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Análisis de la accesibilidad de los portales web de las instituciones educativas de la ciudad de Cuenca – Ecuador

Accessibility analysis of the web portals of the educational institutions in Cuenca, Ecuador

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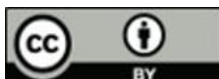
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Resumen

Este artículo presenta un análisis de accesibilidad de los portales web de las instituciones educativas en la ciudad de Cuenca, Ecuador. El propósito de la investigación es evaluar la accesibilidad de los portales web con las Pautas de Accesibilidad para el Contenido Web (WCAG) 2.0 con un nivel de conformidad A y analizar su cumplimiento normativo. A partir de una revisión de diferentes fuentes bibliográficas se indagaron experiencias y resultados de investigaciones de accesibilidad web. Luego se presentan los resultados obtenidos de accesibilidad de 191 páginas web analizadas utilizando las herramientas en línea Examinator, TAW, Markup Validation Service y CSS Validation Service. Entre los resultados, se percibe que es necesario corregir errores en todos los portales web analizados de las instituciones educativas de la ciudad de Cuenca. Para establecer el nivel de cumplimiento se verifican los iconos que certifican la accesibilidad de los sitios por el World Wide Web Consortium (W3C) en HTML, CSS y sus niveles de conformidad A, AA y AAA. Con los datos



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obtenidos de la evaluación de las herramientas automáticas corroboramos el nivel de cumplimiento de los criterios de éxito de la WCAG 2.0 con un nivel de conformidad A. Se concluye que se requiere corregir errores en todos los portales web de las instituciones educativas de la ciudad de Cuenca analizadas. Por el promedio de errores encontrados, es más factible que las instituciones educativas rediseñen sus portales web, a fin de cumplir con las WCAG 2.0. También pueden mejorar el cumplimiento de las WCAG 2.0, con un arduo trabajo de revisión y corrección del código fuente de sus portales web.

Palabras clave

Accesibilidad web, discapacidades, educación, inclusión educativa, WCAG 2.0.

Abstract

This article shows the accessibility analysis of the websites of the educative institutions of Cuenca - Ecuador. The purpose of the research is to evaluate the accessibility of the websites with the Web Content Accessibility Guidelines (WCAG) 2.0 with a level of compliance A and analyze their regulatory compliance. Experiences and results of web accessibility research were investigated from a review of different bibliographic sources. The results obtained from the accessibility of 191 Web pages analyzed using the online tools Examiner, TAW, Markup Validation Service and CSS Validation Service are presented. Among the results, it is observed that it is necessary to correct errors in all the analyzed Web portals of the educational institutions of Cuenca. In order to establish the compliance level, the icons certifying the accessibility of the sites by the World Wide Web Consortium (W3C) in HTML, CSS and their conformity levels A, AA and AAA are verified. With the data obtained from the evaluation of the automatic tools, it is corroborated the compliance level of the success criteria of the WCAG 2.0 with a conformity level A. It is concluded that it is necessary to correct errors in all the web portals analyzed of the educational institutions of Cuenca. For the average number of errors found, it is more feasible for educational institutions to redesign their web portals in order to comply with the WCAG 2.0. They can also improve the fulfillment of the WCAG 2.0, with a hard work of revising and correcting the source code of their web portals.

Keywords

Web Accessibility, disabilities, education, educational inclusion, WCAG 2.0.

1. Introduction

Web accessibility means that people with some kind of disability can use the Web in the same conditions as the rest of the people. Speaking of web accessibility is referring to a design that allows people with disabilities to perceive, understand and interact with the webpage. Web accessibility also benefits other people, including older people who have been depleted of their skills as a result of time. The Web is a very important resource for different aspects of life: education, employment, government, commerce, health, entertainment and many others. It is very important that the Web is accessible in order to provide equitable access and equal opportunities for people with disabilities. An accessible Web page can help people with disabilities to participate more actively in the society (World Wide Web Consortium, 2015).

ISO/IEC 40500:2012 (International Organization for Standardization, 2012) Web content accessibility guidelines (WCAG) 2.0] covers a wide range of recommendations to make Web



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content more accessible. Following these guidelines will make content accessible to a wider range of people with disabilities, including blindness and poor vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movements, speech disabilities, photographic sensitivity and the combinations of these. Following these guidelines will also make Web content more usable for users in general. Non-compliant websites, Web technologies, or Web tools can create barriers that exclude people from using the Web.

Ecuador, like other countries (Instituto Ecuatoriano de Normalización, 2014), uses ISO/IEC 40500:2012 standard. In order to follow the obligatory compliance in Ecuador with the norm NTE INEN-ISO/IEC 40500 (Instituto Ecuatoriano de Normalización, 2014) the Ecuadorian technical regulations RTE INEN 288 "Accessibility for Web content" (Instituto Ecuatoriano de Normalización, 2016) entered into force on 8 August 2016 ((Instituto Ecuatoriano de Normalización, 2016). This regulation applies to the contents published in public and private sector websites that provide public services. In its first transitory, it establishes that until August 8, 2018, all Ecuadorian websites that provide a public service must be accessible WCAG 2.0 level A. As the WCAG 2.0, there are three conformity levels and 61 success criteria that web pages must comply with (25 success criteria), AA (13 success criteria) and AAA (23 success criteria). According to the deadline established in the first transitory, the Ecuadorian websites must have complied with the Accessibility Standard WCAG 2.0 level A. To achieve a conformity level (minimum), web pages must have fulfilled the 25 success criteria of the WCAG 2.0. The public and private institutions of the Republic of Ecuador along with Web developers must welcome and implement the regulations to allow universal access to the Web. In Addition, so far no regulations have been updated in Ecuador, but it may do so in the future with the WCAG 2.1 (World Wide Web Consortium, 2018).

Education is in an evolutionary process that adapts to laws, regulations and new demands in teaching-learning. A key aspect is to achieve the inclusion and participation of all people in the educative sector, as required by article 24 Education of the Convention on the rights of people with disabilities (United Nations). For this, educational websites must also comply with the provisions of the Ecuadorian technical regulations RTE INEN 288. Website administrators must apply the current accessibility regulations so that anyone can use their web portals.

