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PRESENT AND FUTURE OF WEB CONTENT ACCESSIBILITY: AN ANALYSIS

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Original scientific paper

The Web was created as a universal network of knowledge. It represented a huge qualitative and quantitative leap in terms of acquisition and processing of information. However, even today, significant barriers make difficult the access of a large number of citizens to the web, including disabled users and old people with diminished skills as an effect of age. Accessibility is the feature which facilitates access to and successful usage of a web site or service for as many people as possible, regardless of their personal limitations or limitations imposed by their environment. This article reviews the main aspects of web accessibility and its future, passing through the effective implementation of guidelines known as 2.0, which ensure compliance with existing legislation at national and international level.

Keywords: disability, universal design, usability, Web accessibility, Web content

Sadašnjost i budućnost dostupnosti sadržaja Web-a: analiza

Izvorni znanstveni članak

Web je stvoren kao univerzalna mreža znanja. Bio je to ogroman kvalitativni i kvantitativni skok u odnosu na pristup informacijama i njihovu obradu. Međutim, čak i danas, postoje znatne prepreke pristupu mreži velikog broja građana, uključujući osobe s invaliditetom i stare ljude smanjenih sposobnosti kao posljedice godina. Mogućnost pristupa je značajka kojom se olakšava pristup i uspješno korištenje web lokacije ili usluge što većem broju ljudi, bez obzira na njihova osobna ograničenja ili ograničenja nametnuta okolinom. Ovaj članak daje pregled osnovnih značajki mogućnosti pristupa mreži sada i u budućnosti, osvrćući se na uspješnu primjenu smjernica poznatih kao 2.0, kojima se osigurava podudaranje s postojećim zakonskim odredbama na nacionalnom i internacionalnom nivou.

Ključne riječi: dostupnost mreže, invaliditet, iskoristivost, sadržaj mreže, univerzalni dizajn

1 Introduction

The term accessibility is defined as a degree to which a product, device, or service can be accessed and used by humans. It is especially important for those who are influenced by disabilities but it may also be useful for anybody who has to use or access a system in adverse condition (e.g. using a mobile device in a tight space with poor light conditions). Promotion of accessibility normally relies on certain facilities that help to overcome obstacles or barriers to accessibility. The goal is to enable all people to perform the same actions which could be carried out by a person without any disability or adverse condition. These facilities are called assistive technology: e.g. the Braille alphabet, the sign language, a wheelchair or sound signals for traffic lights.

Web accessibility is related to the practice of generating web pages accessed by people with all types of abilities and disabilities. Sites correctly designed, developed and edited enable equal access to information and functionality for all users. Its importance grows continuously due to the development of the Information Society. Accessibility is now linked with the respect to the basic rights of citizens to access information; of course, it attracts huge attention due to its potential for additional benefits like increasing audience and market share of a Web site, improving efficiency, showing social responsibility and reducing potential legal issues.

Accessibility mainly benefits people who have some degree of disability, such as:

- Visually impaired: blind people and those with poor vision or with problems for colour perception.
- Hearing impaired: those with quantitative or qualitative alterations of the correct perception of sounds.
- People with special needs: those affected by reduced mobility or control of movements as well as people affected by epilepsy, dyslexia or poor memory.

Nevertheless, web accessibility also benefits other user groups such as [1]:

- Elderly users with aging problems associated with a gradual diminishing of abilities.
- Users affected by circumstances arising from the environment as low or adverse light, noisy environments, confined space, etc.
- Users accessing Internet services using equipment and connections with limited capabilities, (e.g. reduced mobile devices).
- Users who are not fluent in the corresponding language or jargon or those with low level of literacy.
- Inexperienced or non-self-confident users in the use of various electronic devices.

This review article presents an overview of the current situation and future trends of the field of the Web accessibility. Section 2 describes the current situation in this area and also reviews the regulations and international applicable laws. Section 3 analyses and discusses the future of the Web accessibility, especially influenced by the web accessibility guidelines known as 2.0. Finally, Section 4 presents some conclusions.

