Online Digital Libraries at Universities:
An Inclusive Proposal

Amanda Meincke Melo and Joseane Giacomelli da Silva

Federal University of Pampa (UNIPAMPA), Alegrete – RS, Brazil
amanda.melo@unipampa.edu.br, jogiacomelli.cc@gmail.com

Abstract. Information accessibility at online digital libraries is an essential requirement so people can use them independently. These are very common systems at Universities for sharing academic knowledge and for supporting learning. However, information accessibility to people with disabilities is not properly taken into account when designing and maintaining end-user interfaces and content. This paper is part of a broader research that aims at contributing to the implementation of an accessible online digital library system at UNIPAMPA, Brazil, as well as at promoting the universal access on other online digital library systems. Based on the literature review and a case study in Human-Computer Interaction, this research proposes a set of accessibility guidelines to design and maintain online digital libraries. These guidelines should be part of inclusive educational settings.

Keywords: accessible online digital libraries, information accessibility, universal design, inclusive design, inclusive education, online learning, Brazil.

1   Introduction

Information and communication technologies (ICTs), including online digital libraries, extend the possibilities of information dissemination and access. Online digital libraries support publication and management of digital objects (e.g., technical reports, monographs, theses). At universities their content is made by different academic sectors and it is used for teaching, extension programs, research and management. University online digital library promotes the sharing of knowledge generated by the academia within it as well as with the outside community.

Online digital libraries should be designed with universal access in mind so each and every user could access them independently and on equal terms. However, it has not necessarily been true [7], [8], [12], [14]. Basic guidelines have been neglected, such as providing alternative texts to images or providing labels to forms [21]. Even though Universal Design [6][23] and Web Accessibility Guidelines [3], [24] are widely disseminated, it is still necessary:

To undertake or promote research and development of universally designed goods, services, equipment and facilities, as defined in article 2 of the present Convention, which should require the minimum possible adaptation and the least cost to meet the

specific needs of a person with disabilities, to promote their availability and use, and to promote universal design in the development of standards and guidelines. [6]

This work aims at contributing to the implementation of an accessible online digital library system at UNIPAMPA, Brazil, and at promoting the universal access on other online digital library systems. Differently from other proposals [7], [12], [14], but deeply inspired by the universal design framework, this work deals with universal access of an online digital library from the very beginning of its development, starting with requirement elicitation, going through the assessment of candidate systems and a pilot prototyping of end-user interfaces. This paper also proposes a set of guidelines to support design and maintenance of accessible online digital libraries at Brazilian Universities.

2   Literature Review

An online digital library better suited to inclusive educational context shall allow every person – including users of assistive technologies – to browse its pages, to search within its content and to access and read publications in an equitable way. Academic managers should be able to maintain the system – according to each assigned role – with autonomy. From its conception to updating, Web Accessibility Guidelines should be followed, including the need for several types of end-users throughout the design process [13].

The Brazilian Decree 5.622/2005 states that eLearning courses should provide adequate libraries, with collections that comply with the student's needs [10]. According to the UN Convention on the Rights of Persons with Disabilities [6], information accessibility should be a basic requirement. However, it has not been fully achieved at online digital libraries of Brazilian Universities. Very often alternative texts to images or labels to forms are missing, what is a barrier to screen reader's users to perceive and to operate the user interface [21].

It is essential promoting universal access [2], [5] to make sure academic and external communities can broadly access and use digital objects available at online digital libraries. The concerns regarding the use of online digital libraries by people with disabilities put in evidence the importance of following accessibility standards in the development of accessible materials and the use of assistive technologies resources [8], [12]. However, in Brazil, these initiatives are still very limited to local collections access, to the retrofit of inaccessible systems or to specific groups of users with disabilities, such as blind and deaf people [7], [12], [14].

Moreira [14] presents an academic service to support information access to people who are blind or who have low vision, which offers specialized services, like coding texts to Braille and/or accessing assistive technologies. Although this service is a very important initiative, it isn't enough to provide online digital libraries access and use on equal basis.

Lira [12] reports on a project regarding physical and digital retrofit of Rio de Janeiro's National Library, suggesting that it could be a model to enhance information accessibility in libraries for people with disabilities and elders. The project also

highlights the need to adapt the National Library's website to principles of accessibility as well as to carry out a process taking into account the content and the information accessibility, including alternative media to books.

