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Accesibilidad y legibilidad de las webs universitarias en Finlandia: presente y futuro

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Resumen

Este artículo describe un estudio de los autores para evaluar la accesibilidad y la legibilidad del contenido de los sitios web de siete universidades en Finlandia. La evaluación de accesibilidad ha sido realizada para comprobar el cumplimiento de las directrices de accesibilidad para el contenido de web establecidos en la recomendación del consorcio W3C en WCAG 2.0. La legibilidad ha sido evaluada usando *Flesch Reading Ease*. Se ha estudiado si las universidades ofrecen la información web accesible para cada usuario (profesores, estudiantes, etc.), independientemente de posibles discapacidades. Finalmente, se presentan diversos avances en materia de accesibilidad y legibilidad según las recomendaciones de WCAG 2.0 resaltando sus principales elementos y sus recomendaciones.

Palabras clave: accesibilidad web, legibilidad, utilidad, inhabilidad, WCAG 2.0.

Accessibility and readability of university websites in Finland: present and future

Abstract

This article describes a study conducted by the authors to evaluate the accessibility and readability of the contents of the web sites of seven universities in Finland. The accessibility assessment has been carried out to check compliance with accessibility guidelines for Web content established by the W3C Consortium recommendation in WCAG 2.0. The readability has been evaluated using the Flesch Reading Ease Level formula for English texts. We have determined whether the universities have provided accessible web information which can be accessed by everyone (teachers, students), regardless of whether or not the user has a disability. Finally, advances in accessibility and legibility based on the recommendations of the WCAG 2.0 are presented highlighting the most important points and recommendations.

Key words: web accessibility, readability, usability, disability, WCAG 2.0.

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1. Introduction

Accessibility indicates how easy is to use, visit or access something, in general, for all people, especially those who have disabilities. Web accessibility is referred to design allowing these people to perceive, understand, navigate and interact with the Web.

Among standardization efforts, we remark the Web Accessibility Initiative of World Wide Web Consortium (W3C) which tries to establish recommendations for achieving accessible contents, browsers and Web development environments. Among their recommendations the Web Content Accessibility Guidelines (WCAG), or set of guidelines for accessible Web pages, are specially important. The last version of this recommendation is WCAG 2.0 [1]. The study carried out in this article is based precisely on this latest version, which provides twelve guidelines to follow. These twelve guidelines cannot be directly tested as they provide the basic criteria that authors should fulfil in order to make content more accessible for people with disabilities. For each guideline, it provides testable success criteria that allow guidelines to be used in situations where appear certain requirements and the need for conformance testing.

In this paper, we have analyzed a group of Web pages of the websites of seven universities of Finland, checking the degree of compliance with WCAG 2.0 recommendations. Firstly, in the following section, we justify the choice of universities to be evaluated. In section 3 we describe the accessibility indicators to be evaluated and the calculated metric that will rank universities according to compliance with the established success criteria in WCAG 2.0. In section 4 we discuss the results of the analysis while the last section is dedicated to the results of readability analysis applied to the text in the page in English dedicated to the history of each university.

2. Selection of websites of universities

The main goal of this work is to contribute to the project ESVIAL funded by the EU Alfa program. It includes, as members, the two universities involved in this project (University of Alcala and Metropolia University). One of the initial tasks in this project is an accessibility review of higher education institutions of the countries of the partner universities. This is the reason why the study includes the Metropolia University as a partner of the project ESVIAL while it has been increased to embrace other universities of Finland. We have chosen the six shown in the latest version (data from 2010) in the

"Academic Ranking of World Universities" (ARWU) available at http://www.arwu.org. We chose this ranking as one of the most known and consistent.

The study includes the analysis of three of the WebPages of each of the seven selected universities. The first one is the main page (Home), the second is a page with forms and the third one is a page with tables. The table 1 shows the universities and the pages finally analysed.