2 The literature survey

The creation of accessible websites has been marked from the beginning by the fear of web designers to deal with the accessibility issues, largely caused by a lack of information or poor techniques for accessible design. People often think an accessible website is more expensive and requires much more time than a

conventional system. This has been revealed as a false assumption. Benefits of providing access to a larger population are usually greater than the effort and time required by a designer with proper skills to implement accessible sites. Of course, the cost of implementing most of the accessible features of a site, whether originally planned or at the time of redesign is much less than what is required when modifying an inaccessible website.

Another myth of web design is the belief that all you need for the accessibility of a website is creating an alternate "text only" version, without pictures or colours, etc. In general, an accessible website could also be attractive, but you have to meet certain requirements in order to facilitate access by people with disabilities or influenced by different barriers. These requirements have been collected and stated in a number of recommendations, standards and legal regulation related to web accessibility.

The most popular and internationally used standard is the Web Content Accessibility Guidelines (WCAG). It was created as a result of the Web Accessibility Initiative (WAI) by the World Wide Web Consortium (www.w3.org/WAI/). The W3C released version 1.0 of its web accessibility guidelines in 1999, known as WCAG 1.0 [2]. Its main objective was guiding the design of web pages to reduce barriers to information. These guidelines are widely accepted as an international standard.

WCAG 1.0 includes 14 standards or guidelines, which are general foundations of accessible design. Each of these guidelines is associated with a series of checkpoints (a total of 65) to assist the detection of possible errors. A priority rank is assigned to each checkpoint. The rank indicates how the checkpoint affects the accessibility of a web site in case it is not satisfied. The priorities ranks are the following ones:

- 1: A professional involved in web development must fulfil these control points. Failure to do this will result in the impossibility to access information in the document by one or more groups of people.
- 2: A professional should satisfy the checkpoints. Failure to do this will result in difficult access to information in the document by one or more groups of people.
- 3: A web content developer may address this checkpoint. Otherwise, it will be difficult up to a certain degree to access information in the document by one or more groups of people.

Depending on the degree of compliance with checkpoints by a certain website there are three levels of compliance:

- "A": all Priority 1 checkpoints are fulfilled.
- "AA" (Double-A): all Priority 1 and 2 checkpoints are fulfilled.
- "AAA" (Triple-A): all Priority 1, 2, and 3 checkpoints are fulfilled.

Nowadays a huge number of web pages have an AA compliance level. This is remarked at the bottom of a web page using the W3C symbol to report the level of accessibility of the page. Fig. 1 shows the symbol on the webpage of the Ministry of Education of Spain.

In other sites, a specific web page reporting compliance with accessibility requirements of the website is included. For example, Fig. 2 shows the accessibility information page of a University in Spain.

The information about policies related to the web accessibility in different countries can be found in the W3C web page [1]. The body of national legal regulations and policies addressing ICT accessibility, including the Internet and the Web, are growing permanently. There are several different legal approaches and policies:

- Some regulations establish human and civilian rights related to ICT.
- Other regulations imply that any ICT device or service purchased by government must be accessible.
- Other regulations state that any ICT service or product must be accessible to be sold in a given market

Figure 1 Website of the Ministry of Education of Spain (www.educacion.gob.es)

Figure 2 Web page about accessibility of a university

There are still other approaches. Several countries have legislation explicitly related to the WCAG guidelines: e.g. the case of Spain.

The United States has its own legislation unrelated directly to the WCAG. It is the *Section 508 of the Rehabilitation Act* [4]. Section 508 states that federal agencies' electronic and ICT systems have to be accessible to people with disabilities. All the items given in Section 508 must be applied to the development, procurement, maintenance, or use of electronic and ICT products and services. This includes software-based applications and operating systems, video and multimedia products, WLAN and intranet information systems, products related to telecommunications, self-contained products and PC and laptops. According to this law, since 2001, the government can close web portals that do not meet accessibility criteria.

