InSIDE: Including Students with Impairments in Distance Education

Delivery DEV3.2	Detailed assessment of an open-source LMS

Authors	**V.Salinas[1], K. Miesenberger[1] , G. Kouroupetroglou[2]**
	[1]Johannes Kepler University, [2]National and Kapodistrian University of Athens
Work Package	WP3: Development
Issue Date	20-10-2019
Report Status	Final

Project Partners

University of Macedonia, Greece

Coordinator

National and Kapodistrian University of Athens, Greece

Johannes Kepler University, Austria

University of Aboubekr Belkaid Tlemcen, Algeria

Blida 2 University, Algeria

Mouloud Mammeri University of Tizi-Ouzou, Algeria

Ibn Tofail university, Morocco

University of Sciences and Technology of Oran Mohamed Boudiaf, Algeria

Cadi Ayyad University, Morocco

University of Sfax, Tunisia

Abdelmalek Essaadi University, Morocco

University of Tunis El Manar, Tunisia

University of Mohammed V in Rabat, Morocco

University of Sousse, Tunisia

Project Information

Project Number	598763-EPP-1-2018-1-EL-EPPKA2-CBHE-JP
Grant Agreement Number	2018-3218 /001-001
Action code	CBHE-JP
Project Acronym	InSIDE
Project Title	Including Students with Impairments in Distance Education
Funding Scheme	Erasmus+ KA2
Date of EC approval	13/12/2018

Contacts	Assistant Professor Eleni Koustriava
Address	University of Macedonia, Thessaloniki, Greece
Phone	+30 2310891333
eMail	elkous@uom.edu.gr
Project Website	www.inside-project.org

Document Information

Title	Delivery DEV3.2 Detailed assessment of an open-source LMS
Issue Date	20/10/2019
Deliverable Number	DEV3.2
Work Package	WP3: Development
Task Number	3.2
Activity number	3.2.1, 3.2.2
Partner Responsible	JKU
Partners involved	JKU, UOA
Status	Final
Dissemination Level	PU • **PU** Public • **PP** Restricted to other programme participants (including the Commission Services) • **RE** Restricted to a group specified by the consortium (including the Commission Services) • **CO** Confidential, only for members of the consortium (including the Commission Services)

Version History

Version	Date	Changed	Author(s)
Ver.1	14/10/2019	First Draft	V. Salinas (JKU), K. Miesemberger (JKU)
Ver.2	20/10/2019	Final	G. Kouroupetroglou (UOA)

Table of Contents

1. Introduction

In this document we present the result of the selection of the most appropriate LMS to continue with. Also, a deep analysis in terms of usability, accessibility and educational efficiency of the chosen system. Finally, it is provided the modification proposals which are going to be done in the LMS in order to meet the requirements that the project set.

2. LMS choice

The process for making the final choice of the most appropriate LMS is based on the researches about LMS and adapted material done in previous phases of the project. It is required a software platform that was capable of handling accessible and inclusive educational material, with the leas possible modifications in its core functionality. Thus, document DEV3.1 is considered to be one of the most important for this decision making, as it contains a filtered set of LMS that meet the above requirements. A part of this objective information, there is a discussion between partners in order to provide to the decision making process a subjective view that may add valuable information based in the partners' learning experience.

Firstly, is considered the comparison done of most appropriate LMSs which shows edX and Moodle as most interesting alternatives. That is due their features are aligned to the project requirements, have a good support and the adaptations that may be done are possible and affordable.

Secondly, is considered the survey between partners. The importance of this step in the decision making process bases on the fact that if partners own experience with an alternative that imply a better acceptance between the teaching community which in the future has to adopt this system. In addition, previous experiences with an LMS usually involve an acquisition of knowledge in use and development, so this is a point that the project can take advantage of. Finally in this step, there is a clear result that point Moodle as the most popular LMS, and recommends a continuation with it.

Finally, partners with all information related discuss about the final choice. They agree that based on both approaches of evaluation, the comparative desktop study and after asking partners about DE in their institutions, let us conclude that Moodle is the most recommendable system to be used in InSIDE project. It supports accessibility, is very flexible and we can expect the needed support at most partner institutions (or such support is much easier to find than for other candidates). It meets all requirements in terms of accessibility, functionality, usability, customization and license. Moreover, partners show a noticeable expertise in providing DE with this software, which indicates that the future use and development could be less costly than with other alternatives.

