Evaluation of Learning Systems for Blind Users

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Abstract

Academic institutions around the world are utilizing and investing in online learning management systems. While several research studies have examined the functionality of this type of technology, little attention has been paid to accessibility issues, in particular to the complex web-based interfaces for learners with disabilities--e.g., those with visual impairment. There is also no standardized method for evaluating accessibility features of a learning system. The approaches that are mostly used among practitioners and educators are based on accessibility guidelines or experts' judgments--without direct input from actual users. This results in a lack of user-subjective perspectives. In order to fill in the gap, this research investigated accessibility features of an online learning management system, based on the experiences of learners with visual impairment. Three data collection methods were employed: observation through usability tests, questionnaires, and focus groups. This study contributed to our better understanding of the interactions and experiences of visually impaired learners with online learning management systems. Furthermore, the research findings were applicable to issues of accessibility of a wider range of applications, particularly web-based information systems.

Keywords

Web accessibility; visual impairment; user experience; evaluation methods
Introductions

Education in the 21st century is heavily influenced by the emergence of new information and communication technologies and services. An online learning management system (LMS) is one type of information management tool that has been widely adopted in both distance education and on-site, traditional classrooms. Several research studies have examined the functionality of online learning management systems (Alonso et al, Asiri et al), but little attention has been paid to accessibility issues, in particular to the complex web-based interfaces for learners with disabilities. Consequently, instead of facilitating learning for this group of students, technology can become an obstacle to them. Students or learning system users with visual impairment are a population that is most disadvantaged in terms of accessing and utilizing educational technologies. Statistical data indicate that the number of blind students enrolled at the college/university level increases every year, but the technologies have not improved at the same pace. It is critical to ensure that educational materials, including those offered through online learning management systems, are accessible and usable by this growing group of learners.

This study was aimed at obtaining data that can be used to improve the accessibility of online learning management systems for students with visual impairment. Therefore, the researcher intended to test an online learning management system with learners who are end-users of the tool.

Research Goals and Methods

This research proposed evidence-based research into the design of accessible online learning management systems (LMS) for students with visual impairment. The main objective was to investigate the current functionalities and tools of such systems, in respect to accessibility
issues, as well as the experiences of this group of learners. Based on this goal, the study involved four stages: evaluation, observation, exploration, and analysis. To carry out these stages of the investigation, a computer training course at an academic institution was used to facilitate the study. Eighteen subjects who had visual disabilities and were enrolled in the course were recruited and asked to use the designed online learning management system (Modular Object-Oriented Dynamic Learning Environment or MOODLE version 1.9) throughout a training course (Fig. 1). Subjects were required to be at least 18 years of age and needed to be experienced screen-reader users. The 18 participants were between 18 and 30 years of age, and there were an equal number of males and females. They were in different years of college and different fields of study. All participants were undergraduates, with the exception of one graduate student. All of them used the Job Access With Speech (JAWS) as screen reader technology with varying degrees of experience. Furthermore, 9 students had experience in using an online learning system. Among this group, 3 students had experience using MOODLE as the learning management platform in their universities.

Fig. 1. Screen shot of the course page in the MOODLE.
Several methods were employed for data collection - i.e. observation through usability test, post-questionnaire and semi-structured group interviews. For the user testing sessions, subjects were paired to work collaboratively on the assigned tasks; they were encouraged to talk and discuss with each other when they encountered any problems. A walkthrough script was created to test only some typical features of the MOODLE standard package that were deemed appropriate to the course content. These selected modules/features were homepage, profile, messages, forums, chats, assignments, quizzes, and grades.

All user tests were conducted at the beginning of the training course in a computer room equipped with computers and screen reader technology. Acer Aspires with Intel Core 2 Duo CPU 2GB RAM, 500GB HDD, running Microsoft Windows 7 Professional 32-bit version and Job Access with speech (JAWS) v.13 were used throughout the testing sessions and the whole training course. Participants were allowed to modify the speech output speed to their liking to make it similar to how they typically interact with a computer. The browser used for the study was Internet Explorer 9.

The basic performance matrix was added to each task in order to investigate the relative effectiveness of each module. Task accuracy and task completion were used as the scheme of measurement. At the end of the testing sessions, participants were asked to fill in the questionnaire and participate in group interviews. These preference data were compiled and analyzed together with the notes from user testing observations to enhance understanding.

