

ACCESSIBILITY EVALUATION OF MOODLE CENTRED IN VISUAL IMPAIREMENTS

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Abstract: The use of new technologies has been increasing during last years in education. Specifically, the use of e-learning systems provides for students more freedom to learn through Internet when and where they prefer in each moment. However, e-learning tools are not perfect tools. Most of these e-learning tools present accessibility barriers, so not all students are able to use them completely in their studies. The goal of this paper is to evaluate if Moodle e-learning web tool is accessible for visually impaired people using assistive technologies like screen readers. The evaluation has been divided in two main objectives. Firstly, Moodle was evaluated from a user perspective. The interaction of a blind student with the system was simulated and two screen readers were used. Secondly, this tool was evaluated from an accessibility expert perspective and it was analysed if Moodle is in accordance to ATAG and WCAG W3C guidelines.

1 INTRODUCTION

Nowadays, we are involved in a world where technology is essential. It is becoming true in educational environments because the conventional education is being adapted to new technologies. A new concept, e-learning, emerged as a complementary mechanism to traditional classroom teaching. This learning concept allows students to learn when and where they want regardless of their physical conditions or the technology they use. In order to access the e-learning websites, students only need an Internet connection.

Many educational institutions use a technology named Learning Content Management System (LCMS) to manage their courses. These are web tools which make course management easier for teachers and directors. Oftentimes, the LCMS is even the only tool given to students for communicating with peers and teachers or for accessing particular learning resources. That is why these e-learning tools should be accessible and easily to use for everyone.

This paper is focused on visual impairments. Currently, visual-impaired people use assistive technology for accessing websites. Specifically, they need them to surf on LCMS's. There are different assistive tools for each disability (Cook & Polgar,

2007). Each user can choose the best tool to help her/him to access the system according to her/his disabilities. Particularly, visual impaired people, users with low vision or blindness, use screen readers to read text aloud, screen magnifier or refreshable Braille displays to convert the web contents to Braille among others.

The aim of this work is to evaluate the accessibility of a specific LCMS tool focusing on visual impairments. Moodle¹ has been chosen for the evaluation. This paper presents manual evaluations from two perspectives: user perception and an accessibility expert experience. This work is part of a more complete research work where automatic accessibility evaluations are included too. This combination of manual and automatic methods has obtained best results (Moreno et al., 2010).

The evaluation is presented in two main parts. Firstly, the user evaluation is described by simulating blindness and by using two different screen readers. Next, an expert evaluation is carried out. It analyzes if Moodle is according to W3C guidelines.

The paper is organized as follows: section 2 presents the state of the art. Then, section 3

¹Moodle. LCMS Author tool. Available at: <http://download.moodle.org/windows/> (June 2010).

describes the evaluation process and main results obtained. Finally, main conclusions and further research are presented in section 4.

2 PREVIOUS WORK

2.1 e-Learning

E-learning has become a new way of learning which could be considered as the evolution of learning distance (Marjolein et al., 2007). The concept of e-learning has many definitions, maybe the easiest could be "Access online to learning resources every moment and everywhere" (Holmes et al., 2006). The main difference with traditional learning is that the student decides what, when and where study. As a result, it provides a huge freedom to the user. There are different e-learning tools which help to organize, store and modify efficiently e-learning courses. These tools are divided into three groups: LMS (Learning Management Systems), LCMS (Learning Content Management Systems) and CMS (Content Management Systems) (Harman and Koohang, 2007). Each one has different features: CMS's permit to manage contents; LMS's are focused on administrative and assistive tasks in learning environment; and LCMS's provide authoring tools for learning. Particularly, this paper evaluates Moodle LCMS.

2.2 Accessibility Standards

Designers should consider different guidelines and standards to design e-learning tools if they want to develop these tools accessible for all.

W3C² provides guidelines to help designers to create accessible components. For instance, WCAG guidelines (W3C, 2008) for websites content, ATAG guidelines (W3C, 2010) for authoring tools and UAAG guidelines (W3C, 2002) for user agents. As LCMS's are authoring tools they should be in accordance to ATAG guidelines. In addition, the LCMS should fulfill WCAG guidelines because they are web applications too.