According to statistics published by the National Council for Equality of Disabilities (CONADIS) with information from the Ministry of Public Health of people registered with disabilities in Ecuador from February 2016 to February 2019 (Consejo Nacional para la Igualdad de Discapacidades, 2019) has had an increase of 11.01% in Ecuador, meanwhile from October 2016 to February 2019 in the province of Azuay (Consejo Nacional para la Igualdad de Discapacidades, 2019), the increase was 4.70% and, particularly in Cuenca, the increase corresponds to 5.69% (Consejo Nacional para la Igualdad de Discapacidades, 2019). On the other hand, 1% of the people with disabilities in Azuay are included in the permanent popular education, 55% in regular education and 44% in special education (Consejo Nacional para la Igualdad de Discapacidades, 2015).

The purpose of this research is to evaluate the accessibility of the websites of the educative institutions of Cuenca-Ecuador with the WCAG 2.0 and a conformity level to analyze its normative compliance. To this end, answers of the following questions are sought:

- Which websites of Cuenca's educative institutions comply with the WCAG 2.0 and conformity level A.



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- What is the average of errors in the Websites of the educative institutions of Cuenca?

Additionally, to verify whether the entry into force of the Ecuadorian technical regulations and the fulfillment of the deadline of the first transitory have contributed to improve the accessibility of the educational websites.

Regarding the structure and content of the article, section 2 presents the concepts related to the research. In section 3 is presented the review of different bibliographic sources of experiences and results of web accessibility research. Section 4 details the methodology used to develop this research. In section 5 is observed the accessibility results of the web portals of Cuenca's educational institutions and their normative compliance are shown. In Section 6, the conclusions are established according to the results obtained.

2. Related concepts

2.1 Web Content Accessibility Guidelines (WCAG) 2.0

The WCAG 2.0 (World Wide Web Consortium, 2008) covers a wide range of recommendations for creating more accessible website. It consists of 4 principles, 12 guidelines and 61 compliance criteria (success), plus an unspecified number of techniques and counseling techniques (Luján-Mora, 2018b):

1. Principle 1: Perceptible: User information and interface components should be displayed to users in ways they can understand.

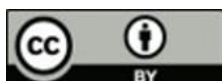
- **Guideline 1.1: Alternative text:** it provides alternative text for non-textual content, so it can be transformed into other formats that people need, such as large characters, Braille language, oral language, symbols, or simpler language.
- **Guideline 1.2: Time-dependent multimedia content:** it provides synchronized alternatives for time-dependent synchronized multimedia content.
- **Guideline 1.3: Adaptable:** it creates content that can be presented in different ways without losing information or structure.
- **Guideline 1.4: Distinguishable:** it makes it easier for users to view and listen the content including the distinction between the most and least important.

2. Principle 2: Operable: User interface components and navigation must be manageable.

- **Guideline 2.1: Accessible Keyboard:** to be able to control all functions from the keyboard.
- **Guideline 2.2 Time:** it provides enough time for users to read and use content.
- **Guideline 2.3: Epileptic Seizures:** do not design content that may cause epileptic seizures.
- **Guideline 2.4: Navigation:** it provides ways to help users navigate, search for content, and determine where they are.

3. Principle 3: Understandable: Information and user operations should be understandable.

- **Guideline 3.1 Readable:** it makes readable and comprehensible the text content.



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- **Guideline 3.2 Predictable:** it makes the appearance and how to use the foreseeable websites.
- **Guideline 3.3 Support for data entry:** it helps users avoid and correct errors.

4. Principle 4: Robustness: Content must be sufficiently robust so that it can be well interpreted by a wide variety of user agents, including assistive technologies.

- **Compatible Guideline 4.1:** it maximizes compatibility with current and future user agents, including support technologies.

2.2 Conformity levels

There are three conformity levels (World Wide Web Consortium, 2008):

- **Level A:** For the compliance with level A (the minimum conformity level), the website meets all the success criteria of level A, or a compliant alternative version is provided.
- **AA Level:** For the compliance with the AA level, the website satisfies all the success criteria of level A and AA level or an alternative version is provided that meets the AA level.
- **AAA Level:** For the compliance with the AAA level, the website satisfies all success criteria of level A, level AA and level AAA, or it provides an alternative version that meets the AAA level.

When a page complies with the Guidelines WCAG 2.0 it can include on it a statement that indicates the users that it complies with the W3C. The conformity level achieved is represented by a logo as shown in Table 1.




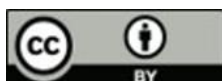
| Conformity level A | Conformity level AA | Conformity level AAA |
|---|---|---|
|  |  |  |

Table 1. Logos that represent the accessibility levels achieved (Confederación de Empresarios de Andalucía, 2010a).

If Some of the above logos are used, it must be accompanied by the following information (Confederación de Empresarios de Andalucía, 2010a):

- Date on which the compliance was revised.
- Title, version and URI of the Guidelines WCAG 2.0.
- Compliance level reached (A, AA or AAA)
- Scope: accurate enumeration of pages that comply with WCAG Guidelines 2.0.
- List of the technologies on which the content depends.

In Figure 1, the criteria of success are presented with their conformity levels for each one of the principles of the WCAG 2.0.