The United Nations Rights and Dignity of Persons with Disabilities Convention and the Optional Protocol have been signed by many countries [5] although it is not a specific national law. According to this document, web accessibility is a right of disabled people and therefore it strongly encourages the governments to maintain their web pages to be accessible to all. However, there is not a high level of correlation between the accessibility of web pages of countries, which have signed the convention, and those ones that have not [6, 7].

In 2006, the United Nations published an audit report of web accessibility with disappointing results [8]: different countries with disability legislation in place, such as the United Kingdom, returned poor results. Even nations where website owners have been taken to court under disability legislation, such as Australia and the United States of America, did not do better. For example, Fig. 3 shows the results of the audit of accessibility of five important Web sites in China corresponding to five different sectors: travel (airline), finance (bank), media (newspaper), politics (central government representative) and retail (shop).

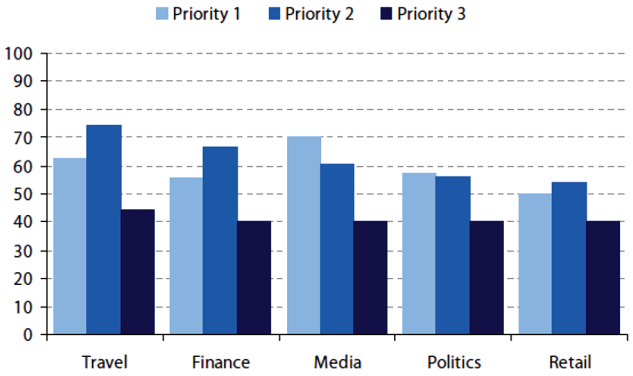

Figure 3 Web accessibility percentage of applicable WCAG 1.0 checkpoints failed in five Chinese Web sites [8]

Reference to a recent world web accessibility report which analyses the government web pages from all United Nations member states [7] shows that the Europe has the highest level of accessibility of web sites because only 24,9 % of the tests detected barriers to access. The second place is allocated to Oceania and America where 32 % ÷ 35 % of the tests detected accessibility constraints while Africa and Asia are in the last positions with 39 % ÷ 42 %. The authors of this study applied the Unified Web Evaluation Methodology for measuring web accessibility [9].

In the case of Europe, European Union also established, as part of its i2010 strategy [10], the goal of making all public Web sites barrier free by the year 2010. The comparison at continental level in the mentioned survey by Goodwin et al. [7] shows how the i2010 strategy had an impact and positive effects on web accessibility in Europe.

In Spain, since 2009, an AA level of accessibility is mandatory for the web pages of public administration, organizations and companies to be responsible for managing public services and private companies that receive public funding. This is also compulsory for companies of "special economic importance" such as banks, insurance companies, travel agencies, transportation, or supply of gas, water and electricity in the case they have more than 100 employees and a turnover above 6 million Euros.

Despite legislation, many companies and governments are failing to meet accessibility requirements in their websites. A report published in 2010 on the web pages of major companies analysed the degree of accessibility of web sites of 29 companies classified in six major sectors: finance, distribution, supply, communications, telecommunications and transport [11]. According to the study, most of the websites of major companies surveyed did not reach the AA level of accessibility. Fig. 4 shows the percentage of accessibility of the sites of the companies.

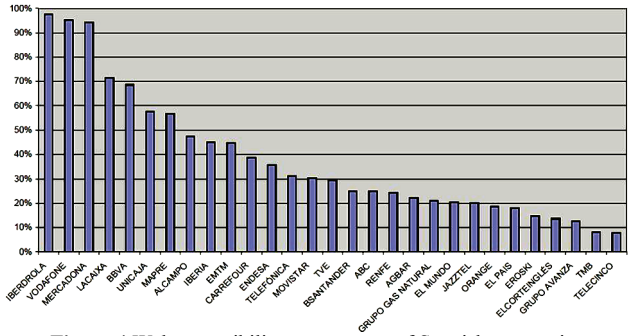

Figure 4 Web accessibility success rate of Spanish companies in 2010 [11]

The result of this analysis shows that the average of web accessibility in 2010 was 36,78 %. This report reflects that the Finance sector was the most successful in compliance with the accessibility, with a percentage of 54,97 %, while the one of Telecommunications is the least one. As noted by the study, all sites of the transport sector portals are still below 50 % of compliance with accessibility requirements stated by law.