3. In-depth analysis of the selected LMS

Moodle is considered to be the most widely used learning management system in academic and enterprise institutions in the world. Specifically, it has 144,332,474 users in 228 countries (Moodle,

2018). Moodle has a simple interface and it is continually reviewed and improved to suit the needs of its users. Also, Moodle has been translated into more than 120 languages and it can be customised to meet its users' needs (Moodle, 2018). Despite the increasing use of Moodle LMS, research has shown that Moodle has usability issues from the point view of its various users (Kakasevski et al., 2008; Melton, 2006; Minović et al., 2008; Rosato et al., 2004; Senol et al., 2014; Ssekakubo et al., 2013; Thuseethan et al., 2014). Usability is "a quality attribute that assesses how easy user interfaces are to use" (Nielsen, 2012). It is one of the most important requirements of LMSs; it improves the effectiveness of students' learning and the overall learning experience (Althobait and Mayhew, 2016; Katsanos et al., 2012; Onacan and Erturkm, 2016; Orfanou et al., 2015). Various methods can be used to evaluate the usability of interfaces. These methods can be either user-based evaluation methods or evaluator-based methods. The user-based evaluation methods include methods which involve users; they aim to collect data on users' satisfaction with an interface (e.g. via questionnaires) or users' performance while interacting with the interface (e.g. user testing) (Hasan et al., 2012). Alternatively, evaluator-based methods include methods which involve evaluators in the process of evaluating and identifying usability problems on an interface (e.g. the heuristic evaluation method, pluralistic walkthroughs) (Hasan et al., 2012).

Bocevska et al. (2018) made an analysis of accessibility of MOODLE according to the WCAG 2.0 Standard Compliance. They found that MOODLE provides the required features to assistive technologies for the users with visual, hearing and motor impairments and fulfils the criteria for levels A and AA of compliance with WCAG 2.0.

According to a recent study (Batanero et al. 2019) the Moodle learning platform was adapted using existing e-learning accessibility standards so that digital learning objects could be automatically presented in formats accessible to blind and/or deaf students. This model is extendable for other types of disabilities, helping educators adapt existing content for access by students with differing capacities. The teacher adds content (in non-auditory and non-visual formats to describe content otherwise inaccessible to deaf or blind students) and students upload reusable profiles/metadata describing their specific accessibility needs to connect to suitably adjusted content. Learning improvement with the adjusted platform was evaluated via multiple choice pre- and post-tests. Students' learning performance improved significantly across all groups: blind (45%), deaf (46.25%) and deaf-blind (87.5%).

Recently Kita et al. (2019) developed Voice User Interfaces to enhance users' activities as well as accessibility on Moodle.

Despite the increasing use of Moodle LMS, there is a lack of extended research which investigates the usefulness and usability of Moodle LMS as used by a case study university from the viewpoint of disabled students. Specifically, there is a lack of research which uncovers whether Moodle LMS supports the requirements of students and whether the features which are required are actually provided by the local instance of Moodle as used by the case study university. Also, there is a lack of research which investigates whether the desktop and mobile interfaces of Moodle LMS are usable from the viewpoint of students, or research which offers details concerning usability problems on both interfaces.

Research has indicated that user-based evaluation methods are mostly used in testing the usability of learning systems (Ivanc et al., 2012). For example, Senol et al., (2014), Thuseethan et al. (2014), Al-Sarrayrih et al. (2010), and Rosato et al. (2004) used questionnaires to evaluate the usability of Moodle which was used in various universities from the perceptions of students. The results of these studies provided examples of usability problems with the interface of Moodle from the viewpoint of students. These included the following: not easy to use for the first time (Senol et al., 2014);

inappropriate choice of colours (Senol et al., 2014); slow downloading of Moodle's pages (Senol et al., 2014); inconsistency problems (e.g. font size and colours) (Thuseethan et al., 2014); the complexity of using the system to log in (Thuseethan et al., 2014); the complexity of submitting assignments (Thuseethan et al., 2014, Rosato et al., 2004; Melton, 2006; Kakasevski et al., 2008); the lack of help included in the system (Thuseethan et al., 2014); the lack of error prevention and recovery (Thuseethan et al., 2014); faults in the internal search function (Thuseethan et al., 2014); not easy to recover when they made mistakes (Al-Sarrayrih et al., 2010); posting a discussion message (Rosato et al., 2004). However, the results obtained from Al-Sarrayrih et al.'s study (2010) showed that most of the students (73%) agreed that Moodle had all the functions and capabilities that they expected it to have.