Besides, IMS Global Learning Consortium³ has developed guidelines to create e-learning tools and make accessible its content. These guidelines are

based on six principles: allow the user to customize the website, provide equivalent alternatives to visual and additive content, provide compatibility to assistive tools and provide access to all tasks through keyboard, provide context and information, follow IMS specifications and other relevant specifications, and consider the use of XML.

Moreover, designers should use Universal Design for providing access to all. This approach has been adapted to learning by creating Universal Design for Learning (UDL) (UDL, 2010). In particular, the characteristics of Universal Design have been tailored to e-learning tools like Moodle (Elias, 2010)

2.3 Assistive Technology: Screen Readers

Disabled people use different assistive technologies to surf on Internet. These technologies help them to complete daily tasks such as: sending emails, read the newspaper and so on. There are different assistive technologies which have been adapted to different disabilities. For example, if a person has mobility problems, s/he can use keyboard with larger, more widely-spaced keys or if a person has visual impaired problems, s/he can use screen magnificents or screen readers.

Screen readers are used by people with visual disabilities or illiterate people to help them when they are using the computer. These people are not able to read the text that is written in the screen so they need an assistive technology which repeats the text loudly or transforms it to Braille. Users can choose the best screen reader for her/his needs because there is available a huge variety of screen readers. There are screen readers developed to provide better support for different browsers; open-source, free or commercial software and so on.

To carry out this work two screen readers have been selected: JAWS⁴ and NVDA⁵. JAWS is one of the most used screen readers around the world. It is commercial software and it has been improved to read websites in Internet Explorer browser. On the other hand, NVDA is an open source and free software which is able to surf on the Internet in different browsers such as: Mozilla Firefox or Internet Explorer. It is also able to show the text

²W3C: The World Wide Web Consortium. Available at <http://www.w3.org/> (June 2010).

³IMS Global Learning Consortium. Available at <http://www.imsglobal.org/> (June 2010).

⁴JAWS 7. Screen reader. Available at:

http://www.freedomsscientific.com/fs_products/software_jaws70_fea.asp (June 2010).

⁵NVDA. Screen reader. Available at: <http://www.nvda-project.org/> (May 2010).

information of the screen reader in audio or Braille in more than twenty different languages, including Spanish.

2.4 LCMS's Accessibility Studies

Accessibility evaluations in e-learning tools can be found in literature. Some of them are centered in e-learning content accessibility. For instance, Fitchen (Fitchen et al., 2009) shows that most e-learning content is not accessible for disabled people. Particularly, documents with Flash technology, videoconferences or PowerPoint presentations online are usually inaccessible. Fisseler (Fisseler and Bühler, 2007) suggested different solutions to these problems. For example, by including alternative texts for images, a good structure for the content or a good color contrasts among others.

Other researches evaluate the accessibility features on e-learning tools. For instance, Power (Power et al., 2010) evaluates accessibility of three different e-learning tools, but it only takes into account a subset of tasks and web-pages to evaluate. The LCMS evaluated are Moodle, dotLRN⁶ and Blackboard⁷. This study concludes that all of them have serious accessibility problems and none of them are in accordance to WCAG 1.0 accessibility guidelines.

And other evaluations were focused on visual impairments, as Open University evaluation, which evaluated accessibility of Moodle v1.6 (Moodle, 2006) by using JAWS 7.0 and Internet Explorer as browser. The evaluation concluded that Moodle was not accessible because there were important accessibility errors of WCAG 1.0. Recently, Buzzi (Buzzi et al., 2009) has evaluated accessibility of Moodle for visual impaired people using WCAG 2.0. This work showed that Moodle should improve its accessibility. Again, these evaluations take into account only a subset of Moodle tasks and these evaluations were not complete.

Besides, there is a study which evaluates the user experience and the user opinion, while the user fill out an assessment task created with Blackboard LMS (Babu et al., 2010). This study concludes that visual impairment users have some accessibility or usability problems to complete the online assessment.

To our knowledge, there are not accessibility evaluations for the current version of Moodle. Moreover, previous evaluations were not complete because the whole set of tasks of Moodle were not evaluated. Furthermore, expert evaluations based on ATAG guidelines are not found in literature. Because of it, this paper tries to improve the previous accessibility evaluations of Moodle.