Results

Findings indicate that the majority of users could successfully complete the tasks, although with a different rate for each module/feature. Messages is the module where most tasks were completed (96%) while Discussion Forum received the lowest rate of task completion (81%). On
the other hand, findings of the task accuracy or error counts revealed that the Discussion Forum was the module where users made the most errors (41%) while Messages was the feature where users made the fewest errors (4%) (Please refer to Fig. 2 for the summary of results). A Pearson product-moment correlation coefficient was computed to assess the relationship between the rate of task completion and total errors. There was a negative correlation between the two variables, $r = 0.713$, $n = 8$. Overall, increases in rate of completed tasks were correlated with decreases in rate of errors made.

Findings from the post-questionnaire and group interviews supported and clarified the results from user testing observation. They revealed that although users had a rather positive impression of overall features of the MOODLE system (4.1 on a scale of 1 to 5, with 5 being the most positive), they felt that some features were not easy to use. Clarity of the labeled sections and relevancy and conciseness of the page content received the highest ratings, 3.76 and 3.75, respectively. On the other hand, navigation of the application screen received 3.36, the lowest rating (see tables 1 and 2).
Table 1 Average rating of overall impression of each module/feature

<table>
<thead>
<tr>
<th></th>
<th>Homepage</th>
<th>Profile</th>
<th>Messages</th>
<th>Discussion</th>
<th>Chat Room</th>
<th>Assignment</th>
<th>Quiz</th>
<th>Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Rating</strong></td>
<td>4.22</td>
<td>4.13</td>
<td>4.11</td>
<td>4.25</td>
<td>3.80</td>
<td>4.25</td>
<td>3.80</td>
<td>3.89</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.548</td>
<td>0.641</td>
<td>0.928</td>
<td>0.463</td>
<td>0.789</td>
<td>0.463</td>
<td>0.789</td>
<td>0.601</td>
</tr>
</tbody>
</table>

Table 2 Average rating of each component

<table>
<thead>
<tr>
<th></th>
<th>Availability of menu function up to expectations</th>
<th>Ease of navigation of application screen</th>
<th>Clarity of button function</th>
<th>Clarity of menu function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Rating</strong></td>
<td>3.62</td>
<td>3.36</td>
<td>3.64</td>
<td>3.53</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.152</td>
<td>0.090</td>
<td>0.178</td>
<td>0.250</td>
</tr>
</tbody>
</table>

Table 2 (continued) Average rating of each component

<table>
<thead>
<tr>
<th></th>
<th>Well-organized buttons</th>
<th>Well-organized menu items</th>
<th>Relevant and concise page content</th>
<th>Good page structure with logical sections</th>
<th>Clearly labeled sections with apparent functions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Rating</strong></td>
<td>3.59</td>
<td>3.71</td>
<td>3.75</td>
<td>3.73</td>
<td>3.76</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.169</td>
<td>0.145</td>
<td>0.202</td>
<td>0.235</td>
<td>0.220</td>
</tr>
</tbody>
</table>

Major issues that influenced the use of MOODLE by blind users are summarized in the following paragraph.

*Design problem*

This includes general design issues that often result in participant confusion, such as the location of navigational items, save/submit buttons, form fields, and confusing layout/links. An example of this design problem was the final buttons on Quiz modules that were difficult to find.
Users had to spend a long time finding the last three buttons on a quiz page until they reached the bottom of the page.

*Form control issues*

This includes unlabeled form controls, binding between labels and form control, ambiguous text area and formatting toolbar, or losing cursor focus after pressing a certain key inside the text area (e.g. backspace and return keys). An example of these form control issues was the editor that is available in several modules (e.g. Forum, User profile, Assignment, etc.) The editor's formatting toolbar and the text area were unlabeled and inaccessible, and hard to control using a keyboard. Despite the provision of editor shortcut keys, none of the users were aware of this. They all had problems when trying to locate the text area at their first attempt and were unable to do any formatting with their content.

*Mouse only/Flash/JavaScript issues*

This includes mouse-overs for accessing any content, situations where JAWS cannot access certain form controls, inaccessible mouse-only flash content, alert dialog boxes, cascading or popping up windows, etc. An example of these issues was the popup window notifying users of new incoming messages. This notification window would automatically appear after a user logged in to the MOODLE; however, JAWS cannot access it and users failed to get the message immediately. Blind users had to intentionally access the specific page in order to check their messages.

*Table issues*

This refers to tables without headers and the ones that are poorly coded/labeled, making it difficult for participants to know what each cell in a row stands for. It also includes tables with
unnecessary blank cells, mainly for a decorative purpose. An example of these table issues was the Homepage in which users had to locate their course. "List of categories" in the tabular format was difficult to understand by blind users. It contains a table with two columns: a category name and the number of courses in that category. There were no labels or column headings to help users understand what those columns represent.