Alternatively, Baytiyeh (2013) and Ivanović et al. (2013) also employed questionnaires but to investigate both students' and teachers' perceptions and use of Moodle in various universities. The results of these studies showed that the students and teachers had positive experiences with Moodle. For example, the results obtained from Baytiyeh's study (2013) showed that the majority of the users believed that Moodle was easy to use and it improved the communication between students and teachers. The results of the study conducted by Ivanović et al. (2013) showed that, despite the students being satisfied with Moodle, they provided suggestions to improve the quality of the teaching materials on Moodle including: presenting additional exercises with different difficulty levels; presenting examples of previous exams; and adding more tests and assignments for students. Also, the students suggested using their own local language for Moodle's interface instead of the English language interface Melton (2006), however, employed the user testing method using Japanese graduate students to evaluate the usability of registering for Moodle and uploading an assignment in Moodle. The English language user interface of Moodle was used during the test. The results showed that the users did not face usability problems while registering for Moodle. However, the results showed that half of the students faced difficulties while submitting an assignment to Moodle. Also, it was difficult for the students to use the English language interface instead of a Japanese interface. This corresponds with Ivanović et al.'s (2013) research which stressed the importance of changing the interface of Moodle to be in the students' own language rather than using the English language interface.

Rather than employing user-based evaluation methods, Martin et al. (2008) employed the heuristic evaluation method, using experts to evaluate the usability of three main learning management systems, including Moodle. The results showed that the experts had positive experiences with Moodle. For example, they indicated that Moodle has the ability to help users recognise and recover from errors. The results, however, showed that Moodle had weaknesses regarding flexibility and efficiency of use. Alternatively, Kakasevski et al.'s study (2008) employed both the heuristic evaluation method and user testing methods to evaluate the usability of Moodle from the perspectives of both students and teachers. The results showed that the students and teachers were more familiar with using the user interface in their own local language (Macedonian) instead of the English language interface. This is similar to the two studies presented above (Melton, 2006; Ivanović et al., 2013). Also, the results showed that Moodle had usability problems regarding the assignment and online chat features.

All the above studies evaluated the usability of the Moodle learning management system from either students', or both teachers' and students', point of view when using a desktop interface. Few studies were found in the literature, however, which considered the usability of Moodle on both desktop and mobile interfaces. Minović et al.'s study (2008), for example, evaluated the usability of Moodle on both desktop and mobile interfaces using the think aloud and questionnaire methods. The results showed that the students faced difficulties in performing the easiest tasks on Moodle using both

desktop and mobile interfaces. However, the number of errors using the mobile interface was higher compared to those on a desktop interface.

Alternatively, Ssekakubo et al. (2013), using questionnaires, investigated students' experience with various interfaces (desktops, laptops, tablets, mobiles) used for accessing two learning managements systems, including Moodle. The results showed that the following LMS services were most desired and used by the students: assignments, announcements, resources, course outlines and the chat room. The results showed that the mobile interface for Moodle had inadequate design (e.g. it was slow to open some pages). The authors indicated that the mobile interface for Moodle had usability and compatibility problems but no examples of usability problems were presented in either of the studies of Minović et al. (2008) or Ssekakubo et al. (2013).

A recent research (Hasan, 2019) investigated the usefulness and usability of Moodle LMS employed by a case study university from the viewpoint of 320 students, taking into consideration two interfaces of Moodle: desktop/laptop and mobile/tablet. The results of this research uncovered two features which were used frequently by all the students on Moodle LMS, and another 15 features which were not currently provided by the local instance of Moodle used by the case study university but which were required by a large number of students. Also, the results of this research showed that a large number of students identified nine usability problems on Moodle interfaces and a large number also identified and suggested nine improvements to the design of Moodle interfaces from their point of view. Based on the results, this research then presented recommendations to create a more useful and usable LMS.

The literature showed that Moodle LMS is used widely in various universities but it still has usability problems which need to be considered to improve users' experience of it. However, there is a lack of research which investigates users' experience with Moodle in terms of explaining features that are required by the students and whether Moodle supports them or not. Also, there is a lack of research which investigates detailed usability problems on various interfaces of Moodle, including desktop and mobile interfaces. Finally, there is a lack of research which suggests guidelines for developing a more useful and usable Moodle LMS from the perspective of users.

