Satisfactory e-learning experience for visually impaired students: recommendations for distance education institutions.

Pablo Rebaque-Rivas
Community Initiatives
Open University of Catalonia
Av. Tibidabo 47
Barcelona, 08035 Spain
prebaque@uoc.edu

Eva P. Gil-Rodríguez
Community Initiatives
Open University of Catalonia
Av. Tibidabo 47
Barcelona, 08035 Spain
egilrod@uoc.edu

Llorenç Sabaté-Jardí
Community Initiatives
Open University of Catalonia
Av. Tibidabo 47
Barcelona, 08035 Spain
lsabate@uoc.edu

CHI'13, April 27 – May 2, 2013, Paris, France.
ACM 978-1-XXXX-XXXX-X/XX/XX.

Abstract
This study offers a series of recommendations for distance education institutions and for its Virtual Campus to facilitate the learning process for visually impaired students. It is based on a case study conducted at the Universitat Oberta de Catalunya (Open University of Catalonia, UOC), a distance learning university in Spain, in which 15 visually impaired students were interviewed in depth in their natural context for studying (their homes) to learn more about their daily activities as students, as well as the main difficulties they encounter in the distance learning process. Additionally, a usability test was conducted on the UOC's Virtual Campus.

Author Keywords
E-learning, visually impaired students, user experience design, customization.

ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): User interfaces

K.3.1 Computers and education: Computer Users in Education

General Terms

Human factors.

Introduction

In higher education e-learning environments, adequate accessibility and usability are critical to ensuring that visually impaired students do not have problems accessing the different parts of the virtual campus and are able to complete their training under equal conditions and with the same ease as students without visual impairments. However, merely complying with accessibility standards does not always guarantee a satisfactory user experience [13, 16, 18, 19]. It is thus necessary to have a more direct understanding of the end users in their routine contexts to ensure that their user experience is truly satisfactory [16, 18, 19].

Nevertheless, this contextual methodology is rarely used to assess the accessibility of the e-learning environments of university institutions, let alone the accessibility of exclusively distance learning institutions. As a general rule, automatic tools to evaluate the accessibility web [1, 10, 11, 15, 17] or the author's own experiences [4, 8] are used to make recommendations for accessible design. Other authors [13, 14 19, 20] have examined users' interactions in online environments, but not in e-learning environments.

It would be mistaken to limit oneself to performing only usability and accessibility tests on online environments without taking into account all the potential interactions that a visually impaired student might carry out in relation to a distance education institution. It is thus critical to expand the concept of accessibility to include not only the website but also other potential interactions, such as access to educational content or the resources and activities proposed by the faculty.

Through the use of questionnaires and interviews with affected parties [2], use cases and the experiences of authors at their institutions [4, 6, 8, 9], and surveys of the state of the art and the literature [5], some authors have looked beyond web accessibility, raising issues and offering recommendations for accessibility and organizational policies and addressing cultural, legal and technical issues.

However, we agree with Candido [7] regarding the lack of research with visually impaired students on their experience with and perceptions of online learning. Candido stressed in his dissertation the importance of using a qualitative approach to examine the experiences of visually impaired students in greater detail in order to understand their specific experiences and perceptions regarding e-learning.

The following paper offers a series of recommendations for distance education institutions and its Virtual Campus in which customization emerges as a key factor. These recommendations seek to ensure a satisfactory user experience for visually impaired students and are based on a case study at the Universitat Oberta de Catalunya (Open University of Catalonia, UOC), a Spanish post-secondary institution that offers its teaching and learning services exclusively on a virtual campus. Although the UOC has been implementing measures to improve accessibility (e.g., conducting accessibility assessments of the virtual

campus, providing more time on official exams, adapting educational content to accessible formats for some subjects, etc.) for many years, it was necessary to determine in greater detail the extent to which accessibility could be improved in the daily activities involved in students' learning processes. To this end, the contextual inquiry method [3] was used and usability tests of the UOC's Virtual Campus were conducted with 15 visually impaired students in their homes, their natural context for studying.