3 EVALUATION

The evaluation presented in this paper checks the accessibility of Moodle version 1.9 in the Internet Explorer 6.0 browser and in Windows XP operating system. The Moodle's accessibility is evaluated in two different ways. Firstly, a user evaluation was made simulating blindness and using two different screen readers (JAWS and NVDA) for accessing Moodle. Secondly, it is evaluated by an accessibility expert in accordance to W3C ATAG 2.0 guidelines (because Moodle is an authoring tool) and WCAG 2.0 guidelines (because Moodle is a Web-based system and a web-site). WCAG 2.0 is the current W3C recommendation and it was used in this paper. However, ATAG 2.0 is a draft, but it is being developed to be compatible with WCAG 2.0, thus this guideline has been chosen for the evaluation.

Both accessibility evaluations analyzed the accessibility of the full functionality of Moodle (for every task of Moodle). In Moodle, administrators have full permissions meanwhile teachers and students have permissions only for subsets of tasks of Moodle. That is why the evaluations were carried out with the administration profile, but the evaluations results can be applied to all the Moodle profiles (students and teachers).

3.1 Evaluation Simulating Blindness

This evaluation was carried out by an evaluator with technical knowledge about accessibility but without any visual disability. She switched off the PC screen in order to simulate blindness. After that, she tried to complete each Moodle task by NVDA and JAWS screen reader. Then, she checked if the task presents accessibility difficulties and if it can be finished by a visual impaired person.

Different accessibility difficulties were frequently found along the Moodle evaluation. These difficulties are listed below and Figure 1 shows a graphic of the percentage for each error. This percentage is calculated after counting how

⁶DotLRN. Screen reader Available at: <http://www.dotlrn.org/> (May 2010).

⁷Blackboard v9.1. Available at: <http://www.blackboard.com/> (May 2010).

many times the error occurs. It is divided by the number of tasks in the application:

- **E1:** Not all text and combo boxes have associated descriptive texts.
- **E2:** Pages refresh without asking to the user.
- **E3:** Moodle redirects the user to another page without warning the user.
- **E4:** The Look & Feel of Moodle changes in some tasks.
- **E5:** Tables are used for layout.
- **E6:** Images of text are used to convey information
- **E7:** It is difficult to know how to complete the task or it is confusing for the user
- **E8:** There is text in English when the selected language of the tool is Spanish
- **E9:** There is not a button that allows the user to cancel the operation.
- **E10:** The table is not well structured so the screen reader is not able to read all tables.
- **E11:** There are not page or table headings.
- **E12:** There are many rows in the table and it is difficult to read s/he has to memorize the table structure.
- **E13:** There is a text that only can be modified with Windows accessible. The Appendix A shows a description about it.
- **E14:** Text description is not correct.
- **E15:** The application does not check the data inserted into. It is not easy for the users to guess what the problem is.
- **E16:** The screen reader does not read the text correctly.

Table 1 and 2 detail the accessibility difficulties found for each Moodle task. First column in the tables presents which profiles can make the task (A: Administrator; T: Teacher; S: Student). Second and third column present the group's task and the task's name. Fourth column presents the accessibility difficulties found during the evaluation (numbered according previous list).

Finally, last column shows if the task can be completed by the user or not. This column has three different values: *Yes*, if the task can be completed without difficulties; *Yes**, if the task can be completed but there are accessibility problems that make difficult to complete the task for visual impaired people and *No*, if the task cannot be completed by the user.

After an exhaustive evaluation of Moodle's accessibility by using JAWS and NVDA we can conclude that the accessibility difficulties found with

both screen readers are similar. The only difference found are related to the way they read tables. When a cell is empty (has not text), NVDA reads the next column and it says aloud the number's column and its content. It is useful because NVDA shows you where you are in each moment. However, in this situation JAWS does not read in which column or row is the cursor and directly reads the next column. It is confusing for users.