**JAWS issues**

These are problems observed from the way JAWS reads form content. These include JAWS not reading page content or content in other languages, reading out of sync with cursor position, no confirmation of actions performed (e.g., file attached, new page ready, radio button checked, etc.). An example of these JAWS issues was an uploading feature in some of the modules (e.g. Assignment and Profile). Users submit their works by uploading their files to the system. However, after a certain file had already been browsed and was waiting to be uploaded, JAWS failed to read the name of the selected file that displayed in an edit field. Consequently, it was difficult for users to make sure that the file was the correct one. Moreover, there was no prompt signal when the file upload completed. Users had to arrow up and down to check the status of the uploading process.

**External/cascading window issues**

This refers to activities opened in multiple tabs or windows, which caused confusion to participants. An example of these issues was when entering the Messages page: a separate page was always open in the new window. Similarly, if someone wants to send a message, a new window would be opened when clicking on the name of the recipient. Most users were confused when working on several windows opening at the same time. They often got lost and did not
know how to get back to the starting page. Or, sometimes users accidentally closed the original course page and had to login to the system again.

*Complex ordering commands*

This refers to activities that require participants to perform a number of steps in order to complete a task. An example of this problem was a tag block within the blogging feature. The blog page (categorized under User Profile) is basically comprised of 4 menu items: "Add a new entry," "View my entries," "Blog preferences," and "View site entries." Moreover, users can customize their page by adding other modules/features, one of which is "Tags" that allows a list of tags to become visible on this same page. As part of the customization, users had to click on "Turn editing on" to toggle between these settings. This button is in the center position of the page that is easy to see. However, blind users had no idea of this placement and did not quite understand its function. No one could make any additional setting changes and easily locate the assigned tags.

*Labeling/instructional problem*

This includes no instruction or title on certain pages or sections of a learning module, confusing instruction, confusing/misleading labels, unclear label or instructions, confusing positioning of instructions or guidelines for completing a task. An example of this problem was the "Edit my submission" label in the "online text" assignment. "Online text" is one type of assignment in the MOODLE that provides a single large text area for users to fill in and submit for grading. Before getting to the text area page, users were required to click on a button labeled "Edit my submission." All users had problems understanding this button and couldn't relate this to the assignment. Users typically reacted by wondering why they had to click on "Edit my submission" even though they had not completed the task before.
Discussion and Conclusion

This study examined the accessibility of the MOODLE, an online learning system, to 18 blind students through usability testing observations, questionnaire, and group interviews. The findings revealed that the MOODLE system was rather accessible for users who are blind. However, some modules/features were still hard to use. Most of the problems, as listed in the previous section, can be improved with minor technical changes by following the Web Content Accessibility Guideline 2.0 (Web Accessibility Initiative). Transcoding is a general concept of transforming content or a program on the fly in an intermediary server, producing other formats (Harper and Yesilada). An application of transcoding techniques can also address some issues, particularly when implemented along with the Web Accessibility Initiative (Accessible Rich Internet Applications). For example, the technique of page rearrangement can be applied to solve the confusing button labels in the Quiz module. Despite this fact, there are also several items that are not covered by the guideline (e.g. an ambiguous label in the online text assignment). This is supported by the previous studies suggesting that accessibility guidelines are not the only component to promote access to web-based application system for users with disabilities (Power et al). Therefore, the usability testing of Web-based information systems should include individuals with disabilities in order to verify that an interface can be used by all individuals. Apart from the design specifications, it is worth noting that although subjects have the same type of disability-visual impairment, their methods of web navigation and interaction are somehow different, hence, resulting in their preferences.

This research is broader than a single study of accessibility evaluation of an online learning management system; rather, it is a contribution to a research stream that attempts to better understand the learner's experiences and interactions with the system. At the same time it
aims to help clarify the difference between the rhetoric and the reality. Anecdotal information proclaims benefits of educational technology that can support all learners. For students with visual impairment, the topic of accessibility is still an issue that requires further empirical study. Moreover, future investigations of accessible learning systems could include the more general application domain. The implications of these research findings could be applicable to a wider range of applications, including most web-based information systems. In addition to application design, through multi-methodological approaches this study will enable the researcher to investigate user experiences that take place in an online learning management system in a more rigorous and empirical manner, which will positively contribute to the disciplines of accessible e-learning and information accessibility in general.
Works Cited