University	Web pages
University of Turku	Home: www.utu.fi/en/ Form: www.utu.fi/en/feedback.html Data table: www.utu.fi/en/studying/programmes/masters.html
Aalto University	Home: www.aalto.fi/en/ Form: eage.aalto.fi/?registration/register&lang=en Data table: www.aalto.fi/en/cooperation/career_services/talentit_en/stands/
University of Jyväskyläse	Home: www.jyu.fi/en Form: www.jyu.fi/en/study/study_frontpage/contact-info Data table: www.jyu.fi/en/contacts/
Helsinki Metropolia University Applied Sciences	Home: www.metropolia.fi/en/ Form: www.metropolia.fi/en/feedback/ Data table: www.metropolia.fi/en/apply/how-to-apply/bachelors-degree-evening-studies/timetable-summary/
University of Eastern Finland	Home: www.uef.fi/uef/english Form: www.uef.fi/palaute Data table: www.uef.fi/tutustu
University of Helsinki	Home: www.helsinki.fi/university/ Form: www.helsinki.fi/funds/feedback.htm Data table: ethesis.helsinki.fi/julkaisut/kas/kasva/vk/karkkainen/6luku.html - table1
University of Oulu	Home: www.oulu.fi/english/ Form: www.oulu.fi/english/contact Data table: www.degree.oulu.fi/admission/language-requirements/

Table 1. URL of the analysed web pages.

3. Accessibility: evaluated criteria

This work examines the main accessibility barriers identified in an analysis of a sample of Finnish university websites in relation to the currently applicable W3C/WAI Web Content Accessibility Guidelines 2.0 (WCAG 2.0). The technical accessibility analysis takes into account a set of accessibility criteria based on W3C guidelines.

For the evaluation of each of the pages of the sample, we use as reference the standard WCAG of Accessibility of Web content in the Web 2.0 of the W3C [1] synthesized in a series of technical checks on those aspects which are most relevant and with highest incidence. Based on the study done by the INTECO [2] these verifications

are transformed into one set of fourteen indicators referred to the recommendations of WCAG.

These indicators have been selected because they reflect most of the guidelines of WCAG 2.0 for the three possible levels (A, AA y AAA). A series of checks to analyse different aspects of each indicator are the key elements used for each indicator. These criteria are commonly accepted as providers of an accurate overview of the accessibility of a website.

The indicators considered for the analysis are shown below:

1. Valid Web documents. Checks if the pages are compliant with the grammars of HTML and CSS (used tools: W3C validator of HTML and CSS http://validator.w3.org/).
2. Images. Checks if there is an alternative text for images or images maps as well as that images are not used to transmit textual information (used tools: manual review and TAW validator http://www.tawdis.net/).
3. Headers. There should be a header structure that adequately reflects the logical structure of documents to facilitate reading, understanding and non-visual navigation (used tools: manual review and TAW validator).
4. Links. Check possible links without content, links with the same text and destinations, or links that open in new windows without a warning (used tools: manual review and TAW validator).
5. Contrast and semantic use of colour. Check whether the colour contrast between foreground and background colour is enough and if the colour is not used as the only visual way of conveying information (used tools: Colour checker – extension for Mozilla Firefox).
6. Presentation. Check if the page uses HTML tables for layout and other requirements related to the visual presentation of text (used tools: manual review and TAW validator).
7. Text size. Text must be defined in relative units to allow the resizing for readability, adapting to the needs of people who is accessing it (used tools: manual review and TAW validator).
8. Forms. Form elements for entering data must be used properly to allow proper interaction with assistive technologies and users (used tools: manual review and TAW validator).

9. Data tables. They must be used properly to identify tabular data and related information (used tools: manual review and TAW validator).
10. Accessibility via keyboard. The components of user interface and navigation must be operable, so it is necessary to have all the functionality of the page available through the keyboard (used tools: manual review and TAW validator).
11. Attacks**.** Aimed at evaluating access to the site without causing problems of photosensitivity-caused attacks (used tools: manual review and TAW validator).
12. Navigable. Web sites should help users to browse and access pages (used tools: manual review and TAW validator).
13. Understandable. Aimed at identifying the use of correct language as well as language changes in the document which facilitate understanding of users who use screen readers or speech synthesis programs (used tools: manual review and TAW validator).
14. Enough time. Provide users enough time to read and use contents (used tools: manual review and TAW validator).

Based on the study made by the INTECO [3], the verification are evaluated based on the values "Hits", "Failures", "Few Failures" y "Not Applicable (NA)":

- Hits. Met the requirements for verification.
- Failures. Do not meet the requirements for verification.
- Few Failures. Exceptional circumstances applicable to checks where the failure is minimal. This situation is valued as half a point.
- Not applicable. Non availability of minimum number or conditions of items for evaluation.

The total number of evaluated indicators is the following one:

$$Total\_of\_indicators = N^{o}\_indicators\_evaluated \cdot N^{o}\_pages\_evaluated$$

Being the number of evaluated indicators equal to 14 (the indicators described in this section) and evaluated numbers of pages equal to 3. Therefore, the maximum number of indicators taken into account in the evaluation is 42.

From this number it is necessary to eliminate the indicators not applicable (NA). For each of the pages, this number will take a different value. Once you have found the previous data, the success rate of the page is calculated as follows.

$$Success\_rate = \frac{100\% \cdot Hits + 50\% \cdot Few\_Failures}{Total\_applicable\_indicators}$$

Being *Hits* the indicator that meet the requirements of the success criteria of WCAG 2.0, *Few_Failures* is the indicator of minor failures, and total_applicable_indicators is the value calculated above (42 - NA). In the case of the total number of indicators are fulfilled, and then the success rate of the page would be 100%.

4. Accessibility: evaluated criteria

Table 2 summarizes the results obtained in the analysis of accessibility for the sample of 7 university portals in terms of percentage of covered or not covered indicators, those with few errors, not applicable and success rate (ranked from highest to lowest level).

University	Hits	Failures	Few failures	NA	Success rate
1. University of Turku	22	12	1	7	62.85%
2. Aalto University	19	12	4	7	54.28%
3. University of Jyväskyläse	18	17	0	7	51.48%
4. Helsinki Metropolia	17	18	0	7	48.57%
5. University of Eastern Finland	16	19	0	7	45.71%
6. University of Helsinki	13	19	2	8	38.23%
7. University of Oulu	13	22	0	7	37.14%

Table 2**.** Results of the analysis made on the portals.

The main problems which were found out are the following ones:

1. University of Turku. During the validation of documents, there aren't any websites that validate HTML or CSS grammar. In the case of presentation, one of the websites contain common errors such as not fulfilling the required minimum spacing as well as having text blocks that contain more than 80 characters. Even more, there are static sizes in the text in every page. The selected website with forms contains errors because it has not labels in its elements. When analyzing the accessibility of keyboard, the user cannot access all the elements with the keyboard in all of the websites. All websites

contains problems of navigation as they have many items that do not have focus option for keyboard and mouse.

2. Aalto University. During the validation of documents, none of the websites properly validates its HTML code because they contain a large number of errors. Only the CSS code of one website is valid. One of the websites presents errors in the headers because it contains two at the same level and not well structured. Regarding the contrast and the semantic use of color, the pages have many links that change color merely when the user passes over them. The selected website with forms contains errors because it has not labels in its elements and does not show enough support for the user. All websites contains problems of navigation as they have many items that do not have focus option for keyboard and mouse.
3. University of Jyväskyläse. During the validation of documents, there aren`t any websites that validate HTML. Two of the websites have errors in the images because they do not contain alternate text. One of the websites presents errors in the headers because it does not contain the header h1. In terms of presentation, all pages containing the mistake of using tables for layout information from the page without being data. The selected website with forms contains errors because it has not labels in its elements and does not show enough support for the user. There are errors on data tables because there is not an abstract of the table and there are not headers in the columns. When analyzing the accessibility of keyboard, the user cannot access to all the elements with the keyboard in all of the websites. All websites contains problems of navigation as they have many items that do not have focus option for keyboard and mouse.
4. Helsinki Metropolia. During the validation of documents, two websites properly validate its HTML and CSS code, the other website do not validate because it contains five errors. We consider this as a minor error. All of the websites have errors in the images, because they do not contain alternate text; we consider this as a minor error. Two of the websites presents errors in the headers because they have repeated headers of the same level. Regarding the contrast and the semantic use of color, there are two pages containing a good number of contrast errors in their texts, images and links. In the case of presentation, all pages have errors because they use style attributes within the

HTML code. There are static sizes in the text of all websites. The selected website with forms contains errors because it has not labels in its elements. When analyzing the accessibility of keyboard, the user cannot access to all the elements with the keyboard in all of the websites. All websites contains problems of navigation as they have many items that do not have focus option for keyboard and mouse.

5. University of Eastern Finland. During the validation of documents, there are not any websites that validate HTML code. Two of the websites have errors in the images because they do not contain alternate text. Regarding the contrast and the semantic use, we have found out several errors in some of the texts of every page, moreover, there are links that are identified only by passing over them. In the case of presentation, all pages have errors. In one of them, a table is used for layout information. There is static size in the text of every page. Besides that all pages use style attributes within the HTML. The selected website with forms contains errors because it has not labels in its elements. There are errors in data tables: there is not an abstract of the table. When analyzing the accessibility of keyboard, the user cannot access to all the elements with the keyboard in all of the websites. All websites contains problems of navigation as they have many items that do not have focus option for keyboard and mouse.
6. University of Helsinki. During the validation of documents, only one website properly validates its HTML code, the others websites do not validate because they contain a large number of errors. In the case of CSS code, all of the websites are correct. All of the websites have errors in the images because they do not contain alternate text and they can be replaced by mark-up. One of the websites presents errors in the headers because it contains headers at the same level and they are not well structured. In the case of presentation, no websites are fulfilling the required minimum spacing and one of the websites has attributes of presentation in its HTML document instead in the CSS document. Even more, a website uses absolute units. The selected website with forms contains errors because it has not labels in its elements and does not shows enough support for the user. There are errors in data tables, e.g. there is not an abstract of the table. When analyzing the accessibility of keyboard, the user cannot easily access all the elements of two websites with

the keyboard. Two of the websites have errors of navigation referred to location and focus. None of the websites has declared the language of the document in the page.

7. University of Oulu. During the validation of documents, no websites validate HTML code. Two of the websites have errors in the images because they do not contain alternate text. One of the websites presents errors in the headers because it does not contain the header h1 and has repeated headers of the same level. All of the websites have errors in the links because contain consecutive links of image and text send the user to the same resource. Regarding the contrast and the semantic use of color, there are two pages containing many contrast errors in their texts, images and links. In the case of presentation, all websites contain common errors such as not respecting the required minimum spacing and including text blocks that contain more than 80 characters. Even more, there is static size declaration in the text of every page. The selected website with forms contains errors, because it has not labels in its elements. When analyzing the accessibility of keyboard, the user cannot access to all the elements with the keyboard in all of the websites. All websites contains problems of navigation as they have many items that do not have focus option for keyboard and mouse.

5. Evaluation of readability of web pages

Readability is the ease in which text can be read and understood. As an additional part of the research, we have done an assessment of the readability of textual contents of web portals of the seven selected universities using the well-know Flesch Reading Ease Level formula (RES) for English texts (Flesh tool: http://flesh.sourceforge.net/) [2]:

$$RES = 206.835 - 1{,}015 \cdot \left(\frac{total\_words}{total\_sentences} \right) - 84{,}6 \cdot \left(\frac{total\_syllables}{total\_words} \right)$$

We have analyzed the readability of the web pages which present the history of each universities. The results are shown in table 3.

University	Accessibility position	Flesch Reading Ease Level	Level of readability
1. University of Jyväskyläse	3	46.8	Hard
2. University of Helsinki	6	42.91	Hard
3. University of Turku	1	37.58	Hard
4. University of Eastern Finland	5	29.72	Very Hard
5. Aalto University	2	27.27	Very Hard
6. University of Oulu	7	26.85	Very Hard
7. Helsinki Metropolia	4	11.27	Very Hard

Table 3**.** Results of readability analysis

6. Future of web content accessibility

The future of the accessibility of Web content is clearly linked to the new version of WCAG Accessibility Guidelines 2.0 [1], which is not currently being implemented in web sites. 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, U.S. President Barack Obama signed the "21st Century Communications and Video Accessibility Act", the new law that will help people with disabilities to access and participate in the digital world. On the European side, in November 2010, the European Commission adopted a new strategy to break the barriers that prevent people with disabilities participate in society on equal terms. This is the "European Disability Strategy 2010-2020: A Renewed Commitment to a Barrier-Free Europe" [5].