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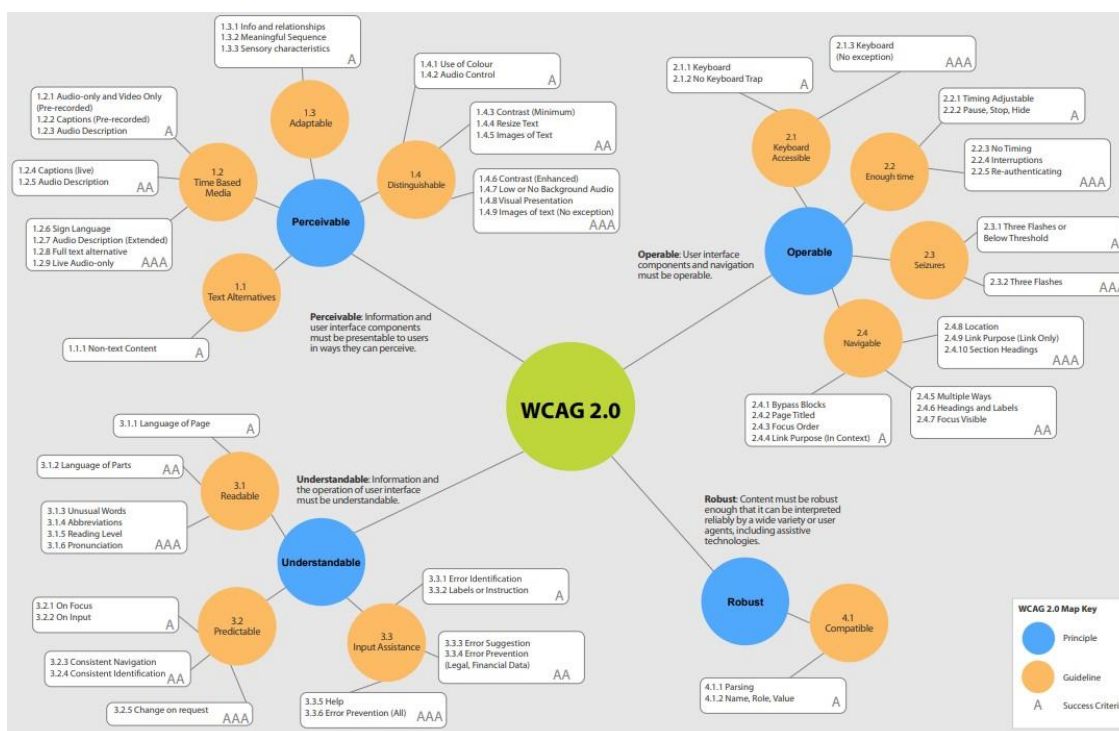


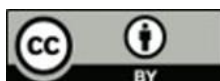
Figure 1. WCAG 2.0 Map (Stamford Interactive, 2012).

2.3 Regulations on web accessibility in Ecuador

On January 28, 2014, the Ecuadorian Institute of Standardization published in the Official Register No 171 the approval of the standard NTE INEN-ISO/IEC 40500 "Information Technology-accessibility Guidelines for W3C Web content (WCAG) 2.0 (ISO/IEC 40500:2012, IDT)" (Instituto Ecuatoriano de Normalización, 2014). On February 10, 2016, the Ecuadorian Standardization service published the Ecuadorian Technical Regulations RTE INEN 288 "Accessibility for the Web content" (Instituto Ecuatoriano de Normalización, 2016). This regulation entered into force on August 8, 2016 and establishes: i) it applies to the Web content published in public and private sector websites that provide public services, ii) the level of conformity AA, established in the standard NTE INEN-ISO/IEC 40500, III). Finally, two transitional provisions are included on the deadline to comply with the regulation and the standard:

- i. It applies to Web content published on public and private sector websites that provide public services.
- ii. The conformity level AA, established in the standard NTE INEN-ISO/IEC 40500, must be fully satisfied.
- iii. Finally, two transitional provisions on the deadline for compliance with the regulation and the standard are included:

- **First transitory:** The owners of the websites to which this technical regulation applies will have a period of 2 years to adapt the existing websites at the time of the entry into force of the regulation according to the conformity level of the current NTE INEN. On August 8, 2018, all Ecuadorian websites that provide a public service must be accessible WCAG 2.0 level A.



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- **Second transitory:** The owners of the websites to which this technical regulation applies will have a period of 4 years to adapt their existing websites at the time of the regulation's compliance with the AA level of the current INEN standard. On August 8, 2020, all Ecuadorian websites that provide a public service must be accessible level AA WCAG 2.0.

In Addition, the Ecuadorian Technical Regulations RTE INEN 288 "Accessibility for the web content" issues sanctions regime: "The owner of the website that fails to comply with the provisions of this technical regulation will receive the penalties provided for the Law No. 2007-76 of the Ecuadorian Quality System, Organic Law of Communication and other laws in force".

2.4 Web Accessibility Assessment Tools

Web accessibility assessment tools are software programs or online services that determine whether web content complies with accessibility guidelines (World Wide Web Consortium, 2006). A tool of this type can never replace the review made by an expert in web accessibility, so these should be used as a first step, but not the only one (Luján-Mora, 2018a). Although they are very useful, it should be taken into account that they have certain limitations and are not able to identify all accessibility problems. They are not enough to ensure that a website is 100% accessible; therefore, the automatic review must be completed with another manual (Confederación de Empresarios de Andalucía, 2010).

2.4.1 Examiner

Examiner¹ is an online service to automatically evaluate the accessibility of a website, using as reference some techniques recommended by the WCAG 2.0. It awards a score between 1 and 10 as a quick indicator of page accessibility and provides a detailed report of the tests performed.

2.4.2 Web Accessibility Test (TAW)

TAW² is an online automatic tool for analyzing website accessibility. TAW's objective is to check the level of accessibility achieved in the design and development of websites in order to allow access to all people regardless their differentiating characteristics. It is intended for both inexperienced users who want to know the degree of accessibility of their website and for website managers, developers, website designers, etc.

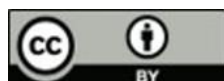
2.4.3 Markup Validation Service

The Markup Validation service³ is a free W3C service that helps verify the validity of Web documents written in HTML or XHTML markup languages. These languages are defined by technical specifications, which generally include a formal, machine-readable grammar (and vocabulary). Comparing a document with these restrictions is called validation, and this is done by the markup validator.