Objective

Our research had 2 objectives. First, a qualitative approach was used to make ethnographic observations and conduct in-depth interviews [3] in the homes of visually impaired students in order to explore their daily activities in relation to the UOC with a view to determining the main difficulties and needs they encounter and how they resolve them. This made it possible to propose recommendations for ensuring accessibility in all the different interactions that students might carry out during their learning process with an e-learning institution.

Second, the research sought to assess the usability and accessibility of the UOC's Virtual Campus, the starting point for the student's online education, where they can find and access to relevant elements for their day to day at the University, such as classrooms, agenda, webmail, news, secretariat. To this end, a usability test was performed with the aim of gathering a series of recommendations for designing Virtual Campuses that are accessible and satisfactory for visually impaired students.

Described below are the methodology, the characteristics of the study population, the results of the fieldwork and the resulting recommendations, as well as the final conclusions

Methodology

As noted by Ribera et al. [15], current best practices on accessibility incorporate the philosophy of user-centered design (UCD). One UCD method is contextual inquiry, a specific type of interview for gathering field data from users [3]. In keeping with this approach, both the in-depth interviews and the tests were conducted at the students' homes.

The aim of this participant observation was, first, to observe in detail what the participants' everyday study context was like in order better to understand how they use the different assistive tools, technologies and devices for the visually impaired. Second, conducting the usability tests at their homes ensured that they were done in the familiarity of their natural context for studying, which made it possible, among other things, to perform the test in some cases using students' own monitors, especially in the case of those students who use ZoomText, as they tend to use much larger monitors.

The in-depth interviews aimed to determine what actions the students carried out over the course of their everyday activities as UOC students and what interactions they needed to carry out in the UOC's Virtual Campus and with other people or devices to complete any step within their learning process (with university management staff, faculty, educational content, other materials, etc.).

The user tests were conducted on the UOC's Virtual Campus. The environment includes a horizontal menu at the start listing different services, as well as a series of widgets offering access to relevant content for the student, such as e-mail, the agenda, classrooms (each student has one classroom per subject on which he or she is enrolled), news, etc. The e-mail widget, for example, shows the number of new messages received and provides a list thereof; the widgets for the different classrooms can be used to access different educational resources and also notify the student of any new messages received from classmates, faculty, etc. Moreover, the widgets can be customized, such that users can add, remove or reposition them or even change their color.

Sample

Of all the visually impaired UOC students contacted for the study, 15 agreed to collaborate, of which 4 were men and 11 women, all between the ages of 22 and 64. Most students lived with a partner and their children or with their parents. All of the tested students were enrolled in an arts or social science degree program, with special emphasis on humanities, law and psychology.

As for the assistive technology used, 4 students used a screen reader (in one case, he had only been doing so for one month); 5 used a screen magnifier and 6 used the zoom function on their PC (they tended to have less vision loss than students who used a magnifier, either because they still had vision in one eye, had a recurrent condition, or were sensitive to light).

Results

Shown below are the results of the content analysis [12] of the interview transcriptions, as well as the results of the tasks carried out during the user tests.

Results of the contextual interviews

The in-depth interviews conducted in the visually impaired students' routine contexts for studying yielded results concerning: a) the planning, time and features of the place of study; b) the materials and study methods used; and c) the difficulties encountered when performing the different tasks involved in the learning process.

PLANNING, TIME AND PLACE OF STUDY

Visually impaired students study like any other student without a visual impairment at the university, that is, they log onto the virtual campus every day to check their e-mail, read messages from the lecturers, forums and debates, and read or listen to the educational content. Once they have completed this reading, they engage in the learning activities (which are sent by the lecturer every 2 or 3 weeks, as assessments are continuous).

