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Michele Capella-McDonnall, Ph.D., CRC, *associate research professor, Rehabilitation Research and Training Center on Blindness and Low Vision, Mississippi State University, P.O. Box 6189, Mississippi State, MS 39762; e-mail: <mcapella@colled.msstate.edu>.*

MySchoolDayOnline: Applying Universal Design Principles to the Development of a Fully Accessible Online Scheduling Tool for Students with Visual Impairments

Wendy Sapp

Technology provides access to information and resources for people who are visually impaired (that is, those who are blind or have low vision), but only if the technology is affordable, accessible, and usable. People with visual impairments often do not use accessible technology because it is too expensive (Microsoft Corporation, 2004), is difficult to use, or is not flexible enough to meet their needs (Jackson-Sanborn, Odess-Harnish, & Warren, 2002). Traditionally, developers created specialized software for small populations with unique needs, which resulted in expensive products, but more recently, developers have attempted to use the principles of universal design to develop software that is accessible to all potential users (Burgstahler, 2002). A review of the literature showed that there are no inclusive and detailed criteria for universal software design, although partial lists are available from some sources. This article presents the universal design features that were identified during the alpha development of a scheduler software program for use in schools and provides preliminary research on the usability of these features. Although the initial testing presented in this report was conducted exclusively with students with visual impairments, future testing will include people with a range of disabilities, such as

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learning disabilities and physical disabilities, and those without disabilities.

Accessible technology has long been a popular topic in special education and rehabilitation (Scherer, 2005), and instruction in the use of accessible technology devices is a component of the expanded core curriculum for students with visual impairments (Hatlen, 1996). More recently, researchers have proposed that "usability" is more meaningful than accessibility in such technology (Iwarsson & Ståhl, 2003). *Usability* refers to a technology that is not only accessible (containing features that make it possible for a person with a disability to use it), but is also usable (organized in a way that makes it easily used by a person with a disability). Many technologies are accessible to people with visual impairments, but the successful operation or use of such technologies require a high level of technological skill and extensive training. Technologies that are usable require only a basic level of skills and are relatively intuitive in their design.

Universal design was originally defined as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (*Center for Universal Design,* 2006). It requires designers and developers of environments and products to be aware of human diversity, to anticipate a variety of needs, and to intentionally approach the development with the intent of creating an inclusive environment or product (Covington & Hannah, 1997). Utilizing the concepts of universal design is far more effective than attempting to fit students into an educational model that is not designed to meet their needs. Universal design requires students to be given access to content, the process of learning, and the products of learning (Udvari-Solner, Villa, & Nevin, 2002).

The development of technologies that use the principles of universal design can eliminate many barriers to access (Puckett & Johnson, 2002). Also, many people other than the intended beneficiaries profit in some way from technologies that use these principles (Scott, McGuire, & Shaw, 2003). For example, the inclusion of audio description allows students with visual impairments to access the visual components of educational videos, and teachers believe that audio description improves comprehension for other students, including those with learning disabilities, by helping these students focus on the essential elements of the video (Goldberg, Joyce, & Field, 1998; Rothberg & Wlodkowski, 2000).

Bridge Builder, which is in its alpha version and under development by Bridge Multimedia, provides a user-friendly platform through which anyone with minimal computer knowledge can build accessible educational web pages or web sites. The "scheduler" portion of Bridge Builder, known as MySchoolDayOnline, provides a format through which teachers, administrators, and students can access an online calendar, task list, and class schedule. The study presented here investigated the accessibility and usability of MySchoolDayOnline for students with visual impairments. Conducting testing early in the development process of a technology is intended to identify important aspects of accessibility and usability that can be incorporated throughout the development process.

Method

Participants

Of the 12 high school students who participated in the field testing, 10 were blind (those with light perception or no light perception) and used a screen-reading program (JAWS for Windows) to access their computers, and 2 had low vision (those who met the definition of legal blindness) and accessed the computer screen using MySchoolDayOnline's screen-enlargement system. The students worked individually or in dyads at eight computers. Each computer was coded as a single subject, for $N = 8$. The students were paired on the basis of equivalent computer skills. They frequently commented about their progress and frustrations and shared

Table 1
Universal design features of MySchoolDayOnline.