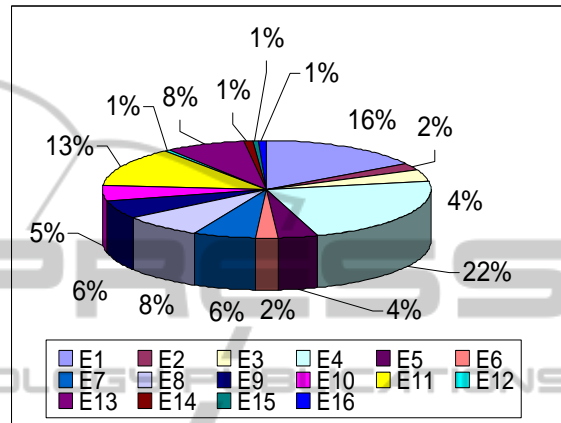


Figure 1: Error frequency.

As Table 1 and 2 show, most of tasks are not accessible. However, they can be completed by the user because these accessibility errors are not critical or do not affect to the main purpose of the task. There are accessibility difficulties in the tool. The most frequent errors are E4 and E1. The user can be confused because the appearance of the website is not always the same and because the content is not clear. The least frequent errors are E12, E14, E15 and E16. Although they are important, these errors are insignificant because they appear once in the tool.

3.2 Expert Evaluation

The evaluation presented in this paper analyses Moodle's concordance with W3C guidelines. Due to Moodle is an authoring tool, it should be in accordance to ATAG 2.0 guidelines. Moreover, as Moodle generates web-sites it should satisfy WCAG 2.0 guidelines. The obtained results after the evaluation show that Moodle is not in accordance to ATAG 2.0 and WCAG 2.0 level A at least. These results are detailed next.

Table 1: Accessibility difficulties found for Moodle tasks related with general users, courses and grades.

User Profile	Functionality (group)	Task Name	Errors	Can it be completed?
A/T/ S	General	Login user	E1	Yes*
A/T/S	General	Change language Moodle	E1/E2	Yes*
A	Users/ Authentication	Manage authentication	E8 /E10	Yes*
A	Users/ Authentication	Email-based self-registration	E5	Yes*
A	Users/ Authentication	No login	E7	Yes*
A	Users/ Authentication	Manual accounts	E5	Yes*
A	Users/Accounts	Browse list of users	E7/E5/E9/E10	Yes*
A	Users/Accounts	Bulk user actions	E2/E11	Yes*
A	Users/Accounts	Add a new user	E6/E8/E11/E13	Yes*
A	Users/Accounts	Upload users	--	Yes
A	Users/Accounts	Upload user pictures	--	Yes
A	Users/Accounts	User profile fields	E3/E7/E13	Yes*
A	Users/Permissions	Define roles	E7/E8/E13	Yes*
A/T	Users/Permissions	Assign system roles	E1/E9	Yes*
A	Users/Permissions	User policies	E8/E9	Yes*
A/T*	Courses	Add /Edit courses	E4/E13	Yes*
A	Courses	Enrollments	E9/E11	Yes*
A/T/S	Courses	Participants	--	Yes
A/T	Courses	Backup	--	Yes
A/T	Courses	Restore a course	E5/E7/E9/ E10/E11	No
A/T	Courses	Import	E4/E5	Yes*

Table 2: Accessibility difficulties found for Moodle tasks related with reports, questions, files, groups, events, calendar, forums and profiles.

User Profile	Functionality (group)	Task Name	Errors	Can it be completed?
A/T	Courses	Reset course	E4	Yes*
A	Grades	My preferences grader report	E1/E3/E4/E6/ E7/E11	Yes*
A/T/S	Grades/View	Overview report	E1/E4	No
A/T	Grades/View	Grader report	E1/E4	Yes*
A/T/S	Grades/View	User report	E1/E4/E10	Yes*
A/T	Grades/Categories and Items	Simple view	E1/E4/E10	Yes*
A/T	Grades/Categories and Items	Full view	E1/E4/E8/E10/ E12	Yes*
A/T	Grades/Scales	View	E1/E4/E10/E13	Yes*
A/T	Grades/Letters	View	E1/E4/E16	Yes*
A/T	Grades/Letters	Edit	E1/E4	Yes*
A/T	Grades/Import	CSV file	E1/E4/E9	Yes*
A/T	Grades/Import	XML file	E1/E4	Yes*
A/T	Grades/Export To	Open doc spreadsheet / Plain text file/Excel spdsht/XML file	E1/E4/E9	Yes*
A/T	Reports	Filter logs	E1/E4	Yes*
A/T	Reports	Activity report	E4/ E14	Yes*
A/T	Reports	Participation report	E4/ E8/E11	Yes*
A/T	Questions	Questions bank	E3/E8/E13	Yes*

Table 2: Accessibility difficulties found for Moodle tasks related with reports, questions, files, groups, events, calendar, forums and profiles. (cont.)