They usually perform these tasks from home. However, some students also take advantage of other times and situations, such as commutes and waits, to read and listen to content, as well as of down time at work to prepare and write their responses to a debate or forum. Thus, students plan their activities based on the different situations they expect to encounter. For instance, if they have a commute or know that, at some point during the day, they will have some down time due to a wait, they prepare the material they will need to take advantage of that time: "*When I have to wait for my son to finish up at the conservatory, I bring*

along the recordings to listen to". Another user does the assessment activities and content summaries and accesses supplementary content at home, but listens to the content in Daisy format on his commutes.

However, when making their plans, they take into account that they will need more time to complete an activity than students without visual impairments because:

- They must spend time resolving accessibility issues with regard to the educational content.
- The use of assistive tools for the visually impaired slows interactions with the website and reading: "*The more you magnify the screen, the slower you go, because you lose your field of view*".
- They have to take breaks from the computer screen to rest their eyes, due to the fatigue caused by the light of the screen.

STUDY METHODS AND MATERIALS

The study method used by visually impaired students is no different from that used by students without visual impairments. Basically, they make use of assistive tools for the visually impaired to read and study the content and take advantage of other formats, such as audio, to optimize their studying.

The interviewed students used the following formats:

***Print*:** Only a few students who use a magnifier or the zoom function on their PC also use the print format. When they do, it is either out of personal preference or because the content is not available in audio format. They tend to use print formats with a page-to-TV magnifier, a magnifying glass or no additional tool at all. Students who use the zoom function on their PCs as well as the print format also tended to use lecterns.

***Audio*:** Whether as an mp3 or in Daisy format, audio is used by many students, regardless of their preferred assistive tools. Some even consider it the ideal format: "*It would be great if I could convert everything to audio*". Most of the audio files used by students are recordings made by the students themselves or a family member. The reasons for using audio include: reviewing, studying or getting a general idea of the content; reading long PDFs and resting one's eyes; lack of time; and when the original material is not accessible and the student has to convert it to audio format.

PDF: This format is used by the vast majority of students (it is the format in which the University provides its educational content), whether with the help of a magnifier, a screen reader or the zoom function on their computers. However, it is also the one that gives the most problems in terms of accessibility.

Word: This is the format used by students who use ZoomText or a screen reader to convert inaccessible PDFs. To do this, they scan the document with an OCR to convert it to a Word document or copy and paste from the PDF to Word. However, both methods can cause layout problems and images are lost. Some students convert the PDF to Word because it allows them to annotate and underline in the original document while also keeping another Word document open to take notes.

***Braille*:** Only 2 of the interviewed students regularly use braille to read content in order to facilitate understanding and memorization, read short documents, and read content with economic data,

tables, legal arguments, slang, etc., as such content is harder to scan and listen to.

MAIN DIFFICULTIES

Visually impaired students face multiple difficulties when studying. The main and most serious problem is encountering content that is not accessible in the educational content and learning activities such as inaccessible PDFs, scanned PDFs, images, videos and flash formats.

As a result, the preferred format for interacting is conditioned by whether or not the specific format is accessible. While some students prefer to use multiple formats, such as audio and text, most students ultimately choose Word, as it gives the fewest problems to read using a screen reader or magnifier and it moreover allows editing and underlining: "*I like to be able to underline because, otherwise, when you come back to a text, you have to read it all over again".*

Additionally, when students do encounter educational content that is not accessible, they are required to spend time making it accessible, whether by asking the lecturer for help, adapting the content themselves (e.g., by converting a PDF to Word or by recording the content themselves to listen to later), or by asking a family member for help: *"If I have problems with a given material, the first thing I do is tell the lecturer. If he can't solve it, I do it myself or try to get someone to help".*

These setbacks due to not having the content can lead to significant distress while waiting for it to become available: *"It makes you very nervous, because you can't start".* Moreover, it affects students' ability to participate in debates and forums about the content in question.