Feature	Purpose
HTML-based programming	Easy for screen-reading software to read
Clear and unique labels for links	Enables a screen reader to locate desired link quickly
Choice of multiple color and black-white options	User-individualized color and contrast
Choice of font sizes for all content on screen	Adjustable for user's visual functioning
Screen that formats to font size so no left-right scrolling is needed	Screen that is easy to read
Visual design that is independent of semantic information	Easily read by screen-reading software
Direct links to needed functions when possible	Reduce the complexity of navigation
Meaning is conveyed through text rather than color	Usable in black-and-white mode or by persons with limited color vision
Fill-in boxes accompany all drop-down menus	Mouse-free use
All fill-in boxes have self-completing choices (for example, "F" becomes "February" in the month field)	Ease of completing forms

hints with each other, so that students who were working individually still had the opportunity to receive help from their peers. This approach reflects the reality of students who are used to sharing tips and hints on technology-related issues. The Institutional Review Board of the American Institute of Research in Washington, DC, reviewed and approved all the procedures. For all students younger than age 18, the parents provided informed consent, and the students consented to participate before they enrolled in the study. All students older than age 18 gave informed consent prior to enrolling in the study.

Apparatus

Using specially designed software, such as screen readers like JAWS, or screen-enlargement programs, people with visual impairments have greater access to computer-based information than ever before. Unfortunately, even with the best available software, most computer programs are not fully accessible and require the user who is visually impaired to rely on a sighted assistant for at least some tasks. In addition, many programs that are technically accessible to people with visual impairments are not "user friendly," meaning that they are unusable by all but the most advanced computer users.

Since its inception, Bridge Builder and its scheduler, MySchoolDayOnline, have been developed according to the principles of universal design to incorporate full accessibility. Although the program has not yet been tested by an outside agency, it is intended to be fully compliant with national and international standards for accessibility (Section 508 of the Rehabilitation Act, Bobby, and W3C). The developers wrote the MySchoolDaysOnline program in HTML, which is easily read by screen-reading software. All important links are clearly and uniquely labeled to be easily located whether a person is using screen-enlargement or screen-reading software. Accommodations for students who access the computer screen visually include the options to adjust color combinations (black on white, white on black, and color) and font size. When the font size is changed, the format of the page is automatically adjusted so that left–right scrolling is not required. When MySchoolDayOnline is fully developed, the developer hopes to create a comprehensive list of accessibility features that are included in the product that other companies can use as guidelines for developing fully accessible computer programs. See Table 1 for an initial

list of the universal design features that are included in MySchoolDayOnline.

Procedures

The two sessions took place over a 2-day period in the computer lab of the Tennessee School for the Blind. In the first session, the students found and input information in a commonly used accessible electronic scheduler, Microsoft Outlook. On the second day of testing, they found and input similar information in MySchoolDayOnline. The students were asked to complete 8 tasks with Outlook and 10 tasks using MySchoolDayOnline; the additional 2 tasks conducted with MySchoolDayOnline were logging in and out of the system. Examples of tasks were locating information that I had inserted in the program's to-do list and adding an event on the calendar. The students had one hour to complete the items during each session.

I gave no instruction in using either system. The eight students who used screen readers had received introductory lessons on using Outlook from their technology teacher, and three of these students regularly used a modified version of Outlook in their electronic notetakers. When the students requested assistance, I would provide hints and suggestions for completing the task, but I did not give direct instruction on using either program. For example, when a student was unable to find the link to complete a task, I asked him or her to think where the link should logically be and what different names the link might have.

I trained four research assistants to gather data on the students' performance. On the first day, four research assistants observed and coded the performance of three students each; on the second day, only three research assistants were available for coding. The research assistants coded the students' performance by indicating which items were attempted, the level of assistance needed (independent, partial assistance, or repeated assistance), and the accuracy of the students' answers; and inputted the data. Performance was coded as independent if the student completed the task without any input from me or the other students. Performance was coded as partial assistance if the student requested help and needed only one suggestion to complete the task. Performance was coded as repeated assistance if the student continued to ask for help after the initial suggestion was given. At the end of the session, the students gave feedback on the experience and the products they tested in a group interview. I transcribed their responses.

Analysis

The percentage of items that were attempted was computed by dividing the number of items attempted by the total number of items that the students were asked to complete for each session. The percentage of items completed correctly and the percentage of items completed independently were determined on the basis of the number of items attempted, rather than on the total number of items that were requested. Even though the sample was small, matched sample *t*-tests were computed on the percentage of items attempted, the percentage of items completed correctly, and the percentage of items completed independently.

Interobserver agreement, which was measured for 19% of the tasks in both sessions, ranged from 80% to 100%, with a mean of 90%. All disagreements were on the student's level of independence. When disagreements occurred, the coding for the lesser level of independence was used so that the students' success with the programs was underestimated. I divided the responses to the interviews into units and identified categories. Each unit was coded into a category, and themes were identified.

Results

Because of the preliminary nature of the study, the small sample, and the strengths of the study, I decided to accept a more liberal *p*-value of .10, rather than use the traditional .05 level. There

Table 2
Comparison of students' performance using MySchoolDayOnline and Microsoft Outlook.

