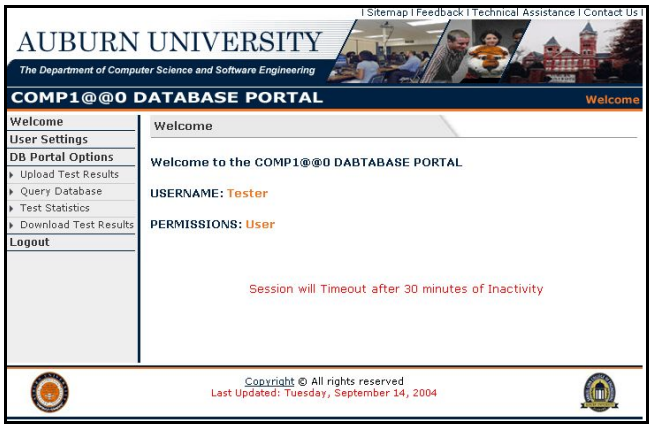

Figure 7. Users View

5. TESTING AND RESULTS

The Accessible Web Portal has undergone extensive testing to remove some minor bugs and accessibility problems. With the Accessibility Evaluation Tools (Watchfire Bobby, aDesigner, W3C Validation Services, and the Accessible Web Publishing Wizard) and Assistive Technology (JAWS and Dragon Naturally Speaking) the web portal has been fully tested and passed the current accessibility guidelines and recommendations. In March 2005, we will be working with the Auburn University Office of Human Subjects, Office for Students with Disabilities, and the Department of Rehabilitation and Special Education, in order to conduct a campus wide spread pilot study to further test the accessibility of the web portal. Also, in spring semester 2005 there will be a visually impaired student taking COMP1000, which will enable us to better understand the needs of a visually impaired student, and to better accommodate people with disabilities in the future.

6. CONCLUSION AND FUTURE WORK

The Prentice Hall Train and Assess II application (URL: http://tait.eng.auburn.edu) we are using for helping students to improve and access their computer skills is currently not fully accessible. It offers a voice tutor, which can be helpful for students visually impaired, as well as prescriptive modules; which can be very useful for students with learning (cognitive) disabilities. However, its web based user interface does not fully comply with the Section 508 and W3C standards. We plan to join efforts with Prentice Hall Company in making this application universally accessible

We have received very positive feedback from the students currently registered in COMP1000, the Graduate Teaching Assistants (GTA) and University administration. This positive feedback has encouraged us to continue our research in order to better accommodate people with disabilities.

7. ACKNOWLEDGMENTS

The development of the Distance Learning version of COMP1000, namely COMP1003/04, would not have been possible without the help of both Prasanthi Pallapu and Bradley Morgan from Auburn University's Outreach Program.

8. REFERENCES

[1] Briggs O., Champeon S., Costello E., and Patterson M. *Cascading Style Sheets: Separating Content from Presentation*. Friends of Designer to Designer: An Apress Company, 2004.

[2] Freedom Scientific: JAWS for Windows, http://www.freedomscientific.com/fs_products/software_jaws.asp, 2004

[3] IBM Alpha Works: aDesigner, http://www.alphaworks.ibm.com/tech/adesigner, 2004

[4] Lovejoy E. *Essential ASP for Web Professionals.* Prentice Hall Inc., Upper Saddle River, NJ, 2001

[5] Marghitu D., Jackson L., and Chang K. Web-Based Software Integration of Skill Assessment and Testing IT Tools for the University Computer Competency Exams. *ACMSE 2003 Preceedings*, Savannah, Georgia, 2003.

[6] Reselman B., *Active Server Pages 3.0 By Example*. QUE, 2000

[7] ScanSoft: Dragon Naturally Speaking 7, http://www.scansoft.com/naturallyspeaking/, 2004

[8] Section 508, http://www.section508.gov/, 2004

[9] Thatcher J., Bohman P., Burks M., Henry S. L., Regan B., Swierenga S., Urban M. D., and Waddell C. D. *Constructing Accessible Web Sites*. Glasshaus, 2002.

[10] Watchfire Bobby, http://bobby.watchfire.com, 2004

[11] Web Content Accessibility Guidelines 1.0, http://www.w3.org/TR/WAI-WEBCONTENT/, 2004