This time investment also means that the students have less time later to complete the learning activities, with the ensuing consequences for the quality of their performance on them. Additionally, when a learning activity requires students to view images or videos in order to answer questions about them, the lecturer may not have prepared an alternative activity that does not include images or videos, and these students may thus be deprived of the chance to complete this activity on an equal basis with students without visual impairments.

Another problem arises when students have to consult content for the learning activities that is not part of the official content, such as websites or other documents. This requires students to spend more time than expected in front of the computer, which is not advisable for some students due to their disability, and to consult other websites or documents the accessibility of which may not be guaranteed.

As noted above, students sometimes encounter educational content and learning activities that are not accessible. When they notify the lecturer about this problem, the proposed solutions are not always adequate, no doubt because the lecturer is not entirely aware of what it means for content to be accessible or has insufficient knowledge of accessibility. One student explained, "*Sometimes when I tell them that I can't see the images, they tell me to enlarge them, but even when I enlarge them, I still can't see them, so they tell me to read whatever, but I can't read in print format either".* Or in the words of another student, "*I bet they would never send an audio file to a deaf person".*

Finally, another factor to be taken into consideration is whether or not students notify the lecturer of their

visual impairment to ensure that the educational content is accessible, as even when they do so in advance, there is no guarantee that the lecturer will find the best way to offer accessible content.
Indeed, not all of the interviewed students do choose to state that they are visually impaired, as it makes them feel uncomfortable and they do not want seem like nags *("If I have to keep repeating in every subject that I can't see, I feel whiny and annoying"*) or they do not want to be shown any favoritism ("*People tend to show favoritism, and I don't want that. I don't want them to find out that I have this problem and then turn around and say, 'Oh, you poor thing'"*).

Results of the user test
As a general rule, the vast majority of students successfully completed the different proposed tasks. Regardless of the adaptive tool used, the students gave positive feedback on having the content relevant to their studies (such as e-mail, classrooms, etc.) organized in widgets, as it allowed them to find it easily and quickly, while also allowing them to customize the layout of the page by moving the widgets around.

The main usability and accessibility problems were the same ones commonly found in other studies involving usability tests with end users, such as the lack of alt text for pictures [13], sentences that start with irrelevant words and the use of the same words for links and other functions [19], etc. Given the objective of this research, we will not list here the recommendations identified in previous studies for online environments in general. Instead, in the section on recommendations, we will simply highlight those recommendations specifically related to the design of Virtual Campuses.

Recommendations for distance education institutions

Shown below are the recommendations drawn from the results of our research to ensure a satisfactory e-learning experience**.**

Recommendations for ensuring a satisfactory e-learning experience
Provide all possible formats. Providing the educational content in all possible formats (audio, Word, PDF, braille, websites, etc.) would allow visually impaired students to choose the format that best suits their needs.

Provide materials that are not only accessible but also usable. The user experience should be improved with regard to the use of different formats, as it would enrich and speed up students' learning activities.

Faculty training in accessibility. Those lecturers responsible for preparing and providing the content and learning activities must be well trained in accessibility issues in order to ensure that they are fully aware of the difficulties that visually impaired students face.

Provide visually impaired students with the learning materials and assessment questions earlier, just as they are given more time on exams.

Offer alternative accessible learning materials in those cases in which, from an educational point of view, it is advisable to use learning materials that are not accessible, such as videos or images.

Ensure access to accessible materials so that visually impaired students do not need to identify themselves as such.

Design recommendations for Virtual Campuses
Listed below are a series of useful recommendations for the design of Virtual Campuses:

Place the main or important content at the start. This way, users can access the relevant content for their studies directly without having to go through other less important content first, such as a menu.

Allow users to customize what content they see. In addition to enabling customizable shortcuts, allow users to choose which widgets they would like to have in their Virtual Campus.

Show all important content at once. If all the content that students are most interested in is located on the same page (e.g., they can see whether they have mail, check forums, etc.), they will not have to open new windows or tabs to access specific content.

