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Accessibility Assessment for Online Education Tools: Towards Accessible Principles for a Mexican University

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Abstract

INTRODUCTION: Characteristics of different disabilities using digital technologies are presented. Web content Accessibility Guidelines (WCAG) are explained according to their principles and how each offers alternatives for the limitations of people with disabilities and the conformance levels A, AA, AAA.
OBJECTIVES: Perform an automatic evaluation of two digital educational platforms for students to validate the conformance with WCAG in the three levels.
METHODS: Techniques derived from automatic checker assessment were used to complete this research.
RESULTS: Results showed that to fix the accessibility issues level A, the technical difficulty is low. Likewise, the investment of time and money is not as significant compared to the benefits that it represents.
CONCLUSION: Adopting the use of these automatic evaluation tools, developers will incorporate good accessibility practices as part of their experience.

Keywords: Accessibility assessment, WCAG, Educational web platforms, Inclusion for students, Visual disability, Hearing disability, Motor disability, Cognitive disabilities.

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1. Introduction

The delivery of learning through digital resources is more common every day, but not all users have equal opportunities to access digital contents. Accessibility refers to the design of products, devices, services, contents, or environments to be usable by people with disabilities (PwD). Access to information on institutional web sites and educational sites, in general, is critical in the inclusion of students and teachers with disabilities. Since most of the contents are delivered in digital format, institutions must become familiar with the difficulties of their teachers and students with disabilities to understand the importance of making their digital contents accessible and begin acting on digital inclusion. Moreover, institutions must be aware of their social responsibility in providing better academic opportunities for people with disabilities, which will contribute to their inclusion in society [1].

Digital accessibility is not a new topic. Since 1999, the World Wide Web Consortium (W3C) has issued Web Content Accessibility Guidelines to promote accessibility on the web. These guidelines have evolved along with the offer of new devices with novel interactions, and nowadays, the guidelines apply to desktop and mobile devices and their contents.

For some years now, Universidad de Colima has been working to enhance its social responsibility as a public educational institution. One of its pillars is welfare solidarity, which means adopting the commitment to supporting vulnerable people. In this sense, the institution has promoted different workshops and activities to help people with disabilities and foster empathy in the rest of the university community. These activities' goal has been to generate good practices related to oral and written language; these good

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practices were targeted to students and workers of the communication field in the institution, but they were open to anyone interested. Additionally, Universidad de Colima has been offering workshops related to sign language. On the other hand, the institution has promoted disability awareness in the community through festivals.

Throughout the years, Universidad de Colima has developed and improved its own e-learning platform, EDUC. However, the institution has yet to improve its practices to offer more usable and accessible technology to their students, workers, and people in general. Unlike some countries that have adopted specific laws and policies to promote accessibility in educational sites, such as the U.S. with Section 508, Mexico does not follow any regulation towards that goal. For that reason, Universidad de Colima is working on identifying the accessibility guidelines that can be considered minimum requirements on its e-learning platform and related applications to make it equitable for all its users. This document is organized as follows: section 2 outlines the Web Content Accessibility Guidelines (WCAG); section 3 mentions tools to evaluate accessibility; section 4 describes institutional e-learning platforms, while section 5 shows the result of their accessibility evaluation; in section 6, the authors reflect on the adoption of accessible practices; and finally, section 7 exposes conclusions.

2. Background

2.1. Barriers Accessing Contents

People with disabilities (PwD) are not visible enough, nor are they represented in everyday life's different scopes. This issue is more prevalent in developing countries, where PwD faces a daily struggle for mobility, access to education, and the workforce.

The aim of accessibility is to enable people with one or more disabilities to access content on different devices. However, the needs of PwD accessing digital contents are not always well understood because the characteristics of each disability are not yet common knowledge [2]. People with perceptual disabilities such as visual and hearing have an impairment that affects written and/or oral communication with people who do not have the same impairment. For example, people with blindness are perfectly able to communicate written content in braille with people who can read braille; people with deafness can communicate with other people who understand their sign language. Such examples seem too logical and simple even to be mentioned; however, many people still consider that having a perception impairment disables people with this condition to do the tasks that a person without a disability can do, just because they do not do them in the same way. People with motor disabilities do not have communication problems with other people, but they have difficulties interacting with devices. Cognitive, learning and neurological disabilities are even less understood because their complexity goes beyond the lack of a perception channel. It goes without saying that both perceptual and cognitive disabilities often appear combined, making it more difficult to characterize in order to propose a one-for-all solution.

Visual disability has many variants. From colour-blindness, partial or blurred vision, to complete sight loss. Causes are also diverse. Most people with blindness, either congenital or acquired, are trained to read, and write in braille, and to do everyday tasks. They are also able to use computers and mobile devices, aided mainly by screen-readers and braille displays. Currently, these assistive technologies are able to read only text contents, not just visible text but also hidden alternative text that describes the visual elements of the interface, provided that it has been considered by the designers and developers of such elements. Another important implication of the lack of sight is the inability to use pointing devices, which implies that navigation and input is reduced or even limited to the keyboard. On the other hand, perceiving the information via audio also brings up the need for active reading, in order to "jump" from one part of the content to another as it is possible with sight and with braille reading, and the need to consider the additional time to read the hidden text that describes controls and other information that must be made available in a non-visual manner. This means that people who use screen-readers require a greater amount of time to perceive information, which is why they prefer to read at high speeds of the screen-reader. Usually, they get used to reading at speeds that make content unintelligible to the untrained ear. Another necessary consideration regarding contents presented in braille devices is that literary information is represented in a common nearly universal alphabet; that is, languages using the Latin alphabet also share a common braille alphabet; however, mathematical contents, though sharing a common notation in print, differ in braille representation across countries. Even reading mathematical contents with a screen-reader is an issue, since to this day screen-readers cannot read mathematical contents natively; in order to work, they require the installation of add-ons which usually depend on the browser in which the contents are displayed.

Motor disabilities may involve the partial or total lack of upper and lower limbs, impaired movement, or strength. The motor impairment that is of specific consideration when building digital devices and applications for accessing information is hand-motor impairment. People with motor impairment may have problems holding devices, pushing buttons, lack of precision doing hand gestures and pointing, and difficulties inputting information [3]. In extreme cases, they might not be able to use any hand interaction, which means that they will need to interact through eye-tracking or speech.

The most critical difficulties inherent to the hearing disability are probably less obvious. People with deafness are probably the most excluded from society, because, unlike people with blindness or with difficulties to move, they are not able to communicate verbally with people without disabilities who do not know their sign language. This issue has very serious implications for people with deafness, especially those who are deaf from birth or from a very early

age. Not being able to communicate in the same language means not being able to socialize; this means that growing up with deafness people are isolated from participating in groups where there are no other deaf people, not having friends that are not deaf, not being able to learn independently in a mainstream school. Also, sign language is not universal, and even communication with deaf people from other countries where the same language is spoken can be difficult because there are variations in the sign language. Most importantly, it is a common misconception that deaf people do not have problems accessing written content because they can read them. However, most people with deafness have problems with reading comprehension and writing [4], [5], partly because the written language is their second language, and because sign language is grammatically different from the spoken language. There are, of course, other reasons that in some cases have to do with late diagnosis of deafness and therefore a late exposure to language, or a limited language input during the critical period for language acquisition [6], amongst others. For the reasons previously exposed, written language is an alternative way of presenting content to deaf readers and therefore it should be used, but it should not be assumed that deaf readers will understand them entirely. Cognitive, learning, and neurological disabilities are also known as "invisible disabilities", because they are not apparent or well understood outside medical or specialized environments [7]. People with this type of disability may be intimidated by long texts and complex contents; they may have decoding, recall, writing, and spelling problems that could represent barriers accessing content. Some of them use assistive technologies.

Currently, operating systems in computers and mobile devices include accessibility features that can be configured according to the needs of the user, enabling them to use the device. However, the accessibility of the applications and the contents that are displayed in them are the responsibility of the people who prepare, design, and develop them.

2.2. Bridging the Gap with WCAG

The Web Content Accessibility Guidelines (WCAG) are recommendations for making web content more accessible to PwD. They were published by the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI). The first version of the guidelines (WCAG 1.0) was released in 1999, it was followed by updates in 2008 (WCAG 2.0), and the current version (WCAG 2.1) was released in 2018. The updates were made to keep up with changes in web-based digital technology, assistive technology, and content for mobile devices [8]. Guidelines promote information delivery in a way that it can be read by assistive technologies, so that users can perceive it through different sensory channels, by providing alternatives for people who lack one or more of these; likewise, in terms of interaction, guidelines also promote alternatives for navigation and input of contents. The current Web Content Accessibility Guidelines establish four principles: perceivable, operable, understandable, and robust; each of these contains specific guidelines and techniques for developers. The principles themselves allow to observe the correspondence with the different disability needs:

- *Perceivable*. The guidelines for this principle involve offering alternatives to compensate for the lack of one or more senses; for example, for people with visual impairment, it is necessary to have high contrast between foreground and background, to include alternative text for graphical contents, and making sure that information and interactions do not rely on sensory characteristics such as colour and position. For people with hearing impairment, it is also important to offer alternatives to sound components, by providing video in sign language and captions (Figure 1).