User Profile	Functionality (group)	Task Name	Errors	Can it be completed?
A/T	Reports	Live logs from the past hour	E2	No
A/T	Questions	Import	E4/E7	Yes*
A/T	Questions	Export	E4/E9	Yes*
A/T	Files	List of files	E1/E4/E7/E10/ E11	Yes*
A/T	Files	Upload a file	E3/E4/E8/E11	Yes*
A/T	Files	Make a folder	E1/E11/E15	Yes*
A/T	Groups	Create group	E4/E6/E11/E13	Yes*
A/T	Groups	Delete group	E4/E11	Yes*
A/T	Groups	Add/Remove users	E1/E4	Yes*
A/T/S	New event	New event	E11/E13	Yes*
A/T/S	Export calendar	Export calendar	E11	Yes*
A/T	Forums	Add / Edit a new topic	E1/E4/E11/E13	Yes*
A/T	Forums	Delete topic	E4	Yes*
A/T	Forums	Reply	E1/E3/E4/E11	Yes*
A/T/S	Profile	Change password	E4/E8/E11	Yes*
A/T/S	Profile	Edit profile	E4/E8/E11/E13	Yes*

This evaluation was carried out by an accessibility expert. Table 3 shows a summary of the checkpoints failed by Moodle. Due to the length of the paper is finite; it is not possible to include the description of each checkpoint failed. The more important accessibility difficulties found in Moodle are related to the absence of automatic accessibility check and to the absence of accessibility support for authors (ATAG: A.3.6.4/ B.2.1.1/ B.2.2(all its testable success criteria)/ B.2.3(all its testable success criteria)/ B.3.1(all its testable success criteria) /B.3.2(all its testable success criteria) /B.3.3(all its testable success criteria) and B.3.4(all its testable success criteria)). Besides, the user is not able to change website presentation because there is not any feature that allows the user to complete it (ATAG: A.2.2.1/ A.2.3.1/ A.3.1.1/ A.3.1.6/ A.3.6.3). Furthermore, shortcuts cannot be changed by the user, so sometimes these shortcuts are the same to different features (ATAG: A.3.1.5). Other accessibility difficulty is that there are different situations in which the user cannot change the structure of the website (ATAG: A.3.4.1), there are themes which are not accessible and the tool does not inform the author about it (ATAG: B.2.5 (all its testable success criteria except B.2.5.5 and B.2.5.6)).

Regarding to WCAG 2.0 guidelines, table 4 summarizes which checkpoints are failed by Moodle.

There are WCAG checkpoints that are not im-

plemented successfully so as a result the tool is not accessible because there are important accessibility errors such as: not all text and combo boxes have associated descriptive texts, the tool's look and feel is not the same along the website, images of text are used to convey information or there are not headings. Besides, these accessibility problems are worst for blind people. For example, if the tool uses tables for layout, the screen reader identify it as a table and it could be confused for the user because s/he thinks that tables are used to structure information. Besides, if the table is not well structured user will be lost in it because the screen reader is not able to read cells which are joined or cells without text.

4 CONCLUSIONS AND FURTHER RESEARCH

After evaluating the accessibility of Moodle using JAWS and NVDA, we can conclude that the difficulties found with both screen readers are similar. If a task can be completed by JAWS it can be completed with NVDA too, and in the other way around. So there is not any accessibility difference between using one of these screen readers.

With regard to the expert evaluation, it demonstrates that Moodle is not in accordance to W3C guidelines. There are many accessibility difficulties which show that the authoring tool and

Table 3: ATAG 2.0 Errors.