Allow users to customize where content is shown. By positioning widgets, students can choose where to locate the content they are most interested in, for example, in a column [20]. This would allow students who use magnifiers not to have to scroll across the page horizontally.

Allow color customization. Allowing users to customize the colors of the elements that frame content or links would make it easier for students with sufficient remaining vision to identify them without having to read.

Accessible colors and contrast. In addition to being fundamental to accessibility, this would allow students to determine at a glance whether there have been any new notifications in the classrooms or any new e-mails.

A list of upcoming events as an alternative to the calendar. An agenda or calendar is useful for students without visual impairments, but it is impractical for students using Jaws or ZoomText. It is thus advisable to offer an alternative to the agenda, such as a list of upcoming events.

Liquid layout. This type of layout makes it possible to enlarge the font by X% without causing information to disappear or generating new horizontal and vertical scroll bars in the widgets. It also allows the page to be reorganized when the zoom function is used.

Facilitate the repositioning of widgets. The use of drag-and-drop and scrolling options within a layout section would allow all students to organize the content as best suits their needs.

Conclusions

This research has gathered the requirements and needs of visually impaired students participating in online courses and used them to formulate a series of recommendations aimed at facilitating the everyday activities of such students.

The fundamentally visual nature of our consciousness and thinking causes people without visual impairments to communicate based on visual references. As a result, it can be difficult to realize that these visual references are invisible and/or relatively useless for the visually impaired. Thus, our recommendations suggest that

training in accessibility issues for the people responsible for providing and preparing learning materials would address the main problems encountered by visually impaired students, namely, educational content and learning activities that are not accessible.

These recommendations also underscore the importance of providing customization options to visually impaired students. Because these students are a very heterogeneous group (with different types of impairments, different tools, different preferred contexts and formats, different preferences for studying, etc.), distance education institutions must strive to accommodate their heterogeneity, for example, by providing educational content in all possible formats [6], which is also beneficial for the rest of the students [4, 9].

Enabling customization is also important in the design of an e-learning environment [8] such as by allowing users to decide what content is shown and where, which can be achieved, for example, by using widgets that can be custom placed and colored. These conclusions follow in the same vein as those of Theolanos and Redish [20] in that they aim to provide a website that can be adapted and customized by users in keeping with their preferences or needs, and irrespective of their disability. In the context virtual campuses, environments that are flexible, customizable and accessible at all levels will facilitate the everyday activities of visually impaired students and help them to optimize the time they spend interacting with the website.

Acknowledgements

We would like to thank the 'eduWAI: Platform for the Creation of Educational and Labor Market Integration Content for the Disabled' project, funded by the Spanish Ministry of Industry, Tourism and Trade; the 'Avanza' research and development program (AETSI Avanza I+D 2009) TSI-020312-2009-27; and the 'UNIDISCAT: Transcription of Mathematical Formulae – Text, Sound and Braille' project, funded by the Catalan Agency for the Administration of University and Research Grants (AGAUR from the Catalan), Case No. 11.

References

[1] Alexander, D. & Rippon, S. *University website accessibility revisited.* Ausweb (2007). Retrieved 2 January 2012, from: http://ausweb.scu.edu.au/aw07/papers/refereed/alexander/paper.html

[2] Asuncion J. V., Fichten C. S., Barile M., Nguyen M. N., Martiniello N., Budd J., Ferraro V., Wolforth J., Malik R. eLearning and Postsecondary Students with Visual Impairments. In *Proc. Vision 2008*, (2008).

[3] Beyer, H. & Holtzblatt, K. *Contextual Design: Defining Customer-Centered Systems.* San Francisco: Morgan Kaufmann (1998). ISBN: 1-55860-411-1.

[4] Burgstahler, S. Distance learning: Universal design, universal access. *Educational Technology Review 10, 1* (2002), 32-61.

[5] Burgstahler, S. The development of accessibility indicators for distance learning programs. *ALT-J, Research in Learning Technology 14, 1* (2006), 79–102.