4. Corrections and adaptations required

Bocevska et al. (2018) made an analysis of accessibility of MOODLE according to the WCAG 2.0 Standard Compliance. They found that MOODLE does not support the following criteria for accessibility:

- Personal Preferences: Font types and sizes, Font color and background color, Navigation elements (breadcrumbs, links, table of content),
- Topic numbering to organize content numerically, Preferred content Type
- Labelled Forms with Instructions: Use of title attribute
- Timing: Session timeout alert and extension option
- Accessible Authoring: The cursor get trapped inside the editor

Primo et al. (2017) presented the results of an investigation regarding the accessibility of blind students within the virtual learning environment (VLE) Moodle. They found the following problems:

- **Content**: (1) Standards and recommendations are not followed by developers and designers; (2) Failure of principles: perception, operability, understanding and robust- ness; (3) Universal Design is not utilized; (4) Little valuation of subjects that need spatial and perception content; Lack of mediation and adequate material; (5) The inputs the user receives when navigating the real world and the stimuli within the simulation are different from the tactile sensation; Absence of equivalent contents for different media.

- **Interface**: (1) Changes of layout during the accomplishment of the tasks and the absence of descriptive texts; Obstacles encountered by the elderly, people with disabilities or little schooling; (2) Mixed content and structure requires greater cognitive effort; (3) Disorientation due to the lack of information about the context and the interface's outlook; (4) Unidentified elements generate understanding difficulties and risk of missing relevant content; Interactions with the platform that require click or tap without access code; Graphic options without a link or access code via keyboard; (5) Difficulties in working with forms control elements; Problems with questionnaires, forms and calendar; (6) Tools do not report creating perceptual problems; (7) Tools do not meet collaborative learning and interactivity. Some modalities were available. There is no clear information on which features are available even though they emphasize the use multimedia systems. Lack of communication and collaboration tools - forums, chats, and wikis; Do not exploit the potential of web 2.0; Need for improvements in Moodle related to adapting and changing synchronous and asynchronous accessible tools.

- Navigation: (1) Contents elaborated in incorrect sequence that does not allow reading HTML codes by screen readers; (2) No mapping of the screen with localization descrip- tion; (3) Disorientation in navigation.

Armano et al (2018) study on the accessibility of Moodle by visually impaired users, with a focus on mathematical content, identified the following errors:

- E1: Headings are not tagged correctly. In this case, the contents of the page can not be browsed with the specific commands of the screen reader;
- E2: A pop-up window opens without warning the user;
- E3: The control is unlabeled. In this case, the screen reader recognizes the control, but it can not be searched within the page by the specific commands of the screen reader. Moreover, when the screen reader encounter it, no description of the control is provided by the screen reader;
- E4: The mathematical content is not read correctly by a screen reader; Specifically, the screen reader reads an alphanumeric sequence that does not provide any information about the meaning of the mathematical content; Notice that all the mathematical content is generated only through the Moodle math editor.
- E5: Plain-text content is not read correctly by a screen reader;
- E6: Refreshable braille display does not display correctly plain text content;
- E7: Refreshable braille display does not display correctly mathematical content;
- E8: The control is not recognized by the screen reader. In this case, the user is not able to use the control;
- E9: User is not advised that the task is finished. For instance, the screen reader can not be able to warn the user when the upload or download of a file is accomplished;
- E10: The table is so big the user cannot understand its overall structure;
- E11: The controls in the page structure are in the wrong order, making the completion of the task difficult;
- E12: Page refreshes without warning the user;
- E13: The controls present a tree-like structure which is difficult to understand.

Based on the results of the evaluation described above, Armano et al (2018) elaborated a set of recommendations in order to improve the accessibility of Moodle and reduce the possible problems of a visually impaired user:

- To overcome errors E1, E3 and E8, one should carefully check all the headings and controls of Moodle and ensure they are all tagged and labeled correctly. Since screen readers use headings and tags to make visually impaired users understand the structure of a page, solving these problems appears a major step towards the full accessibility of Moodle;
- To overcome errors E2, E9 and E12, Moodle should tell the users via a voice command that a pop-up window just opened, that a given task (such as uploading a document) is finished, or that the page has just refreshed;
- Errors E5 and E6 are connected, since the braille display is developed in connection with the screen reader. Although rare (they only occurred in two tasks, see Table 5 and Table 6), these problems can be very difficult for a visually impaired user to overcome. To solve them, one should carefully check the text of the tag of the items involved in the task;
- As in the previous observation, errors E4 and E7 are connected, and they come from the problems with the Moodle text editor with mathematical content addressed in Sect. 3.3. A possible solution to these problems, as far as we know, appears to spread the use of the LaTeX language to the visually impaired users dealing with mathematical content. The learning of LaTeX for visually impaired users (including blind users), has proved to be reasonably achievable.We are well aware of the existence of various LaTeX or MathML to Nemeth converters, however there is not a single standard Braille for mathematics, for instance Nemeth is used mostly in English native-speaking countries. Moreover, it appears more natural to find a solution involving the LaTeX language in this specific context, since Moodle's formulae editor is LaTeX based;
- Error E10 is a common error that can be encountered while dealing with tables. There is extensive literature addressing the accessibility of tables;
- To solve E11, the controls should be placed, in all the tasks involved with the error, in a different order. A clear example is the position of the button used to open the accessible version of the chat (`Versione accessibile') that should be placed before the button of the simple and not accessible chat (`Entra nella chat'), in order to be read immediately by the screen reader;
- To solve error E13 Moodle should simply avoid tree like structures in all the controls. For instance, this error occurred when trying to navigate the \Report" menu in the \Administration" section.

A recent research (Hasan, 2019) proposes the following two parts of usability corrections and adaptations required in Moodle:

Part One: Recommended Features
The following presents recommendations regarding features that could be supported by an LMS to make it more useful from the viewpoint of students:

1. Downloading materials and learning resources to include course outlines, presentations, books and assignments.
2. Uploading assignments.
3. Permitting communication among students: e.g. allowing them to send messages to each other.
4. Displaying the material and learning resources (course outlines, presentations, books) of the courses before registration.
5. Displaying previous exam questions or information about the nature of the course exams.
6. Displaying recorded videos of lectures given by the course teachers.
7. Displaying the dates for the first, second and final exams.
8. Displaying the marks for the first, second and final exams.

9. Displaying the study plans (outlines) for all the courses.
10. Displaying a monthly evaluation for students in each course and providing comments for them regarding their progress on the course.
11. Displaying department advertisements, news and university news.
12. Providing the user with feedback after carrying out any action during his/her interaction with the system.
13. Allowing the students to provide suggestions, comments or feedback.
14. Allowing the students to make changes to an uploaded assignment such as update/ delete.
15. Sending an alert (e.g. a message to the students' mobiles or emails) when a teacher uploads new material or an assignment.
16. Sending a reminder to students regarding submitting a required assignment or material before the deadline.
17. Supplying support and help to students.

Part Two: Recommended Design Characteristics
The following presents recommendations for design characteristics to be considered while developing an LMS to make it more usable from the viewpoint of students:
1. Making the language of the interfaces consistent.
2. Making the Moodle link on the home page of the university obvious.
3. Making the location of the login links on the home page of Moodle obvious.
4. Making the content of the home page appropriate.
5. Adding links on Moodle pages to the registration page or to the home page of the university.
6. Displaying, on the navigation menu, the courses by their names and not by their numbers.
7. Not displaying the titles of all courses in all faculties; a student should be able to display his/her registered courses only.
8. Making it easier to submit an assignment.
9. Making the location of the internal search function appropriate.
10. Changing the interface to support the Arabic language.
11. Improving the design of Moodle's pages.
12. Changing the colours of the design, such as using the blue colour.
13. Changing the font size used for the website (increasing the font size).
14. Changing the design so that the size of the pages would be adjusted automatically according to the size of the mobile screen (free screen size).
15. Making the link to open Moodle more visible: e.g. placing the link at the top of the home page and using a larger font size.
16. Improving the speed of downloading Moodle's pages.
17. Adding a link to the library system.
18. Making Moodle easier to use.

We have found the following Moodle accessibility issues/problems:

1. ALT text missing for Course Image in all course listings

   The course image does not have an ALT text tag.

2. Activity completion manual checkboxes have no focus indicator

   When tabbing through the links on a course page, the manual completion check boxes for activities have no visual focus indicator when tabbing through the page using a keyboard. This can feel like a keyboard trap as the focus disappears from view.

3. Insufficient colour contrast for skip links

Insufficient colour contrast errors are indicated for the skip links. This seems to happen because skip links have a transparent background. So perhaps setting the skip links background to white will fix this issue.

4. Insufficient target sizes for clickable icons

The pointer target sizes for the icons in the header do not have a target area of at least 44 x 44 pixels.

5. Atto HTML tags should comply with HTML5 specifications

The Atto editor does not create accessible, or even consistent, HTML5 content code in all web browsers. When used in Chrome, the dominant web browser in the world these days, the HTML code it produces is seriously non-compliant with WCAG 2.0/2.1 level AA.

6. Contrast of icons in toolbars does not meet WCAG AA

The icons style guide has only one color specified for icons in order to fit in with both light and dark themes. This does not provide enough contrast against either a black or white background to meet the accessibility requirements.

7. Navigation block items not read as links or expandable to screen readers

In the Navigation block, many of the items are not read as links by a screen reader. Also, expandable items such as "My Profile" are not read as expanded/collapsed by a screen reader.

8. Colors in fontcolor plugin for Atto HTML editor lack sufficient color contrast

Font colors in the fontcolor plugin for the Atto HTML editor lack sufficient color contrast with the default background color.

9. User cannot add necessary accessibility attributes to make the default video player accessible

There is no way for a teacher to add the following information:

- Time-Based Media – There is no text alternative provided to describe the video.
- Transcript – There is no descriptive text transcript provided for the content of the video.
- Captions – There are no synchronized text captions provided for the content of the video.
- Audio-description – There is no audio-description provided for the purely visual content of the video.

10. Question feedback in the quiz not linked to the answer field

Quiz feedback on any given question relies heavily on visual positioning in the interface and is not linked with the text field itself, making that much more difficult for non-sighted users to see whether or not they failed the question.

11. Accessibility issue with drag and drop components

The drag and drop components in quizzes are not screen reader accessible. The controls are not recognized as interactive by screen readers and keyboard interaction is not available.

12. Embedded YouTube videos do not have Closed Captioning capability when using VideoJS as player

YouTube videos, when added via the Atto editor Media icon, do not allow for Closed Captioning text to be displayed. This occurs when VideoJS is selected as the YouTube video player.

13. Lesson is not completely accessible

The screen reader skips the page content set for essay questions.

14. Messaging and Notifications contain links with empty href

The notifications button, messaging button and many navigation links within the messaging drawer contain href="#" because they execute javascript when they are clicked, but it is wanted for them to look "clickable" (mouse cursor etc).

15. When using a screen reader and reaching end of the page it confuses the end user on what to do next

The jump to dropdown and navigation elements confuse Jaws screen reader and makes the course navigation extremely difficult.

16. Forms library does not generate accessible forms

Forms generated by Moodle's forms library do not currently meet WCAG 2.1 Level AA.

17. Message Preferences page is not accessible

The message preferences page, found at "Site Administration > Preferences > User Account > Message Preferences", is not accessible in many ways:

- Even someone who can see, cannot read the rest of the page because a popup automatically appears over half the page.
- The appearance and the way that the page works is unexpected and disorienting. This works so differently than 99.999% of all the pages in Moodle.

- For most people, if they have never seen messages overview before, they will not even know what that is or what to do with it. They will likely just leave the page but may not be able to do so because the popup is covering almost everything.
- The "<" arrow is misleading. It is expected something like this to expand the popup window.
- If someone uses keyboard navigation, some of the links on the page are under the popup window.
- On anything larger than a mobile screen, the "X" to close the window is missing.
- If someone do manage to close the popup window, he/she will discover an "H2" on the page with no content.
- If Messaging System is disabled on the Moodle site, this preference page also results in an "H2" with no additional content.
- On wider screens, users of screen magnifier will never even notice the popup, because there is no indicator that a popup showed up all the way at the other end of the screen.

18. Atto produces invalid nested ordered (OL) lists

Nested lists should be inside an "<li>" element of the list in which it is nested. At the moment, embedded "<ol>" tags appear at the same level as the "<li>" tags instead of inside.

19. Atto produces invalid nested unordered (UL) lists

Nested lists should be inside an "<li>" element of the list in which it is nested. At the moment, embedded "<ul>" tags appear at the same level as the "<li>" tags instead of inside.

20. Too easy to forget to add alt to images dropped or pasted into Atto HTML editor

For accessibility, significant images should have a meaningful alt = "..." attribute, and decorative images should have alt = "".

If someone drags and drops an image into Atto, then it is created with no alt, but it is not clear to the casual editor that something is missing.

21. Fix enhanced select dropdown accessibility issues

Forms generated by Moodle's forms library do not currently meet WCAG 2.1 Level AA. Here is a list of issues that can be identified:

- The handling of errors in all Moodle forms do not currently addresses accessibility requirements as described under WCAG 2.1 Success Criteria 3.3.1: Error identification.
- The error messages are in a small font and fail colour contrast ratio requirements.

- The font of error messages is small and its colour fails colour contrast ratio requirements which is a problem for people who are affected by colour blindness.
- Required fields are not identified when listening to the form with a screen reader.
- When the form contains errors, a screen reader may or may not read the same error message or any error message at all, depending on the type of field.
- Many of the icons fail minimum colour contrast ratio accessibility requirements.

22. Accessibility issues with 'clear my choice' feature in multiple choice questions

Currently, the 'clear my choice' feature in multiple choice questions functions by adding a visually hidden radio button to each question's radio group. This hidden radio button is checked by default, and the moment the student makes a selection, a 'clear my choice' button (that was previously visually hidden) becomes visible. This approach causes the following accessibility issues:

- The radio button is visually hidden, but since it's the selected one in the group by default, it's also in the tab order.
- The radio button is not labeled, which means that to a screen reader user it appears as if there is an extra possible answer to the question that just happens to lack a proper description.

23. Accessibility of result on Choice and Feedback

When navigating the submission results with a screenreader (e.g.: "Voice Over") you cannot at first enter the accessible alternative to the chart. If you select "see chart data" and then try get your screenreader to read it (either with tab or a read-all command), it skips to the left set of blocks. You can (eventually) get into the content by doing a series of non-intuitive tabbing back manoeuvres, but this is really fair to expect users to figure out.

24. Quiz navigation buttons use part of btn-secondary styles, can disappear

The quiz navigation buttons in the side bar will become invisible if you change the btn-secondary color to be white (which would generally be a side effect of turning the button color itself darker to the point that dark text no longer works on it).

25. My course overview pagination not accessible

Course overview block generates links with unreadable text. All these links should have understandable descriptions.

26. Quiz Module and resource/activity Accessibility issues

According to test made against WCAG accessibility guidelines, it appears Quiz Module and generally resource/acridity Boost theme pages, appears with accessibility issues: headers are not used in the expected hierarchical order.

27. Participants page bulk action checkboxes do not have labels

The "select user" checkboxes in the participants page do not have labels, this makes them hard to target with behat and would be bad for accessibility.

28. Word count option in Assignment has an empty label that confuses screenreaders

The Word count option in Assignment has an empty label, which can be confusing for screenreader users.

29. Indicate current repository for screenreaders

When switching between file repositories the class ".active" is added to the current on and a gray background is added, but no screen reader accessible method is used to indicate this status. Possibly the alt text on the icon could be changed to indicated which is active.

30. On file picker Add.., Create Folder and Download all buttons should be aria-labelled

The buttons on the top of the file picker are "<a>" tags with "role=button". They contain images with appropriate alt tags but for better accessibility aria-labels on the button links themselves could be added.

31. Add empty alt text to preview image in file picker

After choosing a file from a repository, the confirm dialog displayed shows either an icon or a thumbnail of the image. This should have an empty alt text added to prevent the file "src" being read out by screenreaders.

32. Participant list checkbox for bulk actions not labelled for accessibility

When viewing the participants list for a course, in either of the two view modes ("brief" or "user details") the checkbox for bulk user actions has no label on it. Even for users not relying on accessibility tools it may not be obvious what this checkbox is for and a hover title of "Select <User Name> for bulk action" or similar might be handy and the same text could be used as an aria-label.

33. Quiz - images describing the question type are not announced for screen reader users

The images used to provide context about the type of question, like multiple choice or essay, contain both a role of presentation and alt attributes. When a role of presentation is used with the

alt attribute, it negates the alt attribute, meaning the alternative text will not be read by a screen reader.

34. Notification Preferences page is not accessible

When tabbing between elements in the notifications page, the notification title and body are not read out.

References

Al-Sarrayrih H. S., Knipping L., & Zorn E. (2010). "Evaluation of a Moodle based learning management system applied at Berlin institute of technology based on Iso-9126", in the Proceedings of ICL 2010 Conference Hasselt Belgium, 880-887.Alternatively, Baytiyeh (2013)

Armano, T., Borsero, M., Capietto, A., Murru, N., Panzarea, A., & Ruighi, A. (2018). On the accessibility of Moodle 2 by visually impaired users, with a focus on mathematical content. Universal Access in the Information Society, 17(4), 865-874.

Batanero, C., de-Marcos, L., Holvikivi, J., Hilera, J. R., & Otón, S. (2019). Effects of new supportive technologies for blind and deaf engineering students in online learning. IEEE Transactions on Education, 62(4), 270-277.