Software program	Mean percentage of items attempted	Mean percentage of items completed correctly[a]	Mean percentage of items completed independently[a]
MySchoolDayOnline	100	90	83
Microsoft Outlook	69	56	50

[a] Mean percentages of items completed correctly and mean percentages of items completed independently include only items that were attempted.

were statistically significant differences in all the comparisons. With MySchoolDayOnline, the students attempted to complete more items (X = 100%) than with Outlook (X = 69%) (t = 2.91, $p < .05$). The remaining two comparisons included only the items that the students attempted to complete. The students were able to find the requested information or enter the correct information more frequently using MySchoolDayOnline (X = 90%) than with Outlook (X = 56%) (t = 2.00, $p < .10$) and were able to complete the items independently more frequently using MySchoolDayOnline (X = 83%) than with Outlook (X = 50%) (t = 2.13, $p < .10$); see Table 2.

The responses given during the interview were grouped into three main categories: positive statements about the functionality of MySchoolDayOnline, concerns identified with MySchoolDayOnline, and ways to improve or expand MySchoolDayOnline. The majority of responses were positive statements about MySchoolDayOnline (64%); fewer responses identified concerns with the program (18%) or offered suggestions for improvement (18%).

Most of the positive comments related to the students' ability to navigate the layout without the use of drop-down menus. The students commented that "it was easy to find stuff" and that they "didn't get lost" in the program. For those who accessed the online schedulers with JAWS, specific comments focused on having an HTML-based program that made good use of links. One student stated that the HTML programming was good because "JAWS understands that." For the users with low vision, the main positive feature was the lack of visual clutter on the screen. Neither student with low vision chose to use the options for adjusting the color or font size during testing. When a research assistant demonstrated the color and font size adjustment options during the interviews, the students thought that the options were "cool."

The negative comments and suggestions for improvements all came from the JAWS users. Some of these participants stated that the calendar was difficult to navigate and that the form-field boxes for inputting dates were not as well labeled as they could be. They also said that when links begin with punctuation marks, it was difficult to find them. The suggestions for improvement dealt mainly with adding features, such as a search engine and an e-mail account with an address book.

Discussion

The students preferred and were more successful using MySchoolDayOnline than Microsoft Outlook. Despite the difficulty experienced with Outlook, one dyad was able to complete all tasks using Outlook, which indicates that the program is accessible but not usable. It was interesting to note that the students with low vision who accessed Outlook visually had as many problems and performed equivalently to the students who were blind and used JAWS to access Outlook, although the small number of students precludes generalizing the findings to a larger population.

The difficulties encountered by the students with the calendar and date form fields in MySchoolDayOnline were directly related to

their level of skill in using JAWS. The students who had not learned how to navigate tables with JAWS had difficulty with the calendar, and those who were not familiar with combo boxes (a screen component with an associated list of items in a drop-down menu) had difficulty determining the nature of the form fields in the dates. Students who were more proficient JAWS users did not have difficulty with the test software, but all the students had difficulty using Outlook.

The results of this study should be viewed in light of its limitations. The small sample was the greatest limitation. Although the testing indicated that the students performed better with MySchoolDayOnline than with Outlook, the limited number of participants prevented the statistics from supporting the conclusion unless the alpha acceptance level was changed to the less stringent .10 level for two of the three comparisons. Differences between students who used screen enlargement and students who used screen readers may have been hidden by combining the results from these two groups. The short-term and artificial nature of the research does not necessarily reflect the benefits and disadvantages of the software programs if the programs are used by students daily. The preliminary nature of the study and its strengths (for instance, the model presented for a cooperative working relationship between a private software developer and an independent educational researcher, the description of methodologies developed to compare types of software, and the potential for the research-learning model to be used in a school setting) combine to overshadow the study's weaknesses.

Future studies should include a greater number of participants, both students with different disabilities and those without disabilities; an investigation results for students using screen readers and those using screen-enlargement software; and the establishment of a minimum level of skills in using JAWS that is needed to access this program. Future studies should also gather data on students' success in using these programs to manage their own schedules over time.

All the students, those who used JAWS and those who accessed the screen using screen-enlargement software, found MySchoolDays-Online easier to use than the scheduler in Microsoft Outlook. Since both products are designed to be accessible to people who are visually impaired, the difference in the students' performance indicates that usability or ease of use is as important as accessibility when designing programs to meet the needs of teachers and students with and without visual impairments. This research provided valuable information about the practical accessibility and usability of MySchoolDayOnline and design features that should be incorporated into universally designed software. The students' suggestions and critiques are being incorporated into the beta version of the product. It is hoped that these suggestions will result in a product that is even easier to use.

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Wendy Sapp, Ph.D., COMS, *Visual Impairment Education Services, 5030 Village Drive, Cohutta, GA 30710; e-mail: <wksapp@charter.net>.*