Another sector where it is not rare to find out non-accessible web pages is social network services. Tab. 1 shows the scores (in terms of stars or asterisks) reached by each social network service included in a study of Discapnet's Observatory on ICT Accessibility [12]. This study is based on the technical analyses and the users' experiences. In this Table, a scale of stars is used:

- 0 stars represent a totally inaccessible website
- 1 star very deficient level of accessibility
- 2 stars a deficient level of accessibility
- 3 stars a moderate level of accessibility
- 4 stars a good level of accessibility
- 5 stars an excellent level of accessibility.

We can conclude from this study that accessibility of the most popular social network sites is rather low. LinkedIn is the service with the highest technical accessibility and ranked three stars in five-point scale (moderate level). Only Flickr and XING which is ranked two stars (deficient accessibility), were not included with the rest of the analysed platforms which were rated with one or zero. According to the users' experiences with these services, Flickr is the one with the highest accessibility (3 stars), followed with the ones with two stars: XING, Twitter, Facebook and LinkedIn. The lowest ratings on accessibility, according to the users' opinions,

were MySpace, Windows Live Spaces and Tuenti, with one star (very deficient accessibility) each.

According to the above data, we can conclude that, generally, evaluation of accessibility of websites by users is normally more positive than the corresponding technical analyses because the users have managed how to overcome existing constraints in order to navigate and use the web pages.

Table 1 Levels of accessibility of social network services [12]

Website	Level of accessibility* Technical analysis	Level of accessibility* User experience
LinkedIn	***	****
Flickr	***	***
XING	***	**
Twitter	**	***
Facebook	*	**
Windows live spaces	*	*
Tuenti		*
MySpace		*
General	*	**

As a final item for this global analysis of the current situation in terms of the web accessibility, it should be noted that the access to the web pages is done through a browser. So it is also important to consider the facilities for accessibility provided by the most popular web browsers. Fig. 5 shows the percentage of use of the most common browsers according to a 2011 study.

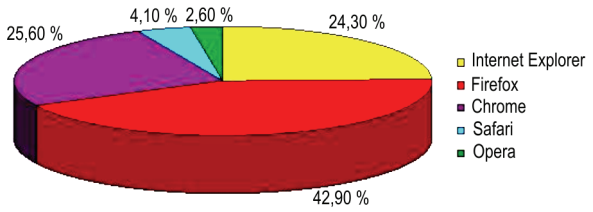

Figure 5 Usage of the most popular web browsers in 2011[13]

In general, all browsers include accessibility aids. Thus, Mozilla Firefox offers many characteristics to keep the browser and web contents accessible to all users even those with impaired vision (partial or total loss) or a limited capacity to use a keyboard or mouse [14]. Microsoft Internet Explorer also provides technical assistance, combined with the facilities included in the Windows operating system, which allows adaptation of web content to user preferences [15].

3 The future of Web accessibility

We have described the current situation regarding the easy approach of Web pages, characterized by the widespread implementation of the principles of WCAG 1.0 accessibility worldwide.

The future of the accessibility of Web content is clearly linked to the new version of WCAG Accessibility Guidelines 2.0 [16], which is not currently being implemented in web sites. In Spain, due to legal reasons, existing legislation is linked to the WCAG 1.0. So adaptation to the new guidelines 2.0 in the near future will require a review of Spanish law and an update of legislation to adapt to the new version of the standard.