Bocevska, A., Savoska, S., Ristevski, B., & Tabakovska-Blazheska, N. (2018). Analysis of Accessibility of the e-Learning Platforms According to the WCAG 2.0 Standard Compliance. International Conference on Applied Internet and Information Technologies. DOI:10.20544/AIIT2018.P06

Hasan L., Morris A., and Probets S. (2012). "A comparison of usability evaluation methods for evaluating e-commerce websites", Behaviour & Information Technology, 31(7), 707-737.

Hasan, L. (2019). The Usefulness and Usability of Moodle LMS as Employed by Zarqa University in Jordan. JISTEM-Journal of Information Systems and Technology Management, 16.

Ivanc D., Vasiu R., & Onita M. (2012). "Usability evaluation of a LMS mobile web interface", in the Proceedings of the 18th International Conference, ICIST 2012, Kaunas, Lithuania, September 13-14, 2012, 348-361.

Ivanc D., Vasiu R., & Onita M. (2012). "Usability evaluation of a LMS mobile web interface", in the Proceedings of the 18th International Conference, ICIST 2012, Kaunas, Lithuania, September 13-14, 2012, 348-361.

Ivanović Mi., Putnik Z., Komlenov Ž, Welzer T., Hölbl M, & Schweighofer T. (2013). "Usability and privacy aspects of moodle: students' and teachers' perspective", Informatica, 37, 221–230.

Kakasevski G., Mihajlov M., Arsenovski S., & Chungurski S. (2008). "Evaluating usability in learning management system Moodle", in the Proceedings of the ITI 2008 30th Int. Conf. on Information Technology Interfaces, June 23-26, Cavtat, Croatia.

Kita, T., Nagaoka, C., Hiraoka, N., & Dougiamas, M. (2019, October). Implementation of Voice User Interfaces to Enhance Users' Activities on Moodle. In 2019 4th International Conference on Information Technology (InCIT) (pp. 104-107). IEEE.

Martin L., Martínez D. R., Revilla O., José M., Santos O. C., & Boticario, J. G. (2008). "Usability in e-learning platforms: heuristics comparison between Moodle S akai and dotLRN", in the Proceedings of International Conference and Workshops on Community based environment.

Melton, J. (2006). "The LMS Moodle: a usability evaluation, Languages Issue, 11/12(1), 1–24.

Minović M., Štavljanin V., Milovanović M., & Starčević D. (2008). "Usability issues of e-Learning systems: case-study for Moodle learning management system", in R. Meersman, Z. Tari, and P. Herrero (Eds.): OTM 2008 Workshops, LNCS 5333, 561–570, 2008. Springer-Verlag Berlin Heidelberg.

Moodle, <https://moodle.org/>, [accessed 10.09.2019].

Nielsen J. (2012). Usability 101: Introduction to usability. Nielsen Norman Group.com,. <https://www.nngroup.com/articles/usability-101-introduction-to-usability/ >, [accessed 7.09.2019].

Onacan M. & Erturk A. (2016). "Usability evaluation of learning management system in a higher education institution: a scale development study", Journal of Global Strategic Management, 10(2).

L. Primo, V. Ulbricht, L.M. Fadel, (2017) "Accessibility in the Virtual Learning Environment Moodle Identification of Problems' Class", In: Rocha Á., Correia A., Adeli H., Reis L., Costanzo S. (eds), Recent Advances in Information Systems and Technologies. World Conference on Information Systems and Technologies (CIST), March, 2017. Advances in Intelligent Systems and Computing, volume 570.

Rosato J., Dodds C., & Laughlin, S. (2004). "Usability of course management systems by students", Department of Computer Information Systems/ Computer Science, College of Scholastica, Duluth.

Ssekakubo G., Suleman H., & Marsden G. (2013). "Designing mobile LMS interfaces: Learners' expectations and experiences", Interactive Technology and Smart Education, 10(2), 147–167. Available at: http://www.emeraldinsight.com/doi/abs/10.1108/ITSE-12-2012-0031 [Accessed 10.9.2019].

Senol l., Gecili H. & Durdu P. (2014). "Usability evaluation of a Moodle based learning management system", in the Proceedings of EdMedia 201, Tampere, Finland, June 23-26.

Thuseethan S., Achchuthan S., & Kuhanesan S. (2014). "Usability evaluation of learning management systems in Sri Lankan universities", arXiv preprint arXiv:1412.0197