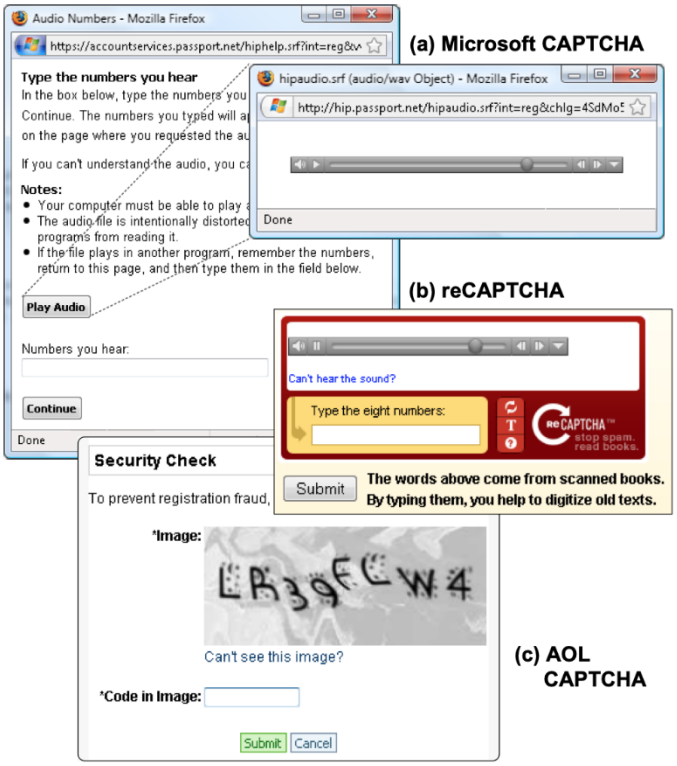

Figure 1. Examples of CAPTCHAs interfaces with audio alternative. Source [9].

- *Operable.* The guidelines include alternatives for navigation and input. For people with visual impairment, it is critical to have the alternative of using the keyboard because they cannot use pointing devices or the touch screen; people with motor impairment may have problems using the mouse or making gestures on mobile devices, and they might even need to connect special keyboards or pointing devices according to their abilities. A simple verification to ensure that elements have a sequential focus order can make a difference in the experience of people using keyboards

for navigation; likewise, using headings to indicate hierarchy, and making links that indicate their purpose in the name (as opposed to the infamous "Click here"), can make navigation more efficient (Figure 2).

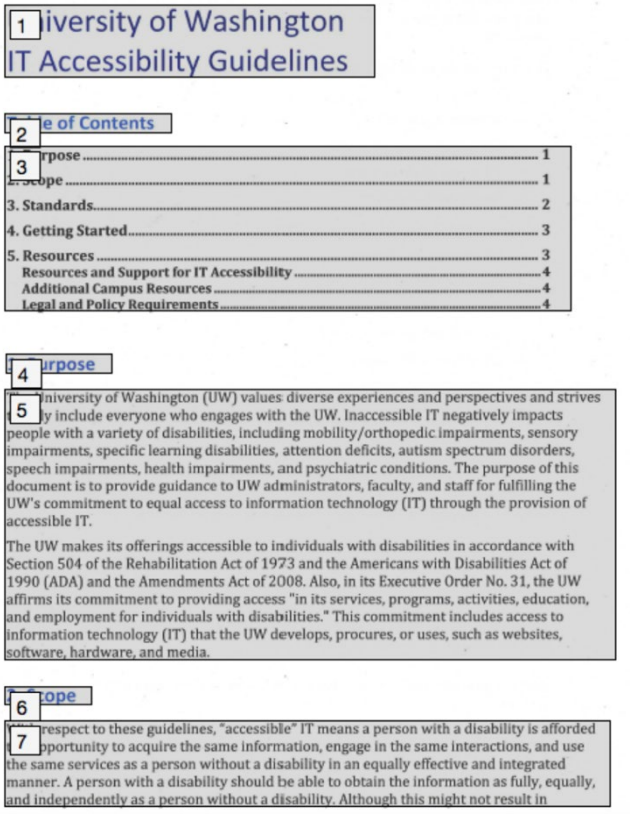

Figure 2. Example of reading order based on the visual position of the elements on the page. Source [10].

- *Understandable*. Guidelines for improving readability and understandability of contents; for example, specifying the language of a page so that screen-readers can detect it and adjust its settings and read contents correctly, indicating optional and required fields in forms, providing labels, instructions, and error prevention in formatted input, and using simple language so that users do not require advanced reading abilities, in favour of most people with deafness and some people with cognitive issues, or simply people with low reading comprehension. Long texts can be intimidating for some people with cognitive disabilities, so visual resources are recommended to support and supplement the text (Figure 3).
- *Robust*. Promote compatibility by making content easy to interpret by assistive technologies. For example, using unique IDs, avoiding duplicate attributes, and using complete start and end tags for mark-up.

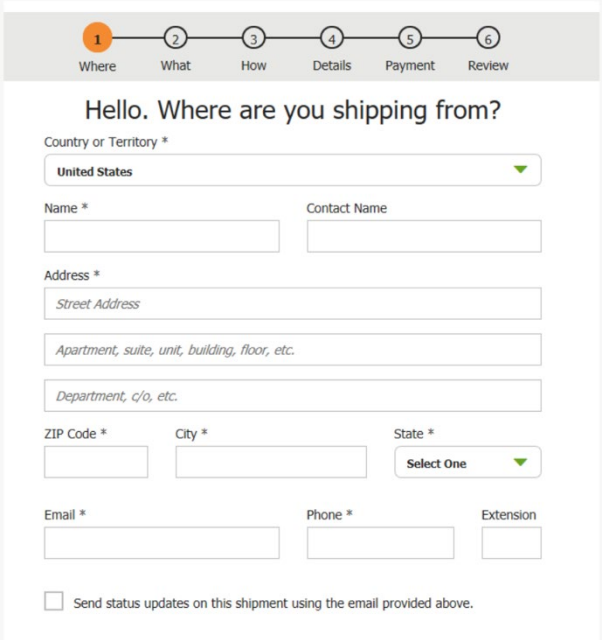

Figure 3. Example of using an asterisk to indicate required fields. Source [11].