One in six people in the European Union has a certain degree of severe disabilities. This means around 80 million people who cannot often participate fully in society and in the economy due to physical barriers and attitudes of the rest of the society. The plan is aimed at enabling that all citizens with disabilities in the European Union can 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 [6]. 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.

WCAG 2.0 is based on version 1.0 and has been designed to be applied to a wide range of Web technologies existing now and in the future. It is also aimed at being testable with a combination of automated testing and human evaluation. WCAG 2.0 is organized around four overall principles that provide the foundations for Web accessibility:

- Perceivable. Information and user interface components must be presentable to users in ways they can perceive.
- Operable. User interface components and navigation must be operable.
- Understandable. Information and the operation of user interface must be understandable.
- Robust. Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies

Some guidelines appear under the principles. Twelve guidelines provide the basic goals which designers and authors should pursue in order to make content more accessible to users with different disabilities. The guidelines are not testable, but provide the framework and overall objectives to help authors to understand the success criteria and to better implement the techniques. For each guideline, testable success criteria are provided to allow WCAG 2.0 to be used where requirements and conformance testing are necessary such as in design specification, purchasing, regulation and contractual agreements.

For each of the guidelines and success criteria in the WCAG 2.0 document itself, the working group has also documented a wide variety of techniques. The techniques are informative and fall into two categories:

- Those which are sufficient for meeting the success criteria
- Those which are advisory that goes beyond what is required by the individual success criteria and allow authors to better implement the guidelines. Some advisory techniques address accessibility barriers which are not covered by the testable success criteria. Where common failures are known, these are also documented.

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 of a web site if the checkpoint is not fulfilled. All of the following conformance requirements must be satisfied if a web page wants to comply with WCAG 2.0:

1. Conformance Level. As WCAG 1.0, this version includes three levels: A, AA and AAA. However, it is not recommended that Level AAA conformance be required as a general policy for entire sites because it is not possible to satisfy all Level AAA Success Criteria for some specific contents.
2. Full pages. Conformance is only for full Web pages and it cannot be achieved if part of a Web page is excluded. For the purpose of determining conformance, alternatives to part of a page's content are considered part of the page when the alternatives can be obtained directly from the page. Authors of Web pages that cannot conform due to content outside of the author's control may consider a statement of partial conformance.
3. Complete processes. When a Web page is one of a series of Web pages presenting a process, all Web pages in the process should conform at the specified level or better.
4. Only Accessibility-Supported Ways of Using Technologies. Only accessibility-supported ways of using technologies are relied upon to satisfy the success criteria. Any information or functionality that is provided in a way that is not accessibility supported is also available in a way that is accessibility supported.
5. Non-Interference. If technologies are used in a way that is not accessibility supported, or if they are used in a non-conforming way, then they do not block the ability of users to access the rest of the page.

We have also started to work in 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 for the top-ranked universities in the world.

From these results, we conclude that most of the analyzed 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, it is still a large way to see a generalized implementation of WCAG 2.0 in the main websites of the world.

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 %

Table 4. Web accessibility success rate of universities in 2011

7. Conclusions

Accessibility of universities in Finland is not bad compared with the results other similar universities in other countries (analysed by the authors in previous studies not yet published) as it is shown by above results. Three of the universities which were analysed (43%) exceed acceptable accessibility barrier, but two (28.5%) are very close to the barrier. Only two universities (25.8%) are out of the acceptable accessibility level. Regarding readability evaluation of the selected seven sites under analysis, three of them have show a «Hard» level of readability while the other four are in the «Very Hard» level. Note that the University of Turku has the best results in both categories, accessibility and in readability. This usually means that the organization has devoted special efforts to the goal of offering good accessibility to users.

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 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, which are 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 of 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 [7] 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 provoke that the websites fit the user rather than requesting the user to adapt to the websites.

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