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The challenge of teaching to create accessible learning objects to higher education lecturers

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Abstract

The EU wide regulations as well as the domestic regulations of many EU members ask to include accessibility lectures on architecture and engineering studies' curricula.

From our point of view, such requirement should be extended to include accessibility lectures at the studies of teaching, this way the teachers are able to develop accessible learning objects while are also able to lecture the creation of accessible web content so that Information Society is not an excluding society.

Teaching how to apply the WCAG regulations is always challenging and that challenge becomes bigger when the student is one that has not the technical skills that are expected from any reader of the WCAG regulations.

You will find in this article, the experience of Sidar Foundation and how we succeeded teaching that tough matter to mathematics, science or language teachers. We will discuss as well, the limitations that currently exists for the full autonomy of the teachers when creating or validating accessible-for-all contents.

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1. Introduction

Teaching web accessibility, or more specifically the Web Content Accessibility Guidelines (WCAG) 2.0 [1], is a challenge, even when the target students of the course are skilled in web content creation, as are designers and developers. Trying to teach people who are not trained in the most basic elements of the technologies involved means, in principle, that the challenge becomes titanic. This article presents the experience and

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success of the Sidar Foundation [2], which demonstrates that the challenge can be achieved, and discusses the methodology and techniques used to do it.

But why is it necessary to teach persons untrained in the creation of websites to apply WCAG 2.0? From our point of view, given that international policies advocate for the inclusion of all people in the Information Society, it is necessary to teach to create web content, of any kind, which is accessible to everyone, including children, since they also participate in the Information Society.

Educators are the ones who teach children, so naturally they have to have the knowledge beforehand. Moreover, regardless of whether or not they teach children to create accessible content, it is imperative that teachers know how to do it themselves, so that, in their daily educational practice, no student is excluded.

2. Policies including accessibility in university curricula

In Europe, the Resolution ResAP (2001)3 “Towards full citizenship of persons with disabilities through inclusive new technologies” [3], adopted by the Committee of Ministers on 24 October, 2001 at the 770th meeting of the Ministers' Deputies, bearing in mind the Convention for the Protection of Human Rights and Fundamental Freedoms, and in particular the right to receive and impart information (Article 10), bearing in mind Recommendation No. R (98) 3 of the Committee of Ministers to member states on access to higher education, inter alia, having regard to other international initiatives and projects, such as Cost 219, Cost 219bis, and the Web Accessibility Initiative (WAI) [4], considering that the estimated number of persons with disabilities in Europe is 10-15% of the population and that the number of elderly and disabled persons is continually growing, considering that the Design for All strategy has a key role to play in the creation of inclusive societies and should therefore be incorporated into all levels of the design process of goods and services; recommends that the governments of the member states: In drawing up national strategies governments should, with due respect to national priorities, pay particular attention to the following specific recommendations for priority policy in education:

- ∞ New technologies in education should be adapted to the needs of all learners, including those with special educational needs.
- ∞ Learners with disabilities should be provided with the assistive technology devices and the services they need, and these should be included in individualized education programs.
- ∞ Training in the use of such devices is an essential component and should be provided for both learners and teachers.
- ∞ New assistive technologies should be used pro-actively to facilitate integrated education, enabling learners with disabilities to be educated in normal surroundings along with their peers.
- ∞ Since some learners, particularly those with learning difficulties, often have less access to assistive technology than others, special efforts should be made to ensure that they have access to appropriate technology and receive adequate instruction and support to use it.
- ∞ The development and use of new special educational hardware and software for the education of learners with disabilities should be encouraged.
- ∞ Given that all educational **staff should be trained** in the use of new technologies, in particular information and communication technologies, for educational purposes, **due attention should be paid to the special educational needs of learners with disabilities in such training.**

Later in the same resolution, in paragraph 5.2 on Design for All, it is emphasized that: “Accessibility and usability of products and services should be ensured at the design stage. Therefore, the Design for All strategy **should be incorporated in the curricula of all designers and engineers.**”

It seems that here is the root of the problem, as it is considered necessary to train educators in the use of Information Technology and Communication (ICT) to pay attention to "special needs", but it is only considered necessary to include Design for All in the curricula of courses related to design and engineering.