¹ Examiner: Web Accessibility Assessment. The information is obtained from <http://examinator.ws/>

² TAW: Web Accessibility Test. The information is obtained from <https://www.tawdis.net/>

³ Markup Validation Service: W3C Markup Validator. The information is obtained from <https://validator.w3.org/about.html/>



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2.4.4 CSS Validation Service

CSS Validation Service⁴ of the W3C CSS Validation Service is a free software created by the W3C to help web designers and developers validate Cascading Style Sheets (CSS). What this tool does is to help people who write CSS to check, and correct, if necessary, their Cascading Style Sheets. Not only does it compare the stylesheets with the CSS specifications, but it also helps to find common errors, typographical errors, or incorrect CSS uses and some use risk.

3. Related work

In the year 2016, an investigation carried out the evaluation of 15 web portals, classified in 7 hospitals, 5 clinics and 3 medical centers using the online tool TAW. The results determine that the health institutions analyzed do not comply with the guidelines of the WCAG 2.0 with a conformity level A. Therefore, the authors conclude that the web portals are not accessible and their biggest problem is in the principle of robustness (Campoverde-Molina, Vizñay-Durán and Reyes-Espinosa, 2016).

A study presented in the year 2016 showed the preliminary results of an accessibility analysis of 31 web portals of educational institutions and schools in Cuenca, Ecuador. It was established in the results that the portals do not comply with the guidelines of the WCAG 2.0 with a conformity level A and its biggest problem is in the principle of robustness. In addition, the author concludes that 92% of the problems in web portals are warnings, 6% are errors and 2% are unverified points that require a complete manual analysis (Campoverde-Molina, 2016).

In the year 2016, an investigation carried out the accessibility evaluation of the websites in the top 20 universities with high academic prestige in the world classified by Webometrics. From the results, the authors conclude that many of the websites analyzed do not reach an acceptable compliance level. Universities with high academic prestige do not show a higher level of web accessibility. In evaluating the websites of the universities, the authors have identified that there are significant barriers for a big number of users (Acosta-Vargas, Luján-Mora and Salvador-Ullauri, 2016).

In the year 2016, an investigation conducted a study of 328 samples of family accommodation websites in Malaysia using the Automated Assessment Tool (Achecker) with the WCAG 2.0. The results show that there are 6 critical key accessibility errors:

- Non-textual content: img, alternative text (1.1.1).
- Information relations: input (1.3.1).
- Contrast: link, text color (1.4.3).
- Link purpose: anchor, text (2.4.4).
- Page language: HTML (3.1.1).
- Labels or instructions: Body, input (3.3.2).

⁴CSS Validation Service: About the CSS Validator. Information obtained from <https://jigsaw.w3.org/css-validator/about.html>



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In Addition, this research provides recommendations for improving the accessibility levels of family accommodation websites in Malaysia (Rahim Wan Mohd Isa, Hakim Suhaimi, Ariffn, Fatimah Ishak and Mohd Ralim, 2016).

In the year 2016, the evaluation of accessibility of 5 websites of the Peruvian State was carried out from its legislation, in the recommendations WCAG 1.0 and WCAG 2.0 of the W3C. To this end, the authors identified the sites that have greater access and importance at the time of the investigation. The results throw a set of deficiencies such as: color errors, audio, text, non-textual content and alt in images (Alt attribute in HTML is used to describe or contextualize an image to visually impaired people who use screen readers), errors in the interface components presented to the user, links without contents and inappropriate browsing order by tabulation (Sam-Anlas and Stable-Rodríguez, 2016).

In a study conducted in 2017, the policy evaluation of Web accessibility was carried out adopted by 51 websites of universities in the world, classified by Webometrics. The authors conclude that 44 out of the 51 evaluated universities did not reach an acceptable level of web accessibility policies. The results show that although most universities have web accessibility policies, most policies have serious problems. The deficiencies identified in this work are sufficiently serious to violate the legal accessibility rights of people with disabilities. They pose a threat to these people who can sue against the websites according to the laws and regulations executed in each country (Acosta-Vargas, Luján-Mora and Salvador-Ullauri, 2017).

In another investigation, the accessibility of 44 Ecuadorian universities was assessed using the online software examiner. From the results obtained, the authors concluded that the websites of the institutions of higher education are not accessible. None of the universities evaluated complies with the Ecuadorian Technical Regulations RTE INEN 288 which is in force and is obligatory for institutions of higher education. The average accessibility score for the Webpages analyzed is 5.0 over 10. From the 54 errors of accessibility that the Examiner tool identified and the 8.970 elements in which these errors have been incurred, it is concluded that: 59% correspond to failures in the principle of perceptible accessibility, 24% at the operable principle, 10% at robust and 7% at understandable; 50% correspond to errors in the conformity level A, and 25% in each of the conformity levels AA and AAA, respectively (Acosta and Luján-Mora, 2017).

In another research, it was stated that the accessibility of websites is an easy way for everyone to access information and be easily understood. The results of the analysis of the 13 websites of the universities analyzed in West Java, Indonesia, were presented in a graph showing the rate of errors of each university. The errors occurring in almost all the websites were: content without text, information and relationships, title of the page, purpose of the link, language of the page, language in the first page, labels and instructions, analysis and name, function, value criteria (Arasid *et al.*, 2018).

The research carried out by Acosta-Vargas, Acosta and Luján-Mora (2018) described the problems of web accessibility identified in 348 websites of universities in Latin America according to their classification in Webometrics. The results show that the websites of the universities have frequent problems related to the lack of alternative text in the images. It is observed that the websites of the universities analyzed violate the Web accessibility requirements based on WCAG 2.0. The many problems identified in the websites indicate that it is necessary to strengthen the policies of web accessibility in each country and to apply standards to make the websites more inclusive.



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The research conducted by Ortiz Ruiz (2019), aimed to analyze policies and regulations in Chile that guide Web design to guarantee an accessibility level according to the current society. This research stipulates that there are laws and regulations on the rights of people with disabilities that have as a requirement an AA level for government sites developed based on the WCAG 2.0 of the W3C. Based on these references, the initial pages developed by the Ministry of Education for the access of teachers, students, proxies, parents and the general public were evaluated. All turned out to be non-accessible sites, with the most recurrent weaknesses being the absence of alternative texts in images, videos or other elements that demand it, as well as unclear links for assertive navigation and basic accessibility requirements.