Corradi and Vidotti [7] analyze accessibility resources available at online digital libraries, such as audio files for blind users and videos with sign language for deaf users. The authors argue that such resources could enhance information access and use to people with disabilities. However, the analyzed resources do not guarantee that each and every user could access the available information on equal basis, especially because among these resources one can find, for example, audio files without equivalent transcript, videos with no captions, and videos without audio to provide equivalent information for users who need them.

Digital Accessible Information System (DAISY) [9] has been recently adopted by the Brazilian Department of Education as a technical standard to deploy accessible books to blind students who are enrolled at public schools [19]. Although it is not mandatory standard in Brazil, digital talking books produced with this technical standard can provide synchronization of text, audio and images, thus providing information accessibility to people who are unable to read standard print [9]. On the other hand, the use of Printable Document Format (PDF) for publishing content at online digital libraries is very common [21]. Files published using this format should be edited providing accessibility at native document applications, such as Microsoft Word and LibreOffice Writer, before exporting to PDF format, which is just a destination file format [16], [20].

Although there are laws [6], [10] and widely known web standards [3], [24] to improve online access to people with disabilities, a great deal of contributions is still necessary to their effective practice. Universal access should be seriously considered in the design of online digital libraries to broad their access and use by people with disabilities on equal terms with any other people.

3   Method

A case study was carried out with a qualitative and exploratory approach at Federal University of Pampa (UNIPAMPA), Brazil. It was based on concepts and techniques from Software Engineering [22] (e.g., requirement elicitation, iterative development, brainstorming, questionnaire) and Human-Computer Interaction [1], [13], [16] (e.g. iterative design and assessment, end-user participation, prototyping, user interface accessibility assessment).

The case study started with a requirement elicitation regarding an online digital library. To do that, an online questionnaire was applied in ten University Campuses and a participatory meeting was realized to address different stakeholders (e.g., teachers, students, librarians, eLearning staff, and IT professionals). In this meeting, the brainstorming technique was used followed by requirements prioritization [21]. Table 1 summarizes the high-priorities user interface requirements to the online digital library.

Table 1. High-priority user interface requirements to an online digital library [20]

- Show user location on the website ("You are here:");
- Clear and simple options on Menus;
- Quick access to other portals (e.g., CAPES);
- High contrast options;
- Easy to use, with usability (observing usability heuristics);
- Accessibility (observing web accessibility recommendations, e.g., e-MAG):
  - o Address accessibility at website structure and content;
  - o Address accessibility at published files.
- Objectivity:
  - o Simple and objective pages.
- Navigability:
  - o *Layout* that helps guiding the user;
  - o Objective *links*;
  - o Uncomplicated operation.
- Colored and dynamic *layout*;
- Human responses.

The generated information in this former stage subsidized the definition of attributes to be observed in Free Software Systems available as infrastructure to online digital libraries development and maintenance (e.g., EPrints, DSpace, Fedora, TEDE, Greenstone). Some DSpace characteristics contributed to its choice among other systems [20]:

- possible interoperability with other digital libraries using OAI-PMH;
- recommendation by the Brazilian Institute of Information in Science and Technology (IBICT) for the deployment of institutional repositories at Brazilian Universities [11];
- successful cases of integration between Content Management Systems (CMS) and DSpace, e.g., Brasiliana USP [4];
- support material for its deployment and customization;
- case studies regarding integration of DSpace into eLearning plataforms, e.g., Moodle;
- qualified staff at University in the programming language used to develop it.

The low-fidelity prototyping, using the BrainDraw participatory technique [15], followed DSpace software choice. Finally, a high-fidelity prototype was designed, and a preliminary accessibility assessment was carried out on it. Prototyping and assessments are described hereafter.

## 3.1 Prototype Building and Assessment

A first prototyping was supported by BrainDraw participatory technique, which is a group elicitation method. This technique supports designers in prototyping so they

can start from different perspectives instead of just theirs own. Usually its groups consist of 2 to 8 members [15].

Undergraduate students from Computer Science Course, who are also prospective users of online digital libraries and had been taking HCI classes, were invited to the initial prototyping. They were organized into three groups, each one with three or four members.

Before applