An empirical WCAG 2.0 guidelines evaluation applied to journal management software

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Abstract: Web Accessibility has become a main concern of building websites that are accessible by all people regardless of their ability or disability. The W3C Web Accessibility Initiative (WAI) has been established to raise awareness of universal access. WAI develops guidelines which can help to ensure that Web pages are widely accessible. This article exposes an approach to determine the Web Accessibility evaluation applied to an e-journal open system, using an automatic validator following the WCAG 2.0 guidelines. The results obtained allow modifying the software in order to increase accessibility on e-journal platforms that are provided by institutes. Results show accessibility errors on the software evaluate. Finally, some considerations are presented.
Keywords: WAI, WCAG 2.0 guidelines, evaluation, W3C, Web Quality, e-journal.

1. Introduction

The advance of ICT in knowledge society can be appreciated in a range of synchronous and asynchronous tools in order to disseminate, communicate and facilitate the interaction between people without spatial-temporal restrictions.

In the this society, and especially in academic-scientific fields, an area of relevance is the e-journal. Electronic journal is one of the products of information and communication technologies (ICT). They provide easy access to a journal and thereby save time. Keyword search ability, accessibility at the time of publication, etc., are some of the features of e-journals [1].

The current work is part of a research which focuses on the investigation of methods and tools to evaluate quality systems, being the main issue the accessibility.

The aim of this paper is to check if open journal CMS are WCAG 2.0 accessible. Web accessibility guidelines are presented in section two, the method followed in this work is exposed in section three. Section four outlined the results obtain evaluating web accessibility of some open journals. Finally the necessity of web accessibility and conclusions the are presented.

1.1 Web Accessibility

Accessibility standards also have an important role in web site designs [2]. So, the application of standards in the design and development of web sites is a way to address innovative technological projects for its scalability. Some accessibility guidelines/standards are ISO 9241-171 [3], ISO 9241-20 [4], ISO 9241- 151 [5], among others. With respect to those proposed by the W3C Consortium are mentioned: WCAG 1.0, WCAG 2.0, WAI-ARIA, among others. UNE 139803:2012 is standard equivalent to the WCAG 2.0 guidelines [6]

The W3C Consortium presented the Web Content Accessibility Guidelines (WCAG), that can help to guide designers in building an accessible web page. This guides provides checkpoints in order to assist the web designers in which specific area an aid should be applied [7].

The accessibility level resulting from the evaluation being [8]:
- Level A (lowest): The web page satisfies all the Level A Success Criteria, or conformance to an alternate version is provided.
- Level AA (medium): The web page satisfies all the Level A and Level AA Success Criteria, OR Level AA alternate version is provided
- Level AAA (highest): The web page satisfies all the Level A, Level AA and Level AAA Success Criteria, or a Level AAA alternate version is provided

WCAG 2.0 added other principles about web content accessibility: Perceivable, Operable, Understandable and Robust. Following [9].
- Perceivable – are alternatives for images and videos provided?
- Operable – can the site be used with keyboard?
- Understandable – are forms labelled and error messages usable?

- Robust – are user interface controls designed for compatibility with screen readers?

1.2 Free software to build e-journals
Journal management software is used in order to publish. Some functionalities are:
- Online submission and management of all content.
- Subscription module with delayed open access options.
- Comprehensive indexing of content part of global system.
- Reading Tools for content, based on field and editors' choice.
- Email notification and commenting ability for readers.
- Complete context-sensitive online Help support.

Journal management software, as other Content Management System or CMS, are product of Software Engineering,
In Software Engineering tools and methods are discussed. The main advantages of using open source software by companies are summary in [10]. They mentioned as relevant: free license, low cost maintenance, support community; the possibility to share and use them for various purposes, access to source code and permission to study and amendment, ability to adapt to the real needs of each organization, constant updating of versions through the contribution of the community that supports it, possibility to try the software without any cost and ease of access to the specific open source repositories to download

This works focused the emphasis on evaluating software oriented to build free e-journals [11] software platform. "Free software" means software that respects users' freedom and community. Roughly, it means that the users have the freedom to run, copy, distribute, study, change and improve the software. A program is free software if the program's users have the four essential freedoms [12]:
- The freedoms to run the program, for any purpose (freedom 0).
- The freedom to study how the program works and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

The free and open-source software includes a set of software products that have in common that they share licenses, include the distribution of the source code and the ability to modify it to suit or better [13].
Nowadays, in societies where knowledge has become a relevant topic, many agencies around the world such as Sidar Foundation [14], World Wide Web Consortium (W3C) [15], International Organization for Standardization among others, have focused on determining how technology, and Information and Communication Technologies (ICT) benefit and help humans improve their life quality.
As mentioned previously, the aim of Web Accessibility Initiative [16, 17] is to define guidelines and facilitate the access to the web content to those who suffer from any kind of disability. Also, Web Accessibility (WA) is a quality criterion in Software Engineering [18, 19].
With the purpose of contributing to the inclusion of disable people with permanent or temporary incapacities, who access the Internet either to use it or to disseminate knowledge, the application of guidelines must be proposed.
The current work is part of a research which focuses on the investigation of methods and tools to evaluate quality systems, being the main issue the accessibility web. It is important to mention the background as presented in [20, 21, 22, 23, 24]. This paper focused on open system accessibility evaluation.

2.   Method
The applied method followed the stages below [24]:
- Stage 1. Projects developed by other areas of the country and the studies mentioned by [19, 23] were surveyed.
- Stage 2. The theoretical framework referred to the subject was studied, using documents and tools provided by the W3C as data sources.
- Stage 3. A software product oriented to build Open Journal Systems [25] was selected.
- Stage 4. Criteria established by the WCAG 2.0 guidelines [26] were defined, using Google Chrome as browser. The hardware configuration used was: Intel (R) Pentium (R) CPU 2020M@2.40 GHz, 4.00 GB RAM, System Type: 64-bit operating system.

- Stage 5. Web accessibility evaluation tools are software programs or online services that help determine if web content meets accessibility standards [27]. Many tools to evaluate the web page accessibility have been designed. TAW [28] is used to examine the pages for the conformance with accessibility standards WCAG 2.0. It is an an automatic validator available on the web.
- Stage 6. Systematization and analysis of data. The results provided by the automatic validator were systematized, in order to analyze the current art state of the application of accessibility, and propose and elaborate further studies from the obtained results.

3. Results

As mentionedin previous studies [20, 21, 22, 23, 24]. it is evident that the measurementof accessibility web in adaptable software productsis a topic ofcurrent interestandrelevance,considering thevalidity of theseregulations topromote a better qualityof technologiesforhuman's use.

The implementation of WA international standards is transmited, in order to improve the quality of access to information.

As mentioned in [15, 16, 29]WCAG 2.0 consists of several layers of guidance, including principles, guidelines, success criteria, and sufficient and advisory techniques. The four principles that provide the foundation for Web accessibility are: Perceivable, Operable, Understandable, and Robust. Under the principles are guidelines, and for each of which areprovided testable success criteria. Also, three levels of conformance are defined: A (lowest), AA (medium), AAA (highest).

In this paper, the evaluation of the accessibility criteria is presented in terms of the principles, criteria and accessibility level (A, AA, AAA) conforming to the Web Content Accessibility Guidelines WCAG 2.0.

A. Perceivable - Information and user interface components must be presentable to users in ways they can perceive:
- Text Alternatives: Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language;
- Time-based Media: Provide alternatives for time-based media;
- Adaptable: Create content that can be presented in different ways (for example simpler layout) without losing information or structure;
- Distinguishable: Make it easier for users to see and hear content including separating foreground from background.

B. OPERABLE: User interface components and navigation must be operable:
- Keyboard Accessible: Make all functionality available from a keyboard;
- Enough Time: Provide users enough time to read and use content;
- Seizures: Do not design content in a way that is known to cause seizures;
- Navigable: Provide ways to help users navigate, find content, and determine where they are.

C. Understandable - Information and the operation of user interface must be understandable:
- Readable: Make text content readable and understandable;
- Predictable: Make Web pages appear and operate in predictable ways;
- Input Assistance: Help users avoid and correct mistakes.

D. Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies:
- Compatible: Maximize compatibility with current and future user agents, including assistive technologies.

Web accessibility tools generate evaluation reports that are designed to help locate errors and give warnings in order to design an accessible website [7]. Table 1 shows a summary of the problems - grouped byprinciples- found through the implementation of the WCAG 2.0 guidelines applied to web site. TheSearchpageseems to presentthe biggest problems inall principles. Figure 1 illustrates the percentages of problems classified by pages.

Table 1: Summary of the problems grouped by WCAG 2.0 principles

Page	Problems			
	Perceivable	**Operable**	**Understandable**	**Robust**
Home	0	0	1	1
About	0	0	1	0
Login	2	0	1	0
Register	0	0	1	0
Search	12	0	7	16
Current	0	0	1	0
Archive	0	0	1	0
Announcement	0	0	1	0
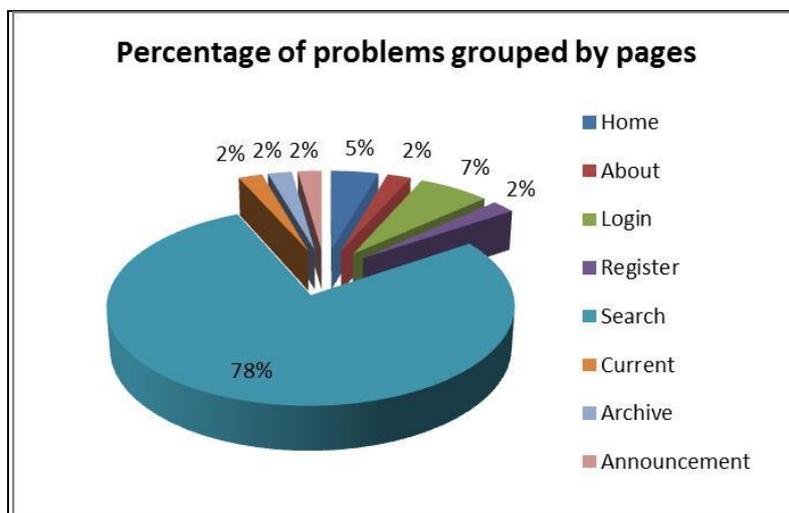
Figure 1. Percentage of problems classified by pages

Table 2 shows the accessibility issues automatically detected in the website. The column Techniques presents the relevant technical error detected accessibility.The techniques are informative and fall into two categories: those that are sufficient for meeting the success criteria and those that are advisory [26]. The column Problems reports the amount of incidents detected for each type of WA problems.

Figure 2 illustrated the percentage of problems classified by principles. The analysis ofthe resultsof accessibility evaluation provides the following information:
- The first principle, Perceivable, represents 31% of errors.
- For thesecond principle, Operable, the analysed web pages don't display errors.
- As regards thethird principle Understandable, corresponds 31% of detected problems.
- For theprinciple Robust, 38% problems were detected.

Figure 3 illustrated the percentage of problems classified by Techniques.

Table 2: Desription of the problems belonged to WCAG 2.0 principles

Page	Principle	Guideline	Success Criteria	Techniques	Problems
Home	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1
About	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1
Login	Perceivable	Adaptable	Info and Relationships	H71: Providing a description for groups of form controls using fieldset and legend elements	2
	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1

Register	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1
Search	Perceivable	Text Alternatives	Non-text Content	H44: Using label elements to associate text labels with form controls; H65: Using the title attribute to identify form controls when the label element cannot be used	6
	Perceivable	Adaptable	Info and Relationships	H44: Using label elements to associate text labels with form controls; H65: Using the title attribute to identify form controls when the label element cannot be used	6
	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1
	Understandable	Input Assistance	LabelsorInstructions	H44: Using label elements to associate text labels with form controls; H65: Using the title attribute to identify form controls when the label element cannot be used	6
	Robust	Compatible	Parsing	G134: Validating Web pages	10
	Robust	Compatible	Name, Role, Value	H44: Using label elements to associate text labels with form controls; H65: Using the title attribute to identify form controls when the label element cannot be used	6
Current	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1
Archive	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1
Announcement	Understandable	Readable	Language of Page	H57: Using language attributes on the html element	1
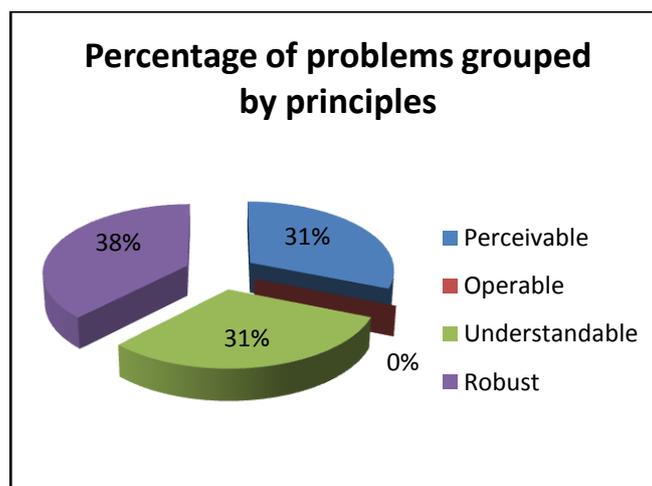
Figure 2. Percentage of problems classified by principles
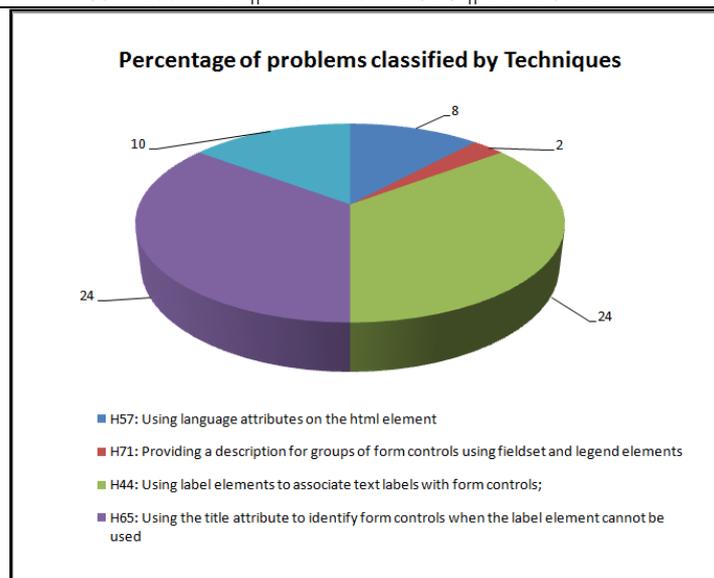
Figure 3. Percentage of problems classified by Techniques

4. Conclusions and future work

Considering the importance of data and information for e-citizen and organizations, is essential the application of Accessibility Web principles. In this context, the aim of this work was to evaluate the WA implemented in open adaptable information system widely used to implement e-journal.

The systematization and analysisof the data, demonstrate that the overallaccessibility guidelines defined by WCAG 2.0 are littlecontemplatedin the standard design anddevelopmentof the platform evaluated. Also, for the Software Industry the application of standards in the design and development of web sites is a way to address innovative and scalable technology projects, focusing the emphasis on evaluating free software platform to facilitate the implementation of e-journal sites.

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References

[1]   Kacherki, U., Thombare, M. J. (2010). Print vs e-Journal and Information Seeking Patterns of Users: A Case Study of SPJIMR. *DESIDOC Journal of Library & Information Technology*.30(1), pp. 22-25.

[2]   W3C.org. (2016) Accessibility, Usability, and Inclusion: Related Aspects of a Web for All. [Online]. Available: https://www.w3.org/WAI/intro/usable

[3]   ISO/IEC 9241-171:2008. Ergonomics of human-system interaction -- Part 171: Guidance on software accessibility.

[4]   ISO/IEC 9241-20:2008. Ergonomics of human-system interaction -- Part 20: Accessibility guidelines or information/communication technology (ICT) equipment and services.

[5]   ISO/IEC 9241-151:2008 Ergonomics of human-system interaction -- Part 151: Guidance on World Wide Web user interfaces.

[6]   Universidad de Alicante, Norma UNE 139803:2012: Aplicaciones informáticas para personas con discapacidad. Requisitos de accesibilidad para contenidos en la Web, Accesibilidad Web, [Online]. Available: http://accesibilidadweb.dlsi.ua.es/?menu=une139803-2012

[7]   Alshamari, M. (2016). Accessibility Evaluation of Arabic E-Commerce Web Sites Using Automated Tools. *Journal of Software Engineering and Applications*.No. 9, pp. 439-451.

[8]   Rodríguez, G., Perez, J., Cueva, S., Torres, R. (2017). Accessibility and usability OCW data: The UTPL OCW.*Computers&Education*, no. 109, pp.582–586.

[9]   Gies, T. (2018). The ScienceDirect accessibility journey: A case study.*Learned Publishing. No.* 31, pp. 69–76

[10]   Tereso, M., Bernardino, J. (2011). Open Source CRM Systems for SMES. *International Journal of Managing Information Technology* IJMIT). 3(4).

[11]   Public Proyect Knowledge, [Online]. Available: https://pkp.sfu.ca/ojs/
[12]   GNU Operating System. What is free software.[Online]. Available: http://www.gnu.org/philosophy/free-sw.en.html.
[13]   Ramirez, J., Reyes, C., Gil, G. yDurgam, F. (2015). Evolución y reusabilidad en FLOSS". *In XVII Workshop de Investigadores en Ciencias de la Computación*. Argentina.
[14]   Fundación Sidar. [Online]. Available: http://www.sidar.org/.
[15]   W3C. Consorcio World Wide Web. [Online]. Available: http://www.w3c.es/.
[16]   Word Wide Web-Oficina Española-Guía Breve de Accesibilidad Web. [Online]. Available: http://www.w3c.es/divulgacion/guiasbreves/accesibilidad.
[17]   W3C. Web Accessibility Initiative. [Online]. Available: http://www.w3c.es/traducciones/es/wai/intro/accessibility.
[18]   ISO. Organización Internacional para la Etandarización. [Online]. Available: http://www.iso.org/iso/home.html
[19]   ISO/IEC 40500:2012. Information technology -- W3C Web Content Accessibility Guidelines WCAG) 2.0. [Online]. Available: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=58625.
[20]   Acevedo, J., Gómez Solis, L., Mariño, S. I., Godoy, M. V. (2013). A guidelines for evaluating web accessibility, Level A. *Journal of Computer Science & Technology. JCS&T.* 13(2), pp. 76-83.
[21]   Fernández Vázquez, A., Acevedo, J. J., Mariño, S. I., Godoy, M. V. y Alfonzo, P. L. (2013). Medición de la accesibilidad en dos sitios web municipales de las provincias de Corrientes y Chaco, Argentina. *Telematique.*12(1), pp. 63-71.
[22]   Fernández Vázquez, A., Acevedo, J. J., Mariño, S. I., Godoy, M. V. y Alfonzo, P. L. (2012). Comunicación y accesibilidad en sitios web municipales de la región del Nordeste Argentino, su evaluación mediante validadores automáticos. *Question*, No. 35.
[23]   Mariño, S. I., Alfonzo, P. L. (2018). Web Accessibility and CMS.A case study about Joomla and Drupal plataforms, *International Journal of Recent Engineering Research and Development (IJRERD),* 3(8), pp. 37-43.
[24]   Mariño, S. I., Alfonzo, P., Gómez Codutti, A., Godoy, M. V. (2014). Automatic Evaluation of WCAG 2.0 Guidelines in a Drupal-based Platform. *International Journal of Information Science and Intelligent System.* 4(1), pp. 35-42.
[25]   Open Journal System. [Online]. Available: http://pkp.sfu.ca/ojs/docs/userguide/2.3.3/es/overview.html
[26]   Web Content Accessibility Guidelines (WCAG 2.0). [Online]. Available: http://www.w3.org/TR/WCAG20/
[27]   Accessibility Evaluation Resources. [Online]. Available: http://www.w3.org/WAI/eval/Overview.html
[28]   TAW. Test de Accesibilidad Web. [Online]. Available: http://www.tawdis.net/.
[29]   Auchariyabut, S. yLimpiyakorn, Y. (2014). Improving Web Accessibility for Visually Impaired with Open Source Browser Extension. *International Journal of Software Engineering and Its Applications.*8(1), pp. 457-468.