In an investigation carried out in 2019, it was announced that a correct methodology should be applied in the correction of errors in the design of the websites in order to avoid poor quality products. In this way, the evaluation is a process that, in addition to visualize the different errors, becomes a quality control tool that allows to develop reliable and usable products. Nevertheless, the comparative evaluation allows to determine the errors with more presence in each of the sites under study, allowing to identify the areas that need more attention (Rodríguez V., Rosas Chávez and Suárez Naranjo, 2019).

4. Methodology

The steps used in this research are described below:

1. **Selection of educative institutions:** the information of the period 2017-2018 of the Master Archive of Educational Institutions (AMIE) of the Ministry of Education of Ecuador was used (Ministry of Education of Ecuador, 2018).
2. **Selection of a representative sample:** 29 websites were selected with the .edu.ec domain. According to the domain types in Ecuador (Network Information Center, 2019), the domain name .edu.ec is "only for entities, institutions or educational organizations such as schools, universities, schools and institutes registered in Ecuador". 7 sample websites were selected from each of the web portal, and all the portals with less than 7 websites.
3. **Evaluation of the selected pages of the Web portals:** To determine the accessibility errors of the 29 main pages and 162 Web pages, the Examinator, TAW, Markup Validation Service and CSS Validation Service online tools were used. The main pages are the first impression as well as the presentation letter given to the user who visits a website. In addition, these pages allow users to move among the other sites on the web portals.
4. **Compliance level:** In order to establish the compliance level, the icons certifying the accessibility of the sites by the W3C in HTML, CSS and their conformity levels A, AA and AAA were verified. Based on the data obtained from the evaluation of the automatic tools, the compliance level with the success criteria of the WCAG 2.0 is corroborated with a conformity level A.

5. Results

5.1 Selection of the web portals according to the.edu.ec domain

The Ministry of Education of Ecuador (2018) in AMIE, collects data from public and private institutions (students, teachers, infrastructure, among others) at the national and territorial level at the beginning and at the end of the school year. Information is available from the period 2009-2010 to 2017-2018. With the information of the period 2017-2018 it has been



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determined that there are 529 establishments among education centers, schools and educational institutions in Cuenca-Ecuador.

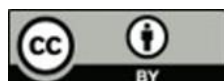
According to the types of domain in Ecuador, the domain name .edu.ec is "only for entities, institutions or educational organizations, such as schools, universities, schools and institutes registered in Ecuador". This has enabled to select 28 web portals with the .edu.ec domain and a portal with the .ec domain as shown in Table 2.

| Nº | Abbreviations | Educative institutions | URL web portal |
|----|-----------------|--|--|
| 1 | Aaschool | Escuela de Educación Básica Particular Asian American School | www.aaschool.edu.ec |
| 2 | Adistanciabg | Colegio de Bachillerato Particular Bill Gates | colegioadistanciabg.edu.ec/index.php |
| 3 | Amauta | AMAUTA | www.amauta.edu.ec |
| 4 | Americancollege | Unidad Educativa American School | www.americanschool.edu.ec |
| 5 | Uepcc | Unidad Educativa Particular Católica de Cuenca | plantelesanexos.ucacue.edu.ec |
| 6 | Benignomalo | Unidad Educativa Benigno Malo | www.colegiobenignomalo.edu.ec |
| 7 | Casc | Colegio Alemán Stiehle de Cuenca | www.casc.edu.ec |
| 8 | catalinas | Unidad Educativa Particular Rosa de Jesús Cordero | www.catalinas.edu.ec |
| 9 | comilcue | Unidad Educativa Abdón Calderón | www.comilcue.edu.ec |
| 10 | continental | Unidad Educativa Continental | www.continental.edu.ec |
| 11 | delasallecuenca | Unidad Educativa Particular Hermano Miguel de la Salle | www.delasallecuenca.edu.ec |
| 12 | herlindatoral | Unidad Educativa Herlinda Toral | www.herlindatoral.edu.ec |
| 13 | laasuncion | Unidad Educativa la Asunción | www.laasuncion.edu.ec |
| 14 | latinoamericano | Unidad Educativa Latinoamericano | www.latinoamericano.edu.ec |
| 15 | madrid | Unidad Educativa Madrid | www.unidadeducativamadrid.edu.ec |
| 16 | manueljcalles | Unidad Educativa del Milenio Manuel J Calle | www.colegiomanueljcalles.edu.ec |
| 17 | mariorizzini | Unidad Educativa Mario Rizzini | www.mariorizzini.edu.ec |
| 18 | santana | Unidad Educativa Santana UNESA | www.santana.edu.ec |
| 19 | Sscc | Unidad Educativa Particular Sagrados Corazones | www.sccc-cuenca.edu.ec |
| 20 | sudamericano | Unidad Educativa Sudamericano | www.sudamericano.ec |
| 21 | Uebi | Unidad Educativa Bilingüe Interamericano | www.uebi.edu.ec |
| 22 | uelac | Unidad Educativa Liceo Americano Católico | www.uelac.edu.ec |
| 23 | uemo | Unidad Educativa Misioneros Oblatos | www.uemo.edu.ec |
| 24 | ueoblatas | Unidad Educativa Particular Corazón de María | www.ueoblatas.edu.ec |
| 25 | ueporvenir | Unidad Educativa Porvenir | www.ueporvenir.edu.ec |
| 26 | Uets | Unidad Educativa Técnico Salesiano | www.uets.edu.ec |
| 27 | uesmacuenca | Unidad Educativa Salesiana María Auxiliadora | www.uesmacuenca.edu.ec |
| 28 | Unidadborja | Unidad Educativa Particular Borja | www.unidadborja.edu.ec |
| 29 | Verbo | Unidad Educativa Cristiana Verbo | www.verbo.edu.ec |