At the international level, and later, in May 3, 2008, the International Convention on the Rights of Persons with Disabilities and its Optional Protocol [5] were enacted. The primary purpose of the policy instrument of the UN is to ensure the full and equal enjoyment of all human rights for all persons with disabilities. In this regard, States which have adhered to the Convention committed themselves to adopting and implementing policies, laws and administrative measures necessary to give effect to the rights recognized in the Convention and abolish laws, regulations, customs and practices which are discriminative. Four years after its entry into force, the Convention has 153 signatories, and 112 States have ratified it, whereas the Optional Protocol has 90 signatories and 64 States have ratified it.

In terms of accessibility, the Convention requires, in Article 9, for Member States to identify and eliminate obstacles and barriers so that disabled people can access their physical environment, transportation, facilities and public services, and information technology and communications. In this sense, it upholds the principle of independence of persons with disabilities. This means that it should be promoted through personal mobility aids, devices, assistive technologies and live assistance. The same principle also applies to access to information in accessible formats and to providing it with appropriate technologies, facilitating the use of Braille, sign language and other forms of communication and encouraging the media and Internet providers to provide information online in formats that meet the above requirements. The measures taken by Member States apply among others to: "c) **To provide training for those involved in accessibility issues facing persons with disabilities**"

But, apparently, the general interpretation about who is to offer such training is that it should be addressed to architects, designers and engineers (informatics, etc.) and it seems that there is widespread awareness that training on accessibility should be provided to anyone who participates in the Information Society and especially to educators.

2.1. Policies in Spain

The first Spanish law which included, among its objectives, the inclusion of accessibility and Design for All in training curricula was the Law 51/2003 on equal opportunities, non-discrimination and universal accessibility for persons with disabilities, published in December, 2003 [7]. In the tenth Final disposition, the law states that the Spanish government had two years to develop accessibility curricula to be incorporated in all educational levels, including universities, to train professionals in the fields of built environment, buildings, infrastructures, transport, communications, telecommunications and services of the information society. So, again, we find that legislators focus on architecture and technology careers, forgetting the importance of training people in the areas that are concerned with education in general.

In February 2006, the "White Book of Design for All at the University" [7] was published. This paper considers that "introducing Design for All as an element of training in those programs related to the design of spaces, products and services, is a very important step for the integration of all people and, therefore, to equality of opportunity. ", which today is a human rights issue. And it encouraged, inter alia, to: "Define the essential curriculum content on Design for All to ensure that the **related careers** professionals can respond efficiently and effectively to accessibility that society demands." The paper also has the same narrow focus which considers Design for All and web accessibility as topics for "related careers".

Finally, the Royal Decree 1393/2007 of 29 October [8], establishing the regulation of university education, in Article 3 Paragraph 5, provides that: "Among the general principles that should inspire the design of new titles, curricula should take into account that any professional activity must be: a) with respect for fundamental rights and equality between men and women must be included, in the curriculum where appropriate, lessons related to these rights. b) from the respect and promotion of human rights and the principles of universal accessibility and design for all in accordance with the provisions of disposal tenth of Law 51/2003, dated December 2, of equal opportunities, non-discrimination and universal accessibility for disabled people must be

included in the curriculum **where appropriate**, lessons related to these rights and principles. c) according to the values of a culture of peace and democratic values, and must be included in the curriculum where appropriate, lessons related to these values. "

It seems clear from the outset that, in the European and Spanish regulations, it is understood that accessibility and Design for All are skills to be acquired only by those who are trained in architecture or engineering.

In fact, at least in the Spanish case, we can check through the study conducted by the association Solcom [9], according to which many universities have incorporated into their curriculum content related to accessibility. Although 66% of them have not done so, those who have done limited themselves to include them in the careers of architecture, computing, telecommunications, engineering, and audiovisual communication. As discussed in the study, among other reasons, this is due to the fact that the law is interpreted literally.

3. Position and experience of the Sidar Foundation

In the Sidar Foundation we believe that if we are to achieve an inclusive society that respects human rights and the right to equal participation of people with disabilities, it is necessary that all persons active in the Society information should know the needs and accessibility criteria for creating web content.

It will be necessary to train all these people and, ideally, to do so since they are children. And in order to train children, you must first train their teachers.

It is at least curious that, in the European regulations that aim to promote the inclusion of accessibility in the curriculum, it is considered that it should "be incorporated in the curricula of all designers and engineers," and that it has not been taken into account that the goal of accessibility is precisely the participation of all people in the Information Society, and in that sense, we all can and must be authors on the web if we want to actively participate. It is understandable that the Resolution ResAP (2001) 3 has not been taken into account this idea, since, at that time, authoring possibilities were more limited. But the web has become more and more participatory, every day there are more applications that enable people who are not developers or designers to create content. Therefore, regulations should have been adapting to the evolution of the Web.

In the field of education, both the regulations and the European plans, as well as those in each country, have focused on the need to facilitate that teachers know and use ICT in class, and on the knowledge of the special needs some students might have, which is very far from the idea of accessibility as a benefit for all, the view of accessibility as a factor of interoperability and usability.

3.1. The barriers

Even though European governments have supported the creation of educational content available through grants, they are aimed at companies or consortia established for that purpose. There are also action plans that have sought to spread the concept and practice of accessibility among teachers. In fact, in 2004, the Sidar Foundation was invited by CNICE (today called INTEF) [10] to give a course on accessibility for secondary school teachers. We have also participated in the preparation of documentation for the educators [11]. But these activities have a very direct impact on a few teachers, and are insufficient to obtain a generalized effect.

Therefore, the first barrier is the method of dissemination that is used.

The second barrier is created by the text of the accessibility guidelines. When using version 2.0 of the WCAG, which was an attempt to make the guidelines more understandable, it was found that, even for students with computer training, the guidelines were cryptic [12]. Therefore, they are much more cryptic for a teacher who does not have to have intimate knowledge of computer science or web content creation. However, there

are of course teachers with greater or lesser degrees of enthusiasm, self-learners who have a deep understanding of the basic elements for creating web content.

The third barrier is the culture: the widespread idea that ICTs are a thing of “technologists” or computer scientists. While the ideal scenario is one in which a product is created by a multidisciplinary team, it is also true that this is not always necessary or even desirable.

3.2. *The solutions*

In order to facilitate the creation of accessible educational content, it seems that the most accepted proposal in Europe is to create in each university a department or office of attention to disability, which will take care of adapting the content created by the teachers. It is therefore necessary to define a workflow that ensures the correct adaptation of the materials, as the project EU4ALL [13] defines.

But from our point of view, this solution has several disadvantages, especially in developing countries.

The first obvious problem is, having to have specialized staff with a monthly wage.

The second drawback –related to the first one– is the fact that it will be difficult to have employees with expertise in all the areas of the university courses that are offered at the university. Because the staff that has to deal with adaptations, necessarily has to consult repeatedly with the professor who is the author of the content to make sure he understood it correctly so that he can, for example, mark it properly if he is using a markup language. This also requires a lot of time to complete so that the contents are directly accessible, or to create the corresponding alternatives.

And the third drawback is that this system implies maintaining the status quo. That is, keeping teachers in ignorance as to the creation of accessible content. This system maintains and supports the idea that accessibility is very difficult and has to be addressed by specialists. It limits the scope of action of teachers, who need to put everything they do through a filter.

From our point of view there is another possible solution: to train educators in creating accessible content, so that they can be autonomous.

As mentioned above, we have a limitation when trying to transmit knowledge of WCAG 2.0, that is, the language of the guidelines. Later on we will see how we can circumvent this limitation and provide appropriate training for educators. But there is another limitation: the fact that some content technologies or knowledge that are not available for everyone are required. For example, right now there is no application which is really able to automatically generate an interpretation in sign language, and it would be illogical to require all teachers to learn to express themselves in sign language, especially in countries where people might need to know more than one. Today we have applications that can be generated from a text, a video with an avatar making interpretation in sign language for Spanish sign language [14], Colombian, Argentinean, and Venezuelan [15]. But those applications still need many improvements to be really useful for a deaf person because the interpretation that is achieved is quite precarious. This will surely improve in the future, and therefore it will be easier for anyone to generate a video with sign language interpretation from any text.

Another example is the extended audio description and the audio description. For the moment, these accessibility requirements are contracted with outside entities fully dedicated to them, although in the future there will be tools to facilitate this task, such as OpenCaps [16]. That is not the case with subtitles: in this moment there is no application that automatically generates subtitles by converting voice to text in Spanish, however, there is for English (e.g. Youtube) [17], in whose case it is becoming increasingly easier to generate a subtitle file, at least if the video is uploaded to a platform that offers such service (Youtube is the case, DotSub, etc.) And there are open source applications that can be installed and made to be compatible with the Learning Management Systems in use at the University (Opencaps is an example), if you want to keep the videos on your own server.

Over time, these limitations will disappear, but meanwhile, we believe in facilitating autonomy as much as possible for teachers, leading to a mixed system until technology allows them to gain complete independence. Let us see therefore what educators are capable of learning or what we are able to teach them as far as accessibility is concerned.

4. Teaching the teachers

The Alter-nativa project, with which Sidar Foundation is involved, aims to make the curriculum for training teachers of language arts, science and mathematics teaching by using information technology and communication in communities with populations at risk of exclusion such as people with disabilities, indigenous people and people displaced by violence. The project involves three European universities (including the National University of Distance Education - UNED), 8 universities in several Latin American countries, and 4 cooperating entities, including Sidar Foundation - Universal Access. The project is funded by the European Commission through the ALFA Program II (DCI-ALA/2010/88).

Sidar Foundation has taught, besides those already mentioned for teachers, numerous courses on the application of accessibility guidelines (WCAG 1.0 and 2.0) in Spain and Portugal and several Latin American countries, aimed at webmasters, developers and designers of public administration and the private sector. Although the experience with the courses for webmasters, developers and designers, is not directly extrapolated, we were able to extract from it some useful lessons applicable to teachers, especially as in these courses we have met students who did not have the deep knowledge you would expect from a webmaster.

From that experience we take the idea of explaining the accessibility of elements or types of information, ie, explaining how the text, images, audiovisual, etc. are treated, instead of explaining one guideline or criterion at a time.

A 5-day course in Bogota, which took place in November, 2011, was aimed at some teachers from each of the knowledge areas covered by the project Alter-nativa, so that they could then replicate the course in their countries to the rest of their schoolmates. Even though attendance was required, the course had the support of the Campus Sidar [18], which created a virtual course with all the contents, examples and exercises. Thus, teachers could focus on addressing the teacher in class and practice, rather than having to engage in note taking, and could rely on the virtual course later when they had to replicate it at home.

The course contents were distributed as follows:

4.1. Introduction

The introduction explains the concepts of accessibility, social function and the policy framework or existing legislation, the concept of Design for All, the introduction of the "personas" used throughout the course –with a photo and description–, and it also provides the students with the knowledge of the barriers disabled people encounter when using the Internet.

Thus, for students it is easier to remember the needs and preferences that end users may have. For example, Roberto has photosensitive epilepsy, which is related to the criterion that prevents epileptic seizures, and Clara's cerebral palsy is related to the need to extend or adjust time. In sum, there are 9 characters that cover all types of disabilities and technological situations that accessibility can cover, from search and

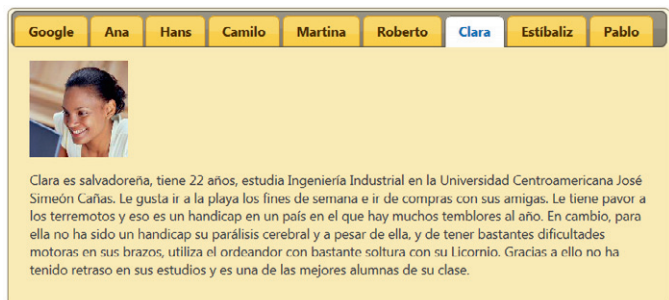


Illustration 1 The "personas" for the course.

indexing robots, to mobile users and users of narrowband and old computers.

4.2. Concepts and Principles

This section explains the concept of learning objects and e-learning standards, including those related to accessibility. It was important to explain the standards involved to teachers, since most of them were unaware of such standards and had never even created a learning object to be used in a e-learning system.

4.3. Use of the text

This module explains the advantages and disadvantages of text, for example, it presents problems for people with low literacy and reading comprehension difficulties. It also presents the advantages of the text being easily converted to voice, enlarged or reduced, and converted to various formats, among others. It explains the essence of the criteria related to the visual presentation of texts such as the use of color, line width, justification, line spacing, spacing, etc. Also, the structuring of information, the use of headings, tables, forms, titled pages, set the page language and the parties, abbreviations and acronyms, etc. Finally, it addresses readability, interaction and navigation, user orientation, links, navigation bars, and consistent identification.

4.4. Using the audio

We explain, in an easy to understand for people without technical knowledge, the issue of contrast, the need for the user to always have control over the sound, the alternatives to be offered, and the automatic generation of audio from the text and the Daisy standard.

4.5. Images and animations

As in all modules, we explain the advantages and disadvantages of these elements. We also explain the issues to consider in terms of color contrast and control by the user. And finally, we explained the right way to generate alternatives to images and animations.

4.6. Multimedia

As for multimedia, the module explains the advantages and disadvantages, the control by the user, subtitles, audio description, transcription and alternative in sign language. It indicates good practices and resources for implementation, rather than the complex texts of the compliance criteria.

4.7. Tables and forms

Understanding the criteria related to tables and forms have always been a headache for some designers and developers. But in this case, rather than explaining each point, we again explain their advantages and disadvantages, and the best practices in markup tabular information and labeling of the forms (identification of controls, label position, use of the title attribute and grouping of controls).

4.8. Scripts, applets and objects

Besides the advantages and disadvantages of their use in various cases, we explain here the essence of the criteria related to the focus, operability and identification of the status of an item as well as appropriate alternatives for each of them.

The use of applets and object is widespread in education because it facilitates the inclusion and use of games with educational purposes. It is therefore very important for teachers to understand the implications and potential conflicts with the accessibility needs of students.

4.9. Scientific and mathematical notation

Since the alternative project covers the areas of math and science, it was essential to explain to teachers in those areas the techniques and methods that facilitate the accessibility of scientific and mathematical notation. They were provided with reference documents and applications to facilitate the practice of creating mathematical content.

4.10. Accessibility testing

We propose the principle of "never publishing without checking." Therefore, the methodology for review of accessibility is a key issue. In the course, the students were told about the review methodology contained in WCAG 2.0 and were provided with tools and extensions to review different aspects of accessibility (They were provided with more than 500MB of information, including documents, applications and tools). The students could use aChecker [19], which is integrated into ATutor, but this tool provides results which are only in English and are expressed in a cryptic language for those who do not know the WCAG in depth. Furthermore, the results are not reliable because the tool reviews the original mark of the contents from TinyMCE instead of the end generated markup. For example, aChecker do not find any fault in a content using specific formatting code used in ATutor, such as:

```
<p>[media|640|480]http://www.youtube.com/watch?v=2dfMWD-9waA[/media]</p>
```

But that code ultimately generates the following html:

```
<p><object width="640" height="480"><param name="movie" value="http://www.youtube.com/v/2dfMWD-9waA"></param><embed src="http://www.youtube.com/v/2dfMWD-9waA" type="application/x-shockwave-flash" width="640" height="480"></embed></object></p>
```

So it is not actually reviewing the generated code, which is what can cause problems for end users.

And it is clearly not possible to learn to check compliance with WCAG 2.0 without a deep knowledge of the guidelines. On the other hand, unfortunately there still is not a screening tool that facilitates the review of the contents in an understandable language and that goes beyond compliance with the guidelines, to focus on accessibility itself.

4.11. Practices

Throughout the course, the students had to create a learning object in their own area of expertise. So that, by the end of the course, each of them could show how they had put into practice the knowledge acquired on each of the elements.

The experience was very satisfactory. Even those teachers who had never created a learning object were able to do so and explain why they did things in a certain way.

The screenshot shows a web application interface for a course titled "La relación pitagórica". The main content area displays an exercise titled "Ejercicio" about the Pythagorean theorem. The exercise includes a diagram of a right-angled triangle with legs a and b , and hypotenuse c . Squares are drawn on each side, with a red square on the hypotenuse and blue squares on the legs. The text explains that the area of the red square is equal to the sum of the areas of the blue squares. The page also features a control bar with buttons for "reinciar", "pant", "zoom", "pansa", "anim", "stop", "intro", and "next".

Illustration 2 SVG example, and contents created by the students.

For the creation of the contents, they were given the Amaya editor [20], which facilitates editing MathML [21], and TinyMCE [22] built in ATutor [23]. They also used some of the tools to review, as the Colour Contrast Analyser [24], and they were able to include an audiovisual object with minimum accessibility.

Each student created one or more lessons, which were included in the associated course created by us, which served to show good and bad practices in the creation of mathematical content, called "The Pythagorean relationship." This learning object also helped us to demonstrate the use of SVG [25] as an alternative to an applet created with GeoGebra [26], and references were given for them to practice converting from one format into another, after the course.

5. Conclusions

The main conclusion is that it is possible to teach educators to be autonomous in creating learning objects with a high degree of accessibility. But they are certain conditions. It is necessary:

- ∞ To facilitate the understanding of the barriers faced by persons with disabilities and the barriers anyone can find when using a technology or in a particular situation.
- ∞ To use simple and clear language, according to the level of expertise of the teachers.
- ∞ To explain the best practices and involvement in the educational field, avoiding reference to the complex language used in WCAG 2.0

- ∞ To facilitate applications and intuitive tools.
- ∞ Provide support for the creation of alternative (equivalent content) that require knowledge or technologies not available to them, such as sign language interpretation.

For the moment, there is a limitation: in-depth review of accessibility. This is basically due to the fact that existing tools are designed to review compliance with WCAG and expressed in the language used in the guidelines. Even Hera [27] –a tool created to facilitate the review by both novice and expert developers, offering aid to indicate the procedure and what needs to be taken into account at all times– is too complex for a teacher that all that really wants is to see if what he have created will be useful for his students. Therefore, for the time being, teachers have to settle for manually checking with the help of various extensions and applications that help them see very concrete elements.

The student satisfaction was very high, because they could prove they were capable, that they did not need depend all the time on a computer specialist to create a learning object according to the standards of e-learning and accessibility. And the teachers were equally satisfied, even though we were not sure if they were going to be able to transmit the necessary knowledge in such a short time and with an audience, in principle, very unpropitious.

Therefore, the only remaining task is to create a tool which is especially aimed at the reviewing of accessible learning objects in a language comprehensible for the people who do not have technical knowledge.

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