The international initiatives, which promote a commitment from countries to achieve a world without barriers, are going to be considered as a compulsory reference in the coming years. In this line of action in October 2010, the U.S. President Barack Obama signed the "21st Century Communications and Video Accessibility Act", the new regulation which helps disabled people in easy accessibility and participation in the digital society.

On the European side, in November 2010, the EC (European Commission) launched a new policy to overcome the constraints which hinder disabled people to participate in society on equal terms. This is the "European Disability Strategy 2010 ÷ 2020: A Renewed Commitment to a Barrier-Free Europe" [17].

One in six people in the European Union has a certain degree of severe disabilities. This means around 80 million people who cannot fully and often participate in the society and in the economy due to physical barriers and attitudes of the rest of the society. The plan is aimed at enabling all citizens with disabilities in the European Union to take a bus without problems or surf the Internet or manage a DVD drive or vote in elections without the help from others.

The Commission has identified eight key areas of action: one of them is the accessibility, understood by the Commission as the access of people with disabilities, under the same conditions as the rest of the population, to the physical environment, transportation, technologies and information systems and communications and other facilities. There are still significant barriers in all these areas. On average, only 5 % of public websites fully conform to WCAG 1.0 accessibility guidelines. The emergence of WCAG 2.0 will surely help to increase this number, as they have been updated considering a more efficient implementation. Adaptation to the technological changes that have taken place in recent years will also help in this initiative.

It is true that there are some important problems with WCAG 1.0:

- Multiple Interpretations: different people could interpret the guidelines in their own way or in very different ways.
- Limited to W3C technologies: WCAG 1.0 is based on the assumption that HTML is the only technology with support for accessibility.
- It does not include new uses of existing W3C technologies: e.g., new uses of JavaScript in HTML + AJAX remain untreated.
- Rigid: it was drafted in the period of rapid evolution in technology access, but not updated.

WCAG 2.0 is based on version 1.0 and has been developed to be applied on a broad variety of current Web technologies and future ones. It is also intended to be testable with a mix of automated testing and human-based controls.

WCAG 2.0 is organized around four overall principles that provide the foundations for Web accessibility:

- Perceivable: it is highly recommendable that information and user interface components are presented to users in the best way for their easy perception.
- Operable: the operation of the user interface components and the navigation must be easy.
- Understandable: understandability of the information and the operation of user interface must be high.
- Robust: robustness of content must be enough so that it can be reliably interpreted by a large variety of stakeholders and agents such as assistive technologies.

Some guidelines appear under the principles. There are twelve rules which represent the basic goals which designers and authors should follow if they want to provide disabled users with more accessibility to the contents. These rules were not created to be testable. However, they represent the framework and the overall objectives that help professionals to know the criteria for success and to get a better implementation of the techniques. For each guideline, they provide testable success criteria to use WCAG 2.0 when requirements and conformance testing is necessary in design specification, purchasing and the contract regulation and agreements.

The working group has also presented a huge variety of acceptable techniques for each of the rules and success criteria in the WCAG 2.0 document. There are two categories of these techniques as follows:

- Those which are enough for fulfilling the success criteria.
- Those which are optional and go beyond the strict requirements of each success criteria. They help professionals to better implement the guidelines. Some few optional techniques address accessibility constraints that are not included in the testable success criteria. Common faults are documented wherever they are found out.

Unlike what happened with the checkpoints in WCAG 1.0, now there are guidelines that are assigned to a priority (1, 2, 3) which indicates how it affects the accessibility to a web site if the checkpoint is not satisfied. All of the following conformance requirements must be satisfied if a web page is to comply with WCAG 2.0:

1. Conformance Level includes three levels: A, AA and AAA, which are the same as in WCAG 1.0. However, Level AAA conformance is not recommended as a requirement of general policy for entire sites because it is not easy to satisfy all Level AAA Success Criteria in certain cases.
2. Full pages: conformance is recognized only for the whole web pages. It cannot be achieved if a part is excluded. We have to consider alternatives to part of a page's content, which can be obtained directly from that page as a part of it when we are evaluating conformance. When those web pages which are not under the control of authors cannot be conformed, professionals may consider getting a statement of partial conformance.
3. Complete processes: all those web pages, which are part of a series and present a process, should conform at the specified level or better.
4. Recommendations for using technologies for accessibility: only such guidelines for using technologies lead to the fulfilment of the success criteria. Any content or functionality provided in a way which does not support accessibility is also available as an accessibility-supported technique.
5. Non-Interference: although the technologies are used in a way which does not support accessibility or are used in a non-conforming way, this should not stop the access of users to the rest of the remaining contents.

Tab. 2 shows a comparative analysis of both versions, adapting the comparison carried out by the World Wide Web [18] and the Spanish National Institute of Communication Technologies [19].

Table 2 Main differences between WCAG 1.0 and WCAG 2.0

WCAG 1.0	WCAG 2.0
Hierarchy of components in the standard. The components are organized in three levels: - Guidelines (normative) - Checkpoints (normative) - Techniques with examples of implementation (only informative) *The equivalence is complex: a checkpoint of the WCAG 1.0 may correspond to several success criteria or none of the WCAG 2.0*	**Hierarchy of components in the standard.** The components are organized in four levels: - Design principles (normative) - Guidelines (normative) - Success criteria (normative) - Sufficient and advisory techniques (only informative)
Supporting documents. Only brief descriptions are given for each guideline in the main WCAG 1.0 document. Examples are presented in HTML format.	**Supporting documents.** WCAG 2.0 presents the technology-independent guidelines and success criteria without additional descriptions. The details of descriptions are given in supporting documents that are clearer in comparison to WCAG 1.0.
Checklist. WCAG 1.0 contains only basic checklist.	**Checklist.** WCAG 2.0 contains customizable quick reference for creating a short high-level checklist/ long detailed checklists.
Conformance claim. A website can declare its compliance with WCAG 1.0 in two different forms: 1) Specifying the guidelines title and URI, There are three levels: A, AA, AAA, which are satisfied by the conformance level satisfied The scope is covered by the claim (e.g. page, site, or defined portion of a site.). 2) Includes on each page:	**Conformance claim.** The following information must be included for conformance claim 1) Date of the claim 2) Guidelines title, version and URI 3) Conformance level satisfied: (Level A, AA or AAA) 4) A brief detail of the web page for example the claimed list of URIs, which

claiming conformance, one of three icons provided by W3C and link of the icon to the appropriate W3C explanation of the claim.	also include whether sub domains are part of the claim. 5) Comprehensive list of the Web content technologies relied upon. 6) a conformance logo should constitute a claim and must be accompanied by the required components of a conformance claim listed above.
Independence of technology. Limited to W3C technologies for many purposes.	**Independence of technology.** It is applicable to a wider range of web content technologies. It allows any technology that supports accessibility, not only W3C technologies. It is not necessary to use a new technology if it is necessary for the user to buy the latest product releases support (plug-in), or if it is hard to find or has a high price.
Layout and presentation. Explicitly refers to the use of CSS for layout and presentation.	**Layout and presentation**. The limitation has disappeared: any technology that has support for accessibility is considered as valid.
Units. Need to use relative units for font sizes or other elements.	**Units.** There is no such requirement, requiring instead that the text can be scaled up to 200 % without support products.
Code validation. Web designers must create documents conforming to the syntax of formal grammars published officially by the relevant bodies at international level.	**Code validation.** Being technologically neutral refers to code only if the web content is presented using a mark-up language such as (X)HTML. This point is meaningless if the Web content is using a different technology that does not have a mark-up language.
User interaction with web content. Basic requirements on forms (alternatives for scripts, association between labels and controls, tab order, and grouping of information).	**User interaction with web content.** It includes several success criteria for monitoring and preventing errors in entering data, in labelling of controls, or in the presence of instructions to the user on how to fill in the fields.