Table 2. Web portals of the educative institutions of Cuenca

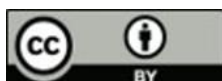
5.2 Selection of websites

After having made the search of the websites in the Web portals of the educative institutions of Cuenca, it is determined that the webpages that students use more frequently to make their consultations or any academic activity are:



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1. aaschool: Home page, the campus, virtual tour, education, languages, services, contact us
2. adistanciabg: Home page, academic information (*8vo básica*), student counseling, Secretariat, English, virtual classroom, school, high school.
3. amauta: Home page, Ecuador, about us, accommodation with families, programs, FAQs, contact us.
4. americancollege: Home page, admission process, scholarships, prices, enrollment, virtual classroom, virtual library.
5. benignomalo: Home page, students, contact us, enrollment sheet, videos, events, online library.
6. casc: Home page, kindergarten, elementary, high school, activities, admission, contact us.
7. catalinas: Home page, professors, parents, program.
8. comilcue: Home page, grades, submission of homework, contact us.
9. continental: Home page, academic information, virtual classroom, program, mission and vision, web mail, our professors.
10. delasallecuenca: Home page, about us, academic programs, academic structure, students, sports, contact us.
11. herlindatoral: Home page, ideas, section, mission, pictures, news, contact us.
12. laasuncion: Home page, Educative institutions la asunción, enter the academic system, news and events, journal indicios, virtual classroom, contact us.
13. latinoamericano: Home page, elementary, middle school, high school, academy.
14. madrid: Home page, our history, mission and vision, location, calendar, history.
15. manueljcalles: Home page, grades, monography.
16. mariorizzini: Home page, educative levels, schedule, app for the mobile, register, location, contact us.
17. santana: Home page, about santana, programs and projects, news, international high school, grades, open school.
18. ssc: Home page, academic offer, news, gallery, contact us, calendar, library.
19. sudamericano: Home page, academic program, news, admission, contact us, grades, prices.
20. uebi: Home page, events, virtual classroom, gallery, contact us, administrative staff, professors.
21. uelac: Home page, about us, gallery, contact us, news, Schedule of elementary school, events.
22. uemo: Home page, about us, elementary, middle school, high school, program.
23. ueoblatas: Home page, academic information, contact us, journalist club, grades, DECE, Institutional policies.
24. uepcc: Home page, information, enrollment from elementary to high school, enrollment for kindergarten, fee, payment distribution.
25. ueporvenir: Home page, mission and vision, Schedule for assisting the parents, location, authorities, contact us, academic follow-up
26. uesmacuenca: Home page, virtual classroom (enter page), academic information, news, letters, baccalaureate in science, elementary school.
27. uets: Home page, professors, news, location, specializations, the building, virtual classroom.
28. unidaborja: Home page, admission, elementary, middle school, high school, courses, contact us.
29. verbo: Home page, about us, the school, news, contact us, location.



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Obtaining as a result 191 web pages of the portals of the educational institutions of Cuenca. Pages such as notes, task entry and virtual classroom will only be logged on for not having passwords for entry and evaluation of their contents.

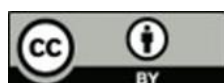
5.3 Evaluation of home pages

In order to evaluate the accessibility of the main pages, the Examiner tool presents a complete battery of 100 automatic tests, which are suitable for a first approximation towards web accessibility. It has been observed that the websites of the educational institutions were not designed with a vision of web accessibility, so the use of automatic tools allows to identify the frequent errors that the technical team at each institution can solve in the first instance (Amado-Salvatierra, Linares, García, Sánchez and Rios, 2012). After having evaluated the main pages of the web portals of the educational institutions, the results can be seen in Table 4 for each of the principles of the WCAG 2.0 perceivable (P), operable (O), understandable (U), robust (R) and HTML and CSS errors.

Using Examiner, an average of 5.43 is reached in the accessibility compliance of the home pages. With the TAW evaluation, it is determined that 86% are warnings that should be reviewed in the design and content of the main pages. 11% are problems that must be corrected according to the compliance criteria (success) of the WCAG 2.0. 3% are unverified points that require a complete manual analysis for the compliance. In the evaluation of HTML content with Markup Validation Service, 54% are errors and 46% warnings. In evaluating CSS content with CSS Validation Service, 3% are errors and 97% warnings.

A Pareto diagram was performed using the values obtained from the Examiner evaluation in order to graphically present the percentage of accessibility fulfillment of the educational institutions of Cuenca, see table 4.

| Educative institutions | Pages analyzed | Examinator | TAW | | | | Markup Validation Service | CSS Validation Service |
|------------------------|----------------|------------|-----|----|----|------|---------------------------|------------------------|
| | | | P | O | U | R | Errors | Errors |
| Aaschool | 7 | 4.6 | 26 | 12 | 3 | 75 | 10 | 4 |
| adistanciabg | 7 | 8.2 | 73 | 31 | 6 | 726 | 0 | 73 |
| Amauta | 7 | 4.8 | 48 | 25 | 5 | 44 | 38 | 30 |
| americancollege | 7 | 4.6 | 99 | 41 | 9 | 38 | 14 | 13 |
| benignomalo | 7 | 4.8 | 51 | 27 | 8 | 17 | 2 | 42 |
| Casc | 7 | 5.8 | 104 | 61 | 2 | 318 | 10 | 21 |
| Catalinas | 4 | 5.3 | 129 | 12 | 2 | 108 | 3 | 40 |
| Comilcue | 4 | 5.6 | 74 | 24 | 6 | 11 | 288 | 201 |
| continental | 7 | 5.3 | 91 | 14 | 3 | 408 | 34 | 6 |
| delasallecuenca | 7 | 4.6 | 192 | 16 | 2 | 159 | 30 | 51 |
| herlindatorial | 7 | 5.4 | 90 | 55 | 9 | 402 | 385 | 294 |
| laasuncion | 7 | 3.1 | 16 | 15 | 3 | 3 | 92 | 126 |
| latinoamericano | 7 | 5.5 | 73 | 31 | 4 | 9 | 13 | 1 |
| Madrid | 6 | 5.8 | 8 | 11 | 2 | 571 | 10 | 0 |
| manueljcalles | 3 | 7.2 | 34 | 20 | 3 | 25 | 11 | 10 |
| mariorizzini | 7 | 6.3 | 36 | 21 | 11 | 10 | 1 | 9 |
| Santana | 7 | 5.0 | 35 | 31 | 5 | 62 | 3 | 1 |
| Sccc | 7 | 4.2 | 53 | 31 | 2 | 166 | 38 | 20 |
| sudamericano | 7 | 6.1 | 59 | 41 | 9 | 13 | 15 | 24 |
| uebi | 7 | 5.2 | 137 | 35 | 20 | 442 | 1 | 8 |
| uelac | 7 | 5.5 | 47 | 27 | 11 | 303 | 23 | 35 |
| uemo | 7 | 5.3 | 214 | 37 | 10 | 1113 | 5 | 10 |
| ueoblatas | 7 | 5.9 | 41 | 30 | 5 | 170 | 21 | 9 |
| uepcc | 6 | 5.7 | 27 | 20 | 13 | 452 | 5 | 19 |



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| | | | | | | | | |
|---------------------------------|------------|--------------|-------------|------------|------------|-------------|-------------|-------------|
| ueporvenir | 7 | 5.4 | 37 | 26 | 2 | 16 | 13 | 123 |
| Uesmacuenca | 7 | 4.5 | 200 | 24 | 2 | 125 | 36 | 33 |
| Uets | 7 | 7.5 | 72 | 31 | 7 | 661 | 28 | 12 |
| unidadborja | 7 | 5.6 | 356 | 116 | 2 | 181 | 18 | 143 |
| verbo | 7 | 4.7 | 38 | 25 | 5 | 71 | 39 | 18 |
| TOTAL: | 191 | 157.5 | 2460 | 890 | 171 | 6699 | 1186 | 1376 |
| Total errores / páginas: | | 5.43 | 12.9 | 4.7 | 0.9 | 35.1 | 6.2 | 7.2 |

Table 4. Accessibility analysis of the home pages of educative institutions in Cuenca

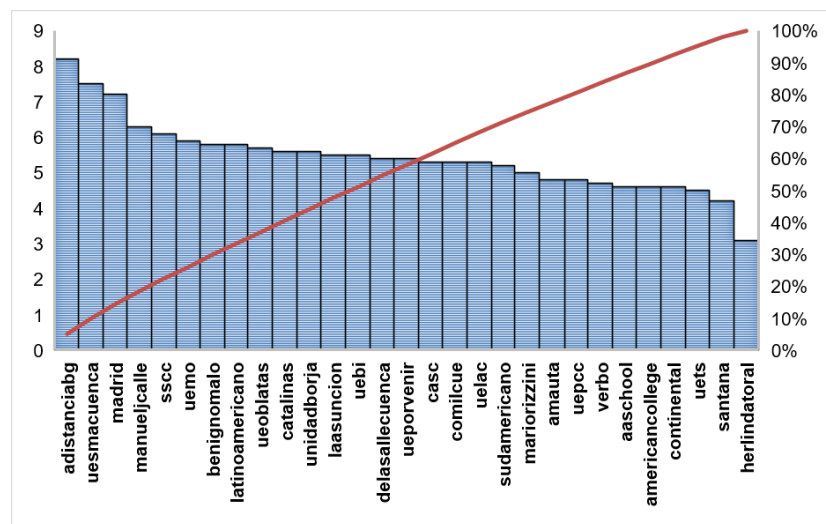
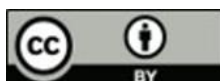


Figure 2. Pareto diagram of the educative institutions of Cuenca

5.4 Evaluation of the web portals

After having evaluated the web portals of the educative institutions. The errors are determined by each of its perceivable (P), operable (O), understandable (U) and robust (R) principles, and finally the errors HTML and CSS, as can be seen in Table 5.

| Educative institutions | Pages analyzed | TAW | | | | Markup Validation Service Errors | CSS Validation Service Errors |
|------------------------|----------------|-----|-----|----|------|----------------------------------|-------------------------------|
| | | P | O | U | R | | |
| aaschool | 7 | 250 | 120 | 21 | 555 | 25 | 4 |
| adistanciabg | 7 | 332 | 191 | 49 | 3923 | 32 | 32 |
| amauta | 7 | 284 | 115 | 35 | 321 | 31 | 30 |
| americacollege | 7 | 320 | 248 | 64 | 367 | 6 | 25 |
| benignomalo | 7 | 246 | 154 | 44 | 72 | 10 | 36 |
| Casc | 7 | 342 | 189 | 30 | 2232 | 5 | 21 |
| catalinas | 4 | 366 | 43 | 12 | 375 | 3 | 40 |
| comilcue | 4 | 200 | 62 | 29 | 40 | 95 | 67 |
| continental | 7 | 473 | 115 | 34 | 1646 | 10 | 1 |
| delasallecuenca | 7 | 997 | 92 | 20 | 870 | 17 | 36 |
| herlindatoral | 7 | 435 | 189 | 55 | 1949 | 313 | 237 |
| laasuncion | 7 | 271 | 184 | 61 | 283 | 15 | 51 |
| latinoamericano | 7 | 491 | 84 | 17 | 57 | 8 | 17 |
| madrid | 6 | 72 | 66 | 11 | 2888 | 2 | 0 |
| manuelcalle | 3 | 71 | 38 | 13 | 30 | 30 | 9 |
| mariozizini | 7 | 96 | 78 | 38 | 23 | 5 | 1 |
| santana | 7 | 132 | 128 | 33 | 315 | 5 | 1 |