[6] Burgstahler, S., Corrigan, B. & McCarter, J. Making distance learning courses accessible to students and instructors with disabilities: a case study. *Internet and Higher Education 7* (2004), 233–246.

[7] Candido, JVisual impairment in a visual medium: Perspectives of online learners with visual impairments. PhD dissertation, Drexel University, Pennsylvania, United States (2008). Retrieved 30 August 2010, from Dissertations & Theses: Full Text. (Publication No. AAT 3338731).

[8] Cooper, M. Making online learning accessible to disabled students: an institutional case study. *ALT-J, 14, 1* (2006), 103–115.

[9] Edmonds, C. D. Providing Access to Students with Disabilities in Online Distance Education: Legal and Technical Concerns for Higher Education. *American Journal of Distance Education, 18, 1* (2004), 51 - 62. [Retrieved 29 April 2011.] DOI: 10.1207/s15389286ajde1801_5 URL: http://dx.doi.org/10.1207/s15389286ajde1801_5

[10] Kane, S. K., Shulman, J. A., Shockley, T. J. & Ladner, R. E. A web accessibility report card for top international university web sites. In *Proc. W4A '07,* ACM Press (2007), 148 – 156.

[11] Kelly, B., Sloan, D., Phipps, L., Petrie, H. & Hamilton, F. Forcing standardization or accommodating diversity? A framework for applying the WCAG in the Real World. *International Cross-Disciplinary Workshop on Web Accessibility (W4A). ACM International Conference Proceeding Series, Vol. 88*, New York, ACM (2005), 46-54.

[12] Krippendorff, K. *Content Analysis: An Introduction to Its Methodology* (2nd ed.), Thousand Oaks, CA: Sage, (2004).

[13] Lazar, J., Allen, A., Kleinman, J. & Malarkey, C. What frustrates screen readers users on the web: a study of 100 blind users. In: *International Journal of Human–Computer Interaction, 22, 3* (2007), 247–269. Copyright © 2007, Lawrence Erlbaum Associates, Inc.

[14] Porras, M. & Ribera, M. Estudio de caso: Una Evaluación de la Accesibilidad Web Mediante WCAG y Observación de Usuarios Ciegos y con Restos de Visión. *IX Congreso Internacional de Interacción Persona-Ordenador* (2008), 119-126. ISBN: 978-84-691-3871-7

[15] Ribera, M., Térmens, M. & Frías, A. La accesibilidad de las webs de las universidades españolas. Balance 2001-2006. *Revista Española de Documentación Científica, 32, 3* (2009). July-September, 66-88, 2009 ISSN: 0210-0614. DOI: 10.3989/redc.2009.3.683

[16] Ribera, M., Térmens, M. & García, M. Cómo realizar tests de usabilidad con personas ciegas. *El profesional de la información 17, 1* (2008), 99-105.

[17] Schmetzke, A. *Web page accessibility on University of Wisconsin campuses: 2005 survey data and seven-year trend data* (2005). Retrieved 2 January 2012, from: http://library.uwsp.edu/aschmetz/Accessible/UW-Campuses/Survey2005/contents2005.htm

[18] Sloan, D., Kelly, B., Heath, A., Petrie, H., Fraser, H. & Phipps, L. Contextual Web Accessibility - Maximizing the Benefit of Accessibility Guidelines. In *Proc. W4A.* New York: ACM Press (2006), 121-131. Retrieved from: http://www.ukoln.ac.uk/web-focus/papers/w4a-2006/

[19] Theofanos, M. F., Redish, J. C. Guidelines for accessible and usable web sites: Observing users who work with screen readers. *Interactions, 10, 6* (2003), 38-51.

[20] Theofanos, M. F. ; Redish, J. C. Helping Low-vision and Other Users with Web Sites That Meet Their Needs: Is One Site for All Feasible?. *Technical Communication, 52, 1* (2005), 9-20.