Principle	Checkpoints		
	Level A	Level AA	Level AAA
A.1	A.1.1.1; A.1.2.1	A.1.1.2	A.1.1.3
A.2	A.2.2.1; A.2.2.2 ; A.2.3.1	--	--
A.3	A.3.1.1; A.3.4.1; A.3.4.2 A.3.7.1; A.3.7.2	A.3.5.1; A.3.6.1; A.3.6.2	A.3.1.4; A.3.1.5; A.3.1.6 A.3.6.3; A.3.6.4
B.1	B.1.1.1	B.1.1.2	B.1.1.3; B.1.2.3
B.2	B.2.1.1; B.2.1.2 ; B.2.2.1 B.2.2.2; B.2.2.3; B.2.2.4 B.2.3.1; B.2.4.1; B.2.4.2 B.2.4.3; B.2.5.1; B.2.5.2	B.2.2.5; B.2.2.6; B.2.2.7 B.2.3.2; B.2.4.4; B.2.5.3 B.2.5.4	B.2.2.8; B.2.3.3; B.2.5.7 B.2.5.8; B.2.5.9
B.3	B.3.1.1; B.3.2.1; B.3.2.2 B.3.3.1; B.3.4.1	B.3.1.2; B.3.2.3; B.3.2.4 B.3.4.2	B.3.1.3; B.3.3.2; B.3.4.3

Table 4: WCAG 2.0 Errors.

Principle	Checkpoints		
	Level A	Level AA	Level AAA
1. Perceivable	1.4.1	1.4.4; 1.4.5	1.4.8; 1.4.9
2. Operable	2.1.1; 2.2.2; 2.4.2	2.4.5; 2.4.6	2.1.3; 2.4.10
3. Understable	3.1.1; 3.2.1; 3.2.2; 3.3.2	3.1.2; 3.2.3	3.2.5
4. Robust	4.1.2	--	--

the generated website are not accessible. Many ATAG 2.0 and WCAG 2.0 checkpoints are not according to accessibility level A at least, mainly because the tool does not provides automatic accessibility checkers and it does not support the user when using the authoring tool. So, it is difficult for the author to create content and a website accessible. Moreover, these accessibility problems become more critical when a person with vision problems try to access to a website.

To conclude, Moodle, as many LCMS, is not accessible. Although Moodle's community is trying to solve this problem, there are many changes that should be easily done to be accessible to everybody regardless of their circumstances. Currently, we are working to complete the evaluation presented in this paper. A visual-impaired person is evaluating Moodle. Moreover, it could be interesting if other impairments are considered to evaluate the tool, such as: deaf or movement disabilities. Furthermore, we are aware that the used technologies are not enough to evaluate the tool. Thus, it should be taken into account other environments and technologies such as: other operating systems, different web browsers and other assistive technologies.

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APPENDIX

There is a Windows editor that Moodle uses to change the text format, the editor is showed in Figure 2. This editor is not accessible because the user cannot access to all tasks using keyboard. In general, this editor has a help feature to inform the user about the shortcuts to access to all features. However, some of these shortcuts are not right because they are the same shortcut to access to different Windows features. For example, Moodle provides the shortcut *ctrl+P* to change width print, it is ok because it is an alternative to access to this feature, but there is problem, Windows SO uses this shortcut to show print settings. Thus the user cannot complete the task successfully because s/he cannot use all features.

Also, this editor has combo boxes which have not associated descriptive texts and as a result the screen reader cannot read it right. Another important accessibility problem is that the component uses images to convey information instead of using descriptive text.

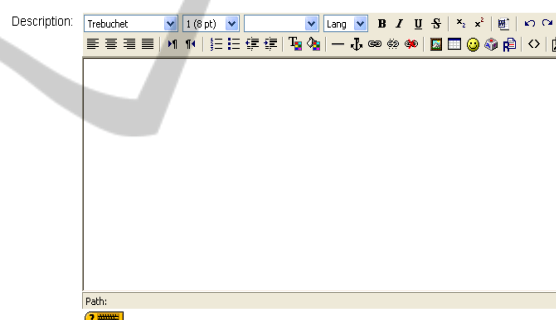


Figure 2: Windows editor for long strings.