Despite these differences, most websites that comply with regulations 1.0 are not required for major modifications to satisfy the requirements of version 2.0 (even some of them may not require any changes).

A study published in 2009 [20] was carried out with the assistance of EC in order to facilitate the transition to WCAG 2.0 guidelines. The core focus of the report is the score for 'distance' from current situation to WCAG 2.0 accessibility for each analysed website. As seen in Table 3, the web pages, which are closer to WCAG 1.0 compliance, are in general requiring fewer modifications to make them compliant with WCAG 2.0 criteria in comparison to those, which are not closure to WCAG 1.0.

The conclusions of the present work show that, if the work/effort has been done for WCAG 1.0 compliance to achieve the accessibility, it will certainly save the time and effort to get to WCAG 2.0 compliance.

Table 3 WCAG 2.0 distance' indicator score according to WCAG 1.0 compliance categories in Europe [20]

	Average score on 'WCAG 2.0 distance' index		
	Government websites	Public interest websites	All websites combined
Sites that passed automatic testing against WCAG 1.0	12,3	35,0	14,3
Sites that marginally failed automatic testing against WCAG 1.0	20,6	37,6	26,3
Sites that failed automatic testing against WCAG 1.0	29,9	36,7	34,9

Most published papers on the implementation of accessibility guidelines for the web sites refer to WCAG 1.0 compliance because the owners of the web pages have this version in mind when they design the web site. Only recently, web designers have started considering the second version as accessibility requirements for the web pages.

We have also started to work on developing studies about the compliance of WCAG 2.0. For example, we have participated in an analysis of the 2.0 accessibility of the web portals of top-ranked universities. Table 4 shows the results of this analysis.

Table 4 Web accessibility success rate of universities in 2011

Web site	Success rate, %
University of Cambridge	55,41
University of Oxford	51,35
Columbia University	48,68
University of Chicago	45,95
Harvard University	44,44
Massachusetts Institute of Technology (MIT)	41,89
Princeton University	41,89
Stanford University	39,19
California Institute of Technology	38,89
University of California, Berkeley	34,72

From these results, we conclude that most of the web sites of these ten universities did not reach an acceptable

level according WCAG 2.0 (50 %). Only two of them (Cambridge and Oxford) successfully passed the test of accessibility. Therefore, there is still a long way to see the generalized implementation of WCAG 2.0 in the main websites of the world.

4 Conclusion

Online technology barriers have been progressively reduced thanks to the accessibility standards of the Web content published since 1990s, especially WCAG by the World Wide Web Consortium, as well as to the laws derived from them. This is creating an increasing social awareness so nowadays it is common to enforce minimum requirements in order to achieve web accessibility. Stakeholders have realized its benefits, which are not only for disabled or elder people but also for everybody.

If the effective implementation of accessibility guidelines is promoted, and if the initiatives announced at the international level are finally implemented, it will be finally possible to get websites for everybody, regardless of the limitations of the users. In the future, it would be possible to see that universal design (or "design for all") as a working philosophy for creating web pages: as in other areas where design focuses in simplifying everyday tasks of users, building products, services and environments, which are more usable for everyone, requiring the minimum effort.

We expect that a major advance in this field will occur when accessibility guidelines (already a reality) join other standards related to the automatic adjustment of web environments to user characteristics. This means allowing the automatic customization of both web pages and browsers to detect the user's personal characteristics (hearing impairment, blindness, etc.) but also the adaptation to the environment in which they are placed at a given time (low light, excessive noise, mobile device, etc.). Such standards are beginning to appear: one of the best examples is the recent ISO 24751 [21] which, in the field of education, will allow the description of the characteristics of the student and the automatic adaptation of the corresponding learning environment. This is already beginning to be implemented in e-learning environments. In the future, it should be extended across the web in order to encourage that the websites fit the user rather than requesting the user to adapt to the websites.

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