Accessibility Requirements for educational packages in dotLRN

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Abstract. dotLRN open source developers community is making a great effort to improve the user interface of this learning management system and to adapt it to the accessibility requirements proposed by the W3C Web Accessibility Initiative. This paper contributes to this task by analyzing the current accessibility status of three fundamental packages for dotLRN future: LORS, Assessment and IMS-LD and providing appropriate recommendations. These packages provide the educational standards support in the platform. More specifically, they implement SCORM, IMS-CP, IMS-QTI, IMS-LD and IMS-MD specifications.

Keywords: Accesibility, W3C, WAI, dotLRN, UAAG 1.0, WCAG 1.0, LORS, SCORM, IMS-QTI, IMS-LD, Evaluation.

1. Introduction

dotLRN[i] is an open source e-learning platform based on the OpenACS[ii] framework, which is intended for developing web based scalable applications. dotLRN is currently used by half a million users in higher education, government, non-profit, K-12, etc[iii]. Regarding its functionality, it is strongly compliant with educational standards for courses delivery (IMS-LD[iv], IMS-CP[v], IMS-MD[vi], IMS-QTI [vii] and SCORM[viii]). In particular, these standards are supported in the following dotLRN packages[ix]: LORS (IMS-CP, IMS-MD and SCORM standards), Assessment (IMS-QTI standard) and IMS-LD.

The usage of educational standards in e-learning platforms allows the reusability of contents by the authors among different courses. However, in order to provide an inclusive support for learners with disabilities, it would be desirable to deliver those contents in the appropriate way to cope with the special needs that students may have. dotLRN is currently the only learning management system that covers IMS-LD and it supports a high level of accessibility features. However, the educational packages have not already been fully included in the last accessibility review[x].

In this paper, I analyze the three educational packages provided by dotLRN (i.e. LORS, Assessment and IMS-LD) from the accessibility point of view considering the following two guidelines from the W3C Web Accessibility Initiative: the ‘Web

Content Accessibility Guidelines 1.0' (WCAG 1.0) and the 'User Agent Accessibility Guidelines 1.0' (UAAG 1.0). As a result, I provide some requirements for the improvement of these developments. These recommendations are contributed to the dotLRN open source community.

2. Analysis scope

This study does not cover the platform installation, the course creation, the course administration nor the course contents but the application usage from the learners' point of view. This analysis focuses on the structure and way of presenting the contents offered by the three educational packages: LORS, Assesments and IMS-LD.

LORS package consists on three pages, a frameset (lors.htm) which contains two other pages, one with the menu for the tree of contents defined by SCORM (lors_menu.htm) and the other which shows the course contents (lors_body.htm).

IMS-LD package consists on four pages, a frameset (IMS-LD.htm) which contains three other pages: one with the menu for the tree of contents defined by IMS-LD (imsld_tree.htm), the other which shows the course contents (imsld_activity-frame.htm) and a third frame that loads a complementary page (depending on the course at hand) that is not being analyzed here.

Assesment package consists on four pages, one with the form to present the questions (assesment.html), the page returned when the form is submitted, to show that the assessment has been submitted (assesment_return.html), the result of the answers (assesment_results.html) and the sessions log (assesment_sessions.html). Unlike LORS and IMS-LD packages, Assesment package is embedded within dotLRN user interface. For this reason, to avoid any interferences of dotLRN templates in this analysis, I have not taken into account the code surrounding the package, but just the code included in <DIV id=portal> tag, appart from the css and js related to the package.

I would like to remark that the above names for the HTML pages do not exist as such in the application. I have renamed them to identify them along the evaluation.

3. Methodology

dotLRN is a web server application, which is used by the users through web-browsers. For this reason, the analysis has to be done from the application point of view. Therefore, UAAG[xi] should be applied. Moreover, there is also content generated by dotLRN application, fully independent from the course or questionnaire at hand. This content has to be analyzed with the WCAG[xii]. Therefore, both UAAG and WCAG have been applied to analyze the accessibility of the educational packages.

In order to perform the evaluation according to the WCAG, first a automatic validation has been carried out with TAW3[xiii] validation tool. This evaluation has been complemented with an

heuristic manual revision with Opera browser. This manual validation has been done with and without javascript, and with the functionality for screen reader where it is required by the checkpoints .

Regarding the UAAG evaluation, the analysis has been done with the heuristic method, since there is not any tool that make this evaluation in a automatic way. On the other hand, the assistant tool proposed by the W3C[xiv] has been ruled out since it was not working at the time of the evaluation. Furthermore, it was not intended to adequate the study to accomplish any conformance profile since this study is a first approximation of UAAG to this packages. Once dotLRN community developers have made this packages comply with these guidelines, an official conformance profile can be achieve.

This analysis focuses just in WCAG and UAAG Priority 1 checkpoints to guide dotLRN developers in order to carry out the needed improvements to achieve conformance level A. WCAG and UAAG are complementary guidelines. Sometimes it may happen that they overlap. For instance, regarding Content Type labels “Visual Text” and “Image”, as well as in Events Label. For this reason, the analysis has been done for both, with the appropriate point of view.

4. Accessibility evaluation

This section includes the accessibility evaluation performed for LORS, Assessment and IMS-LD packages in dotLRN applying both WCAG and UAAG. A Web content development must satisfy priority 1. Otherwise, one or more groups of persons will find it impossible to access information in the document. Satisfying it is a basic requirement for some groups to be able to use Web documents.

4.1 WCAG evaluation

Next the errors detected after the evaluation according to WCAG is presented in a tabular format to facilitate the transmission of information to dotLRN community developers.

Table 1. LORS package WCAG 1.0 evaluation results

Page	Detected errors
lors.htm	2 errors, both related to 12.1 checkpoint (frames do not have a title attribute to allow the browser its identification and navigation). Moreover, although it is not specified in level 1 checkpoints, it has to be pointed out that when LORS is accessed, it takes the user to a page out of the context of the course space. This may cause disorientation in the learner.
lors_menu.htm	This page is not shown if scripts are deactivated (checkpoint 6.3), and there is not an alternative <NOSCRIPT> for this case. Consequently, checkpoint 8.1a gives an error, too.
lors_body.htm	This page shows errors if scripts are deactivated (checkpoint 6.3), and there is not an alternative <NOSCRIPT> for this case. Consequently, checkpoint 8.1a gives an error, too.

Table 2. IMS-LD package WCAG 1.0 evaluation results

Page	Detected errors
IMS-LD.htm	3 errors related to 12.1 checkpoint (frames do not have a title attribute to allow the browser its identification and navigation). As in LORS package, when IMS-LD is accessed, it takes the user to a page out of the context of the course space. This may cause disorientation in the learner.
Imsld_tree.htm	This page is shown correctly if scripts are deactivated (checkpoint 6.3), but there is not an alternative <NOSCRIPT> for this case. Consequently, checkpoint 8.1a gives an error, too.
imsld _activity-frame.htm	If javascript is deactivated, some functionality is lost. However this functionality is not fundamental for the working of the application, such as minimizing the menu frame. Moreover, there is an <iframe> tag which contains the course material. This iframe tag does not have its corresponding alternative (checkpoint 6.2). This implies that a browser that does not support iframes cannot show the course contents, i.e., the most important part of the application.

Table 3. Assessment package WCAG 1.0 evaluation results

Page	Detected errors
assesment.html	The page levels are ordered in the wrong order (checkpoint 6.1). For this reason, the user may be confused when browsing the application with style sheets deactivated.
assesment_return.html	The page is not ordered in levels (checkpoint 6.1). For this reason, the user may be confused when browsing the application with style sheets deactivated. Moreover, I suggest avoid using the BLOCKQUOTE tag.
assesment_results.html	The data tables where results are shown are not identified with headings (checkpoint 5.1). Moreover, checkpoint 5.2 is not achieved either, since there are nested tables which are not clearly identified. The page is not ordered in levels (checkpoint 6.1).
assesment_sessions.html	The page levels are ordered in the wrong order (checkpoint 6.1).

.4.2 UAAG evaluation

Next the errors detected after the evaluation according to UAAG are presented in a tabular format to facilitate the transmission of information to dotLRN community developers. If the user agent does not satisfy priority 1, one or more groups of users with disabilities will find it impossible to access the Web. Satisfying it is a basic requirement for enabling some people to access the Web. The scope for this analysis includes: a) Input modalities, b) Output modalities, c) Size and color of non-text content, d) Background image interference and e) User control of every user interface component.

The following legends have been used:

- FAILS: It does not comply with the checkpoint and provision
- PASSES: It complies with the checkpoint and provision

- N/A: This checkpoint and / or provision is not applicable for this application.
- BROWSER DEPENDANT (BD): The browser satisfies the checkpoint.

Table 4. UAAG 1.0 evaluation results for LORS, Assessment and IMS LD packages

Checkpoints	Provisions	LORS	Assmnt.	IMS-LD
1.1 Full keyboard access	Users can operate, through keyboard input alone, any user agent functionality available through the user interface.	PASSES	PASSES	PASSES
1.2 Activate event handlers	Users can activate, through keyboard input alone, all input device event handlers that are explicitly associated with the element designated by the content focus.	PASSES	PASSES	PASSES
	Users must be able to activate as a group all event handlers of the same input device event type.	N/A	N/A	N/A
1.3 Provide text messages	Every message that is a non-text element and is part of the user agent user interface has a text equivalent.	FAILS	PASSES	FAILS
2.1 Render content according to specification	Content renders according to format specification	FAILS	FAILS	FAILS
2.2 Provide text view		N/A	N/A	N/A
2.3 Render conditional content	Allow configuration to provide access to each piece of unrendered conditional content.	FAILS	PASSES	FAILS
	When a specification does not explain how to provide access to this content, do so as follows...(4a) allow the user to follow a link to C from the context of D.	PASSES	N/A	PASSES
2.4 Allow time-independent interaction		N/A	N/A	N/A
2.5 Make captions, transcripts, audio descriptions available		N/A	N/A	N/A
2.6 Respect synchronization cues		N/A	N/A	N/A
3.1 Toggle background images		N/A	N/A	N/A
3.2 Toggle audio, video, animated images		N/A	N/A	N/A
3.3 Toggle animated or blinking text		N/A	N/A	N/A
3.4 Toggle scripts		N/A	N/A	N/A
3.5 Toggle automatic content retrieval	The user agent only retrieves content on explicit user request.	PASSES	PASSES	PASSES

Checkpoints	Provisions	LORS	Assmnt.	IMS-LD
4.1 Configure text scale	Allow global configuration of the scale of visually rendered text content. Preserve distinctions in the size of rendered text as the user increases or decreases the scale.	BD	PASSES	BD
	Provide a configuration option to override rendered text sizes specified by the author or user agent defaults.	BD	N/A	BD
	Offer a range of text sizes to the user (...)	BD	N/A	BD
4.2 Configure font family	Allow global configuration of the font family of all visually rendered text content.	BD	BD	BD
	Provide a configuration option to override font families specified by the author or by user agent defaults.	BD	BD	BD
	Offer a range of font families to the user ...	BD	BD	BD
4.3 Configure text colors	Allow global configuration of the foreground and background color of all visually rendered text content.	BD	BD	BD
	Provide a configuration option to override foreground and background colors specified by the author or user agent defaults.	BD	BD	BD
	Offer a range of colors to the user...	BD	BD	BD
4.4 Slow multimedia		N/A	N/A	N/A
4.5 Start, stop, pause, and navigate multimedia		N/A	N/A	N/A
4.6 Do not obscure captions		N/A	N/A	N/A
4.7 Global volume control		N/A	N/A	N/A
4.8 Independent volume control		N/A	N/A	N/A
4.9 Configure synthesized speech rate		BD	BD	BD
4.10 Configure synthesized speech volume		BD	BD	BD
4.11 Configure synthesized speech characteristics		BD	BD	BD
4.14 Choose style sheets	Allow the user to choose from and apply alternative author style sheets.	BD	BD	BD
	Allow the user to choose from and apply at least one user style sheet.	BD	BD	BD
	Allow the user to turn off author and user style sheets.	BD	BD	BD
6.1 Programmatic access to HTML/XML infoset		N/A	N/A	N/A
6.2 DOM access to HTML/XML content		N/A	N/A	N/A
6.3 Programmatic access to non-HTML/XML content		N/A	N/A	N/A
6.4 Programmatic access to information about rendered content		B/D	B/D	B/D
6.5 Programmatic operation of user agent user interface		B/D	B/D	B/D
6.6 Programmatic notification of changes		B/D	B/D	B/D
6.7 Conventional keyboard APIs		PASSES	PASSES	PASSES
6.8 API character encodings		PASSES	PASSES	PASSES
7.1 Respect focus and selection conventions		PASSES	PASSES	PASSES
7.2 Respect input configuration conventions		PASSES	PASSES	PASSES

Checkpoints	Provisions	LORS	Assmnt.	IMS-LD
8.1 Implement accessibility features		FAILS	FAILS	FAILS
9.1 Provide content focus	Provide at least one content focus for each viewport (including frames) where enabled elements are part of the rendered content.	PASSES	PASSES	PASSES
	Allow the user to make the content focus of each viewport the current focus.	PASSES	PASSES	PASSES
9.2 Provide user interface focus		PASSES	PASSES	PASSES
9.3 Move content focus	Allow the user to move the content focus to any enabled element in the viewport.	PASSES	PASSES	PASSES
	Allow configuration so that the content focus of a viewport only changes on explicit user request.	PASSES	PASSES	PASSES
	If the author has not specified a navigation order...	N/A	N/A	N/A
9.4 Restore viewport state history	For user agents that implement a viewport history mechanism, for each state in a viewport's browsing history, maintain information about the point of regard, content focus, and selection.	B/D	B/D	B/D
	When the user returns to any state in the viewport history (e.g., via the "back button"), restore the saved values for the point of regard, content focus, and selection.	FAILS	FAILS	FAILS
10.1 Associate table cells and headers	For graphical user agents that render tables, for each table cell, allow the user to view associated header information.	N/A	FAILS	N/A

Checkpoints	Provisions	LORS	Assmnt.	IMS-LD
10.2 Highlight selection, content focus, enabled elements, visited links	Allow global configuration to highlight the following four classes of information in each viewport: the selection, content focus, enabled elements, and recently visited links.	B/D	B/D	B/D
	For graphical user interfaces, allow at least one configuration where the highlight mechanisms for the four classes of information: differ from each other, and do not rely on rendered text foreground and background colors alone.	B/D	B/D	B/D
	For graphical user interfacesif a highlight mechanism involves text size, font family, rendered text foreground and background colors, or text decorations, offer at least the following range of values...	B/D	B/D	B/D
	4. Highlight enabled elements according to the granularity specified in the format.	B/D	B/D	B/D
10.6 Highlight current viewport	Highlight the viewport with the current focus (including any frame that takes current focus).	PASSES	PASSES	PASSES
	For graphical viewports, as part of satisfying provision one of this checkpoint, provide at least one highlight mechanism that does not rely on rendered text foreground and background colors alone	PASSES	PASSES	PASSES
	If the techniques used to satisfy provision one of this checkpoint involve rendered text size, font family, rendered text foreground and background colors, or text decorations, allow global configuration and offer same ranges of values required by provision three of checkpoint 10.2.	FAILS	FAILS	FAILS
11.1 Provide information to the user about current user preferences for input configurations.		N/A	N/A	N/A
12.1 Provide accessible documentation (level Double-A WCAG 1.0)		FAILS	FAILS	FAILS
12.2 Provide documentation of accessibility features		FAILS	FAILS	FAILS
12.3 Provide documentation of default bindings		N/A	N/A	N/A

The following table summarizes the above results.

Table 5. Summary of checkpoint status for the educational packages

	LORS	ASSESMENTS	IMS-LD
FAILS	8	7	8
PASSES	15	17	15
BD	23	20	23
N/A	21	23	21

5. Conclusions and recommendations to dotLRN community

This paper presents the accessibility evaluation performed for LORS, Assessment and IMS-LD packages in dotLRN applying both WCAG and UAAG. The analysis performed intends to help dotLRN community produce software that is expected to be more flexible, manageable, extensible, and beneficial to all users.

In my opinion, future developments should be focused on those areas that require more accessibility improvements in each package, which are as follows for each of the guidelines analyzed in this paper:

WCAG 1.0

- LORS
    - Promote the independence of javascript code
    - Platform integration
    - Small changes in code
- ASSESSMENT
    - Improve session data rendering. This improvement implies a deep code change.
- IMS-LD
    - Promote the independence of javascript code
    - Platform integration
    - Small changes in code

UAAG 1.0

The following graphics summarize the accessibility evaluation performed. Data are obtained from Table 5.

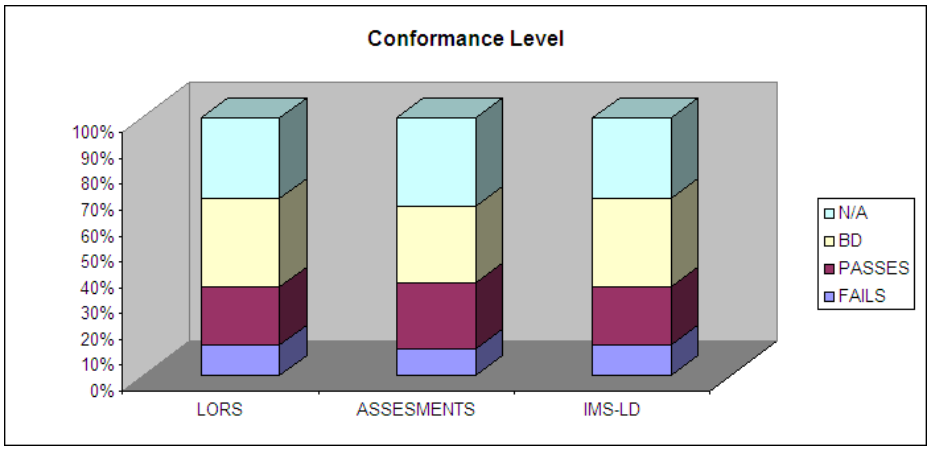

Figure 1. Conformance level.

Figure 1 shows that the 3 packages have provided similar results for UAAG evaluation. This implies that the design made follows the same approach regarding accessibility in the 3 packages.

Figures 2, 3 and 4 shows that, as far as dotLRN is a web-server application and the user interacts with it through a web browser, it counts on the browsers for many accessibility features. This does not mean a failure in the accessibility compliance, but a benefit derived from being a web-based application. Each figure corresponds to each educational package analized.

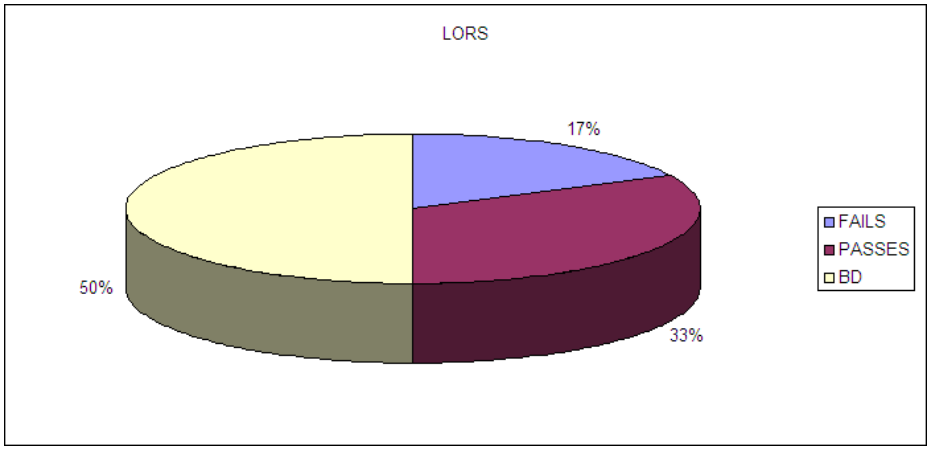

Figure 2. LORS package results

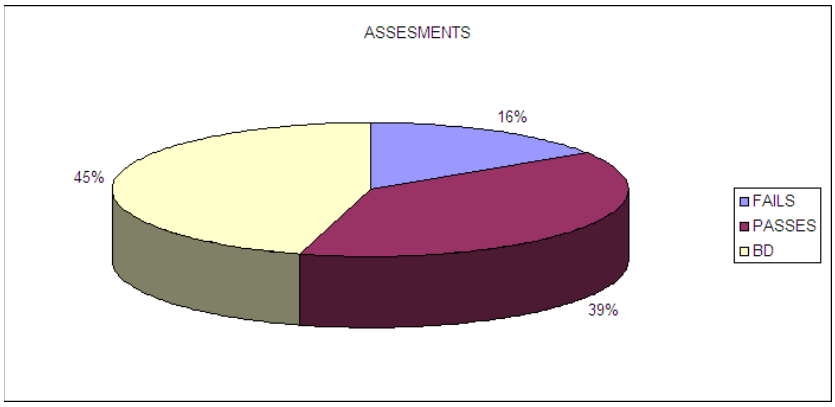

Figure 3. Assessment package results

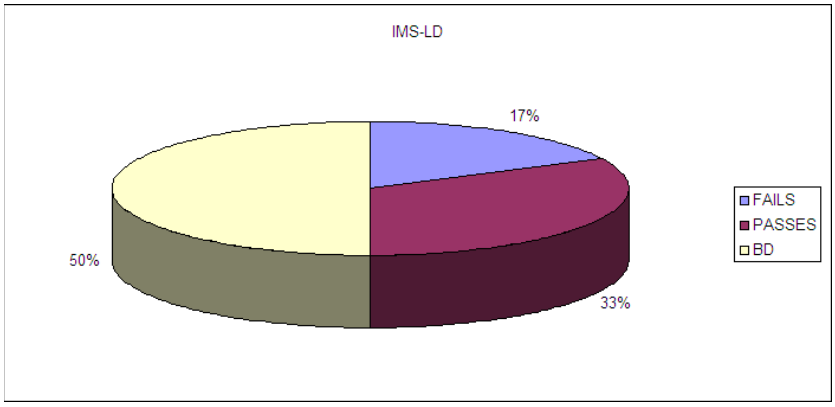

Figure 4. IMS-LD package results

Data for optimism

The percentage of features that pass checkpoints is very high in the three packages (around 75% considering both browser dependent and passed), which demonstrates a remarkable developing effort from dotLRN community. Nevertheless, I would suggest continuing working on the checkpoints to reach a W3C WAI level A of accessibility for the packages analyzed.

6. References

See footnotes at the end of the paper.

i. Known as **.LRN:** http://dotlrn.org
ii. Open Architecture Community System: http://openacs.org
iii. dotLRN users: http://dotlrn.org/users/
iv. Instructional Management Systems – Learning Design: http://www.imsglobal.org/learningdesign
v. Instructional Management Systems – Content Packaging: http://www.imsglobal.org/content/packaging
vi. Instructional Management Systems – Metadata: http://www.imsglobal.org/metadata
vii. Instructional Management Systems – Question & Test Interoperability: http://www.imsglobal.org/question
viii. Sharable Content Object Reference Model: http://www.adlnet.gov/scorm/index.cfm
ix. Educational standard support in dotLRN: http://openacs.org/xowiki/Educational_Standards
x. Accessibility status in dotLRN: http://openacs.org/xowiki/Accessibility
xi. The User Agent Accessibility Guidelines (UAAG) documents explain how to make user agents accessible to people with disabilities, particularly to increase accessibility to Web content. User agents include Web browsers, media players, and assistive technologies, which are software that some people with disabilities use in interacting with computers. User Agent Accessibility Guidelines Overview http://www.w3.org/WAI/intro/uaag.php
xii. Web "content" generally refers to the information in a Web page or Web application, including text, images, forms, sounds, and such. Web Content Accessibility Guidelines Overview http://www.w3.org/WAI/intro/wcag.php
xiii. TAW (Web Accessibility Test) is a tool for the analysis of Web sites, based on the W3C - Web Content Accessibility Guidelines 1.0 (WCAG 1.0) http://www.tawdis.net/taw3/cms/es
xiv. UAAG 1.0 Evaluation Form Generator http://www.w3.org/WAI/UA/2002/08/eval