Each guideline includes sufficient and advisory techniques for its implementation. Sufficient techniques are reliable ways to meet the success criteria, while advisory techniques are suggested ways to improve accessibility [12]. Each guideline is also given a conformance level: A, AA, AAA. These levels represent the degree of accessibility; the basic level (A) is defined as the minimum requirements to enable access to contents, which includes 25 success criteria. The other two levels indicate the easiness of access to the contents of the site. In the case of level AA - the middle level -, besides the criteria from level A, a website must meet the criteria from level AA, which includes 13 additional success criteria. While at the highest level - the AAA level - a website must comply with all the criteria in levels A, AA, and AAA. It includes 23 additional success criteria [13], [14].

The W3C Web Accessibility Initiative has developed a comprehensive quick reference on how to meet WCAG [12].

3. Evaluating Accessibility

In order to evaluate accessibility, different strategies are needed: automatic accessibility validators, manual checking, and user evaluation. The automated accessibility of a website or application can be evaluated with several online tools. These tools can go from doing a complete evaluation of the different versions of WCAG in the specific conformance levels, to checking specific aspects of accessibility, such as

checking the colour contrast or simulate how users with different eye diseases will see the pages. Most of the guidelines can be checked automatically, such as those that consist of adding properties to interface elements, but some must be verified by a human in addition to the automatic checks because they refer to good or bad implementation of the guideline. It is also worth mentioning that these tools are very easy to use; almost any person, even without technical knowledge is able to do a check, as long as they know what they are evaluating. In order to evaluate a site online, all that is needed is an URL; results are presented in an organized and clear manner so that the accessibility problems are highlighted. However, once they are detected, correcting the accessibility problems requires the direct intervention of the developer of the site being analysed. Both automatic and manual checks are conducted without intervention from the final user.

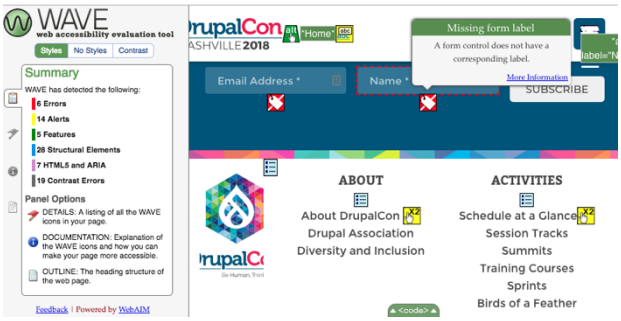

Figure 4. Example of an automatic tool for accessibility check. This tool annotates errors and warnings in-line, which allows the developers to know the problem directly from the page. Source [15].

On the other hand, a user evaluation is the most realistic verification of the accessibility of a web site or application; however, this type of evaluation requires planning, time, and money.

4. Access to Education for PwD at Universidad de Colima

An important number of countries worldwide, such as Australia, Canada, China, India, and the United States, to name just a few, have adopted laws and policies to ensure access to content for people with disabilities [16]. Most of the countries have WCAG or its derivative as a reference, and they have established their scope: contents of the public sector, private sector, or government. In Mexico, the General Law for the Inclusion of People with Disabilities establishes that people with disabilities should have equal access to education, transport, information technology, and communications. The Law establishes that the Ministry of Education should promote the inclusion of people with disabilities in all educational levels; however, the law is operational only in basic education.

Universidad de Colima is a public institution of higher and middle education in Mexico. It is the most important public educational institution in the State of Colima. Universidad de Colima was a pioneer in the development of educational materials in the past decades, and it has always made efforts not just to be a consumer but also a producer of its own resources [17]–[19]. For some years it has been in charge of developing EDUC, a distance education platform for b-learning and online courses, as well as EvPraxis, a platform for online exams. Created in 2001, EDUC is the official e-learning platform of Universidad de Colima, developed by the Department of Distance Education of the same institution. EDUC defines its primary function as “the management of distance education services in the institution; its substantive activities are the planning, design, development, and release of online courses” (Figures 5 and 6).

Figure 5. EDUC’s login page.

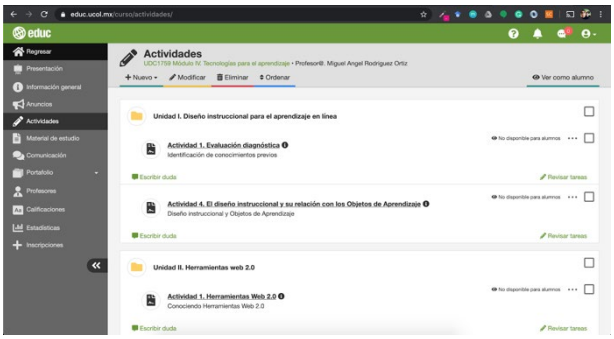

Figure 6. EDUC’s workspace.

EvPraxis is the Online Assessment System of Universidad de Colima that offers its users the opportunity to design, apply, and answer exams through the internet that are developed by the Department of Digital Educational Resources (Figures 7, and 8).

Online platforms for e-learning enable both students and teachers to access information regardless of their physical location. Another advantage that online education platforms provide is that students have the opportunity to study at their own pace because of the flexible schedule and environment. In addition, it can result in lower costs and debts because students can save money in housing, transportation, among others. For students with problems to attend school due to

mobility problems, an online platform would be an ideal option for continuing their education. Therefore, it is important that any online platform, tool or educational material considers and implements accessibility so that anyone can use it.

Figure 7. EvPraxis home page.

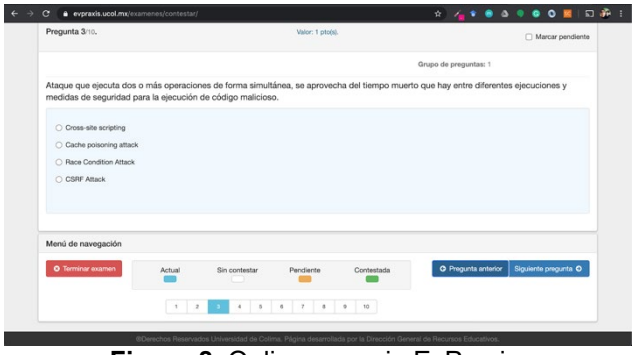

Figure 8. Online exam in EvPraxis.

In their previous versions, EDUC, as well as EvPraxis, did not take into consideration the WCAG guidelines, making it hard to create content more accessible to people with disabilities. However, in recent years, the university has promoted the inclusion of students and professors with disabilities. The strategies for inclusion so far have been guidance and support for students who are about to start middle and higher levels, as well as increasing awareness in teachers and students about the needs of people with disabilities. Nevertheless, the work on the accessibility of online platforms is still a work in progress, and students with disabilities are not able to use these platforms in full. Currently, the institution's accessibility policies focus on general issues, such as dismissing the use of Flash, not including moving images with a duration longer than five seconds, and using alternative text and description in images. These official guidelines could be described in a more complete and specific way and would affect positively all of the institutional sites and its contents.

It is important to mention that, at the present time, accessible tools and content are more urgent than ever, as the pandemic of coronavirus and the COVID-19 disease are affecting the whole world, and higher education is no exception. As [20] declares, the shift to online teaching is an opportunity for instructors and teachers to create online accessible content from scratch. Likewise, this is an opportunity for designers and developers to learn and follow accessibility best practices.

5. Accessibility Evaluation of EDUC and EvPraxis

The two main educational platforms developed by Universidad de Colima, the online education platform EDUC and the exam platform EvPraxis, were evaluated for accessibility with an automatic checker. The evaluation of these institutional platforms was motivated by the gradual increase of students with disabilities, who are located on different campuses and departments, from high school to postgraduate; and in this sense, we need to provide them with tools and platforms to encourage their independence, since they currently depend on someone else to use not only these platforms but almost any other in the institution. Another motivation is the potential that these platforms have to be used in other institutions as well. Lastly, since these platforms were created and are managed by our institution, it is possible to give suggestions for improvement, knowing that their implementation is feasible. The recommendations that emerge from this study can substantially improve the creation of institutional web platforms.

The online tool chosen for this purpose was PowerMapper, which checks for conformance with WCAG in the three levels, as well as for broken links, browser compatibility, and search engine optimization. In its demo version, it evaluates ten pages from a specific website, and it does not require advanced technical knowledge in order to perform the evaluation. The scope of this evaluation was to observe the most common accessibility issues using WCAG 2.1 as a reference, and to analyse the issues for compliance level A, in order to observe how critical it is the current situation and how much effort it will take to comply with this minimum level. Level A conformance includes guidelines in each of the four principles. *Perceivable*: alternative text for non-text content, prerecorded captions, prerecorded audio description, meaningful sequence of contents, consideration of different sensory characteristics. *Operable*: keyboard accessible, titles on pages, focus order, meaningful links. *Understandable*: language of page, labels or instructions. *Robust*: correct implementation of HTML tags.

Firstly, the evaluation of five main sections of the Distance Education platform of the Universidad de Colima, EDUC was carried out: (a) Landing page, which is public, and the following four sections belonging to a previously published course (b) section of Announcements, (c) Study material, (d) Activities and (e) Communication. The results are shown in Figure 9 and Table 1 shows the results for each page.

Despite showing a considerable number of accessibility errors with an average of 25.6 per section, level A can be reached by correcting these following 32 *unique* errors.

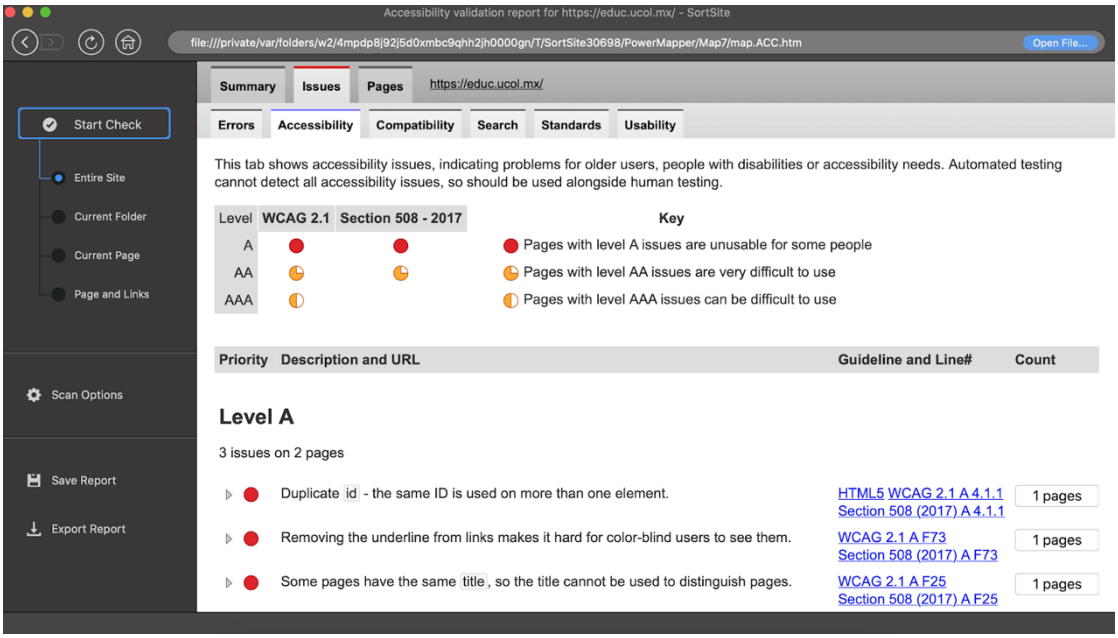

Figure 9. Results of the Accessibility validation report for EDUC (landing page).

Table 1. Number of accessibility errors by section for EDUC

	A	AA	AAA	Total errors
(A) LANDING PAGE	3	2	2	7
(B) ANNOUNCEMENTS	16	6	2	27
(C) STUDY MATERIAL	25	6	2	33
(D) ACTIVITIES	24	7	3	34
(E) COMMUNICATION	19	6	2	27

1. The aria-describe dby attribute must point to IDs of elements in the same document.
2. The aria-labelled by attribute must point to IDs of elements in the same document.
3. Absolute CSS positioning can make pages unreadable when style sheets are turned off.
4. All fieldset elements should be labelled with legend elements.
5. All onclick handlers should have an equivalent onkeyup or onkeydown handler.
6. An element with aria-hidden=true contains focusable content.
7. Document must have a title.
8. Document title must not be blank.
9. Duplicate id - the same ID is used on more than one element.
10. Each *a* element must contain text or an img with an alt attribute.
11. Element *a* not allowed as child element in this context.
12. Figures and images in PDF documents should have non blank ALT text, except for decorative images which should be marked as artifacts.
13. HTML form control has no label.
14. Identify row and column headers in data tables using th elements, and mark layout tables with role=presentation.
15. Removing the underline from links makes it hard for color-blind users to see them.
16. Some pages have the same title, so the title cannot be used to distinguish pages.
17. The tab order does not follow logical sequences on the page.
18. This form control has a blank label or title.
19. Use semantic markup like strong instead of using the CSS font-weight property.
20. iframe and frame elements must have a title attribute.
21. img elements must have an alt attribute.
22. For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells.
23. Content inserted with CSS is not read by some screen readers, and not available to people who turn off style sheets.
24. End tag *b* violates nesting rules.
25. No space between attributes.
26. The label element is blank.
27. This button element is empty and has no accessible name.
28. Word document contains a graphic without Alt Text.
29. Word document contains a non-inline graphic or object.

30. PDFs must be tagged to be accessible by screen readers.
31. Use the lang attribute to identify the language of the page.
32. alt text should not be an image file name.

In this case, EDUC is a platform in which the teachers generate the content, that is why the problems numbered as 12 and 30 referring to PDF files are out of reach since their creation does not depend on the development team.

The estimated time effort to correct these 30 unique errors (removing PDF issues) to fulfil with level A is six hours, with a cost of USD 215.83. This calculation was done by estimating the development effort of one developer for each unique error, with an average of 10 minutes for each mistake and 60 minutes for error number 3. The rate per hour is USD 35.

The technical difficulty of the fixes is low, so a high degree of developer specialization is not required.

In addition to accessibility problems, the following usability errors on Table 2 were also detected according to the guidelines established in Usability.gov, which affect all users in general.

The number of usability errors is shown since we consider it important to take them into account when updating the site; however, usability is not the focus of this work.

In addition to the EDUC platform, the analysis of the online evaluation platform EvPraxis was carried out taking the following sections: (a) Landing page, (b) Schedule, (c) Exams, (d) Create exams and (e) Answer exam; from which the accessibility results shown in Figure 10 and Table 3 were obtained.

Table 2. Number of usability errors by section for EDUC

PRIORITY	1	2	3	4	Total errors
(A) LANDING PAGE	0	4	1	0	5
(B) ANNOUNCEMENTS	0	6	5	1	12
(C) STUDY MATERIAL	1	9	6	1	17
(D) ACTIVITIES	0	6	6	1	13
(E) COMMUNICATION	0	6	4	1	11

Table 3. Number of accessibility errors by section for EvPraxis

	A	AA	AAA	Total errors
(A) LANDING PAGE	6	4	3	13
(B) SCHEDULE	9	4	3	16
(C) EXAMS	8	4	3	15
(D) CREATE EXAM	10	5	3	18
(E) ANSWER EXAM	9	4	3	16

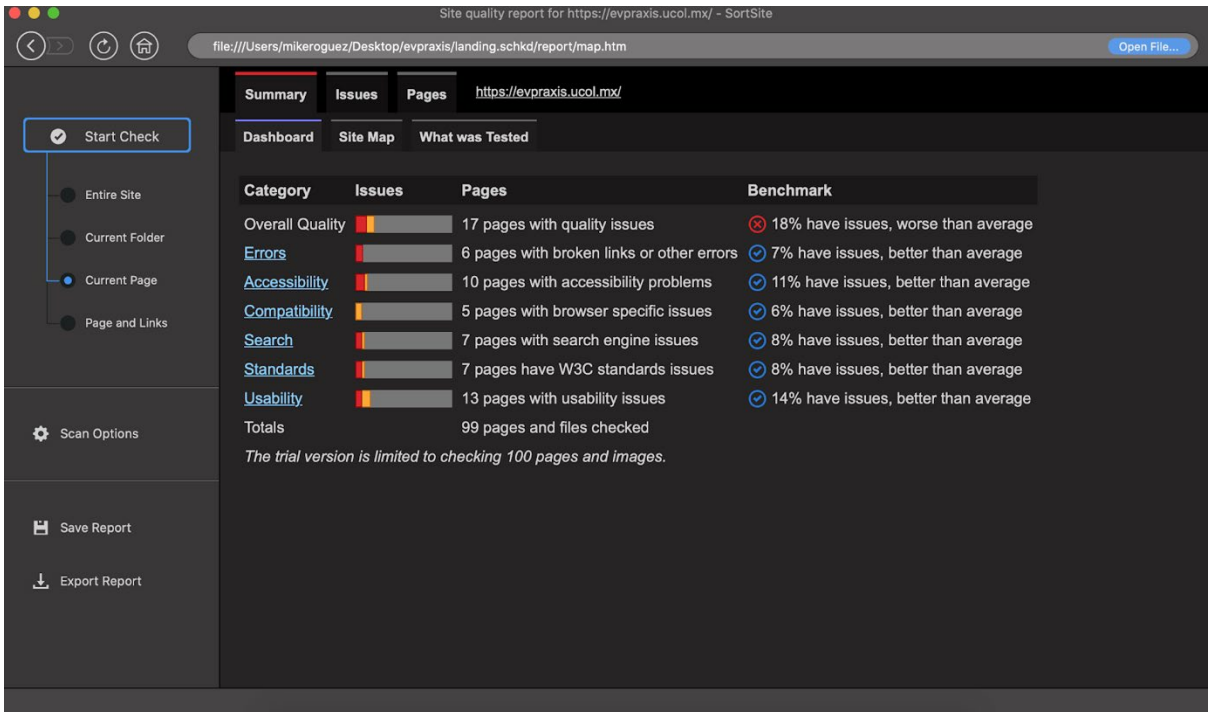

Figure 10. Results of the Accessibility validation report for EvPraxis (landing page)

There was an average of 15.6 errors per section, to obtain a conformance level A it is necessary to correct the following twelve unique errors:

1. Content inserted with CSS is not read by some screen readers, and not available to people who turn off style sheets.
2. The document must have a title.
3. Removing the underline from links makes it hard for colour-blind users to see them.
4. Some pages have the same title, so the title cannot be used to distinguish pages.
5. Use the lang attribute to identify the language of the page.
6. iframe and frame elements must have a title attribute.
7. HTML form control has no label.
8. Identify row and column headers in data tables using the elements, and mark layout tables with role=presentation.
9. form control has a blank label or title.
10. Use semantic mark-up like strong instead of using the CSS font-weight property.
11. Headings should not contain other headings.
12. The button element is empty and has no accessible name.