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| | | | | | | | | |
|---------------|---|------------|--------------|-------------|-------------|--------------|------------|-------------|
| Sccc | 7 | 454 | 499 | 44 | 1177 | 28 | 28 | |
| sudamericano | 7 | 578 | 225 | 64 | 969 | 18 | 23 | |
| uebi | 7 | 424 | 187 | 91 | 2837 | 7 | 8 | |
| uelac | 7 | 390 | 202 | 76 | 1756 | 5 | 16 | |
| uemo | 7 | 501 | 147 | 58 | 7435 | 8 | 10 | |
| ueoblatas | 7 | 244 | 137 | 76 | 1026 | 13 | 6 | |
| uepcc | 6 | 358 | 163 | 64 | 2827 | 14 | 17 | |
| ueporvenir | 7 | 238 | 146 | 33 | 151 | 17 | 120 | |
| uesmacuenca | 7 | 704 | 126 | 52 | 552 | 29 | 34 | |
| Uets | 7 | 736 | 252 | 43 | 3828 | 172 | 26 | |
| unidadborja | 7 | 712 | 466 | 38 | 1106 | 6 | 139 | |
| verbo | 7 | 258 | 168 | 50 | 498 | 28 | 18 | |
| TOTAL: | | 191 | 10975 | 4814 | 1255 | 40108 | 958 | 1054 |

Table 5. Accessibility analysis of the web portals of the educational institutions of Cuenca

With the TAW evaluation, it is determined that 87% are warnings that should be reviewed in the design and content of the Web pages. 9% are problems that must be corrected according to the compliance criteria (success) of the WCAG 2.0. 4% are unverified points that require a complete manual analysis for their compliance. In the evaluation of HTML content with Markup Validation Service, 52% are errors and 48% warnings. In evaluating CSS content with CSS Validation Service, 3% are errors and 97% warnings.

It is worth mentioning that errors in Markup Validation Service (HTML) and CSS Validation Service were averaged as a final result, since the errors were identical, because the same HTML and CSS code were used on all web pages of the Web portal. In Table 6, the summary of the errors of the web portals of the 29 educational institutions can be seen.

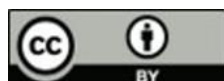
| | P | O | U | R | Errors HTML | Errors CSS |
|----------------|-------|-----|-------|------|-------------|------------|
| Minimum | 71 | 38 | 11 | 23 | 2 | 0 |
| Mean | 342 | 147 | 43 | 870 | 14 | 23 |
| Media | 378.4 | 166 | 43.28 | 1383 | 33.07 | 36.31 |
| Maximum | 997 | 499 | 91 | 7435 | 313 | 237 |

Table 6. Summary of accessibility errors of web portals

The greatest number of errors is in the robust (R) principle, because the analyzed web pages are not robust enough to be reliably interpreted by a wide variety of user agents, including technical aids (processing, name, function, and value). Correcting errors in HTML or XHTML markup languages and CSS cascading style sheets on web portals will contribute to compliance with the principles of WCAG 2.0 and its compliance levels.

5.5 Compliance level

After having analyzed the web portals of the educational institutions of Cuenca, Ecuador, it is observed that none has the icons that certify the accessibility of the sites by the W3C in HTML, CSS or its conformity levels A, AA and AAA. According to the results obtained, it is determined that it is necessary to correct errors in all the web portals analyzed of the educational institutions of Cuenca. It is evident the non-fulfilment with the first transitory of the Ecuadorian technical regulation RTE INEN 288, which establishes that all the Ecuadorian websites that provide a public service must be accessible WCAG 2.0 level A until August 8, 2018. Educative institutions must undertake with responsibility the regulatory compliance of existing accessibility to provide universal access to their web portals.



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6. Conclusions

The greatest number of errors is because the analyzed web pages are not robust enough. The content must be robust so that it can be interpreted by a wide variety of user agents, including supportive technologies. The 22 websites of educational institutions use content management systems⁵ (8 WordPress, 9 Joomla, 3 DNN and 2 Wix), the remaining 7 are designed and programmed. The previous assessment provides a first impression of the structure and design of the websites, considering that the results are preliminary. In order for the results to be reliable and complete, manual tests should be carried out with experts.

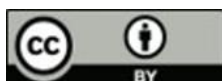
Despite the importance of web accessibility, its fulfillment in the Web portals of the educational institutions analyzed is limited. It is necessary to correct errors in all the analyzed web portals of the educative institutions of Cuenca. For the average number of errors found, it is more feasible for educational institutions to redesign their web portals in order to comply with the web accessibility guidelines. They can also improve the fulfillment of the WCAG 2.0, with a hard work of revising and correcting the source code of their web portals. For this, developers must understand accessibility, learn how to implement it and know its legal obligations. The benefits would be to provide universal access to the web and improve its usability. According to WHO statistics (Banco Mundial, 2011, pág. 5), and CONADIS (Consejo Nacional para la Igualdad de Discapacidades, 2019) people with disabilities increase by leaps and bounds and web accessibility is a mechanism that improves the quality of life of these people.

The use of the standard NTE INEN-ISO/IEC 40500 in Ecuador requires that the web portals of the educational institutions of Cuenca be accessible. This is a hard work that software developers must undertake to meet the web accessibility guidelines and their compliance levels. If developers or programmers are not aware of the current regulations and apply it in the development of web pages, then universal access to the web is not being promoted. The challenge of the educative community is to undertake web accessibility projects for the fulfillment of the WCAG 2.0 on their websites with a conformity level AA, as established in the Ecuadorian technical regulations RTE INEN 288 "Accessibility for Web content" until August 2020. A limitation of this research is the size of the sample taken from the Web portals of the educational institutions of Cuenca, which does not make it possible to generalize the results obtained.

Acknowledgment

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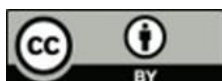
⁵Content management systems (CMS): ¿which CMS is used by this site? Obtained by <https://whatcms.org/>



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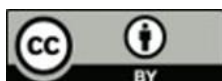
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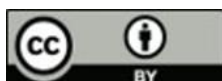
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