In order to correct these twelve unique errors to conform with level A, it is required an estimated time effort of three hours, with a cost of USD 110.83. For this platform, the estimation was done using the same methodology as EDUC; the average time was 10 minutes for ten mistakes, one hour for error number one, and 30 minutes for 10.

In this case, the technical difficulty of the corrections is also low, so a high degree of developer specialization is not required.

In addition to accessibility problems, the following usability errors were also detected according to the guidelines established in Usability.gov, which affect all users in general (see Table 4).

Table 4. Number of usability errors by section for EvPraxis

PRIORITY	1	2	3	4	Total errors
(A) LANDING PAGE	1	6	3	1	11
(B) SCHEDULE	1	5	3	1	10
(C) EXAMS	1	5	3	1	10
(D) CREATE EXAM	1	5	4	1	11
(E) ANSWER EXAM	0	2	0	0	2

As in the EDUC platform, EvPraxis has usability issues that should be considered, but as it was mentioned before, usability is beyond the scope of this document.

From the accessibility issues obtained as a result of the automatic evaluation, and the level of difficulty to fix those issues, it can be suggested that any developer who is able to build a Web page is also able to make it accessible, at least in order to pass an automated test. In most cases, developers are unaware of the needs of users with disabilities, and most probably also unaware of the existence of the WCAG and its implementation techniques. In some cases, developers might find it cumbersome to meet WCAG due to the number of guidelines; however, it is not compulsory to conform to the highest accessibility level (AAA). In this regard, we recommend to start by addressing level A guidelines at least for the Perceivable and Operable principles (or even a subset of those guidelines) and to implement them including only the sufficient techniques. As for EDUC and EvPraxis, we consider that it is feasible to comply with all level A guidelines for all principles. We propose to include these level A guidelines for all principles in the official accessibility guide for the institution, as part of the commitment with inclusive practices.

This study is limited to the evaluation of the aforementioned educational platforms and not to the contents since as mentioned above, these are currently outside the scope of the development team and there are no mechanisms designed to control the level of accessibility of the content created by users, this being an area of opportunity for future developments. The work constraints are based on the evaluation capacity of the PowerMapper tool used in its free version, which allows us to review a maximum of 10 pages in depth, a limit that was not reached in this evaluation.

6. Reflections on the Adoption of Accessible Practices

The adoption of accessible practices in educational institutions requires a joint effort amongst stakeholders: policy-makers, institutional authorities, project leaders, designers, and developers; basically, it depends on everyone who creates digital content, from web sites to text documents. In order to raise awareness of the importance of accessibility and to act upon it with commitment and responsibility, universities are strongly encouraged to acknowledge inclusion as part of their normative, establishing accessibility policies that include the guidelines and standards that will regulate the digital contents created in all of its sectors.

In this regard, Universidad de Colima has already made the commitment of social inclusion, and has devised strategies to improve the academic access of students with disabilities; however, many of the strategies are not yet operational. Therefore, an important step in the implementation of effective measures to promote the accessibility of digital content is the definition of the guidelines that will officially regulate the creation of digital content. In order to do this, the participation of institutional

authorities, developers, and accessibility consultants is advised.

Across this document we have referred to the accessibility of online web contents; however, any digital content can be made available online, and it will be evaluated by accessibility checkers, as evidenced by error 12 level A from the results of the accessibility check of EDUC ("Figures and images in PDF documents should have non blank ALT text, except for decorative images which should be marked as artifacts"). On the other hand, understanding the difficulties of PwD using digital devices and contents, and the Web Content Accessibility Guidelines made for this purpose, will make it easier to establish guidelines for the accessibility of other type of documents, such as text and PDF.

7. Conclusions

In the present paper, the characteristics of the different disabilities and their implications using digital technologies have been described. The W3C WAI Web content Accessibility Guidelines have been explained according to their principles and the way each one offers alternatives for the limitations of people with disabilities; additionally, the accessibility evaluation modalities were briefly introduced. Once the background was established, we introduced the two main digital educational platforms for students developed by Universidad de Colima, EDUC and EvPraxis, proceeding later to the automatic evaluation of both platforms using an automatic accessibility checker. Results showed that in order to fix the accessibility issues level A, a high degree of developer specialization is not required, because the technical difficulty of such fixes is low. Likewise, the investment of time and money is not as significant compared to the benefits that it represents.

While it is desirable that accessibility is considered from the beginning of the development phase, improving the accessibility of a page does not involve an extreme investment of time and effort, provided that the development followed good practices in web development. By using an automatic checker it is possible to identify the main accessibility issues and even reach the basic conformance level. Adopting the use of these automatic evaluation tools, developers will incorporate good accessibility practices as part of their experience, and will realize that they are able to create high-quality web sites that are also available to a range of users that they may not have considered before. On the other hand, academics from different areas such as IT, design, education, and law, also play an important role in raising awareness of the needs of people with disabilities amongst their students, analysing possible contributions to the inclusion of this particular population group. Lastly, educational and governmental institutions, whether compelled by law or not, have the social responsibility to promote the equitable participation of people with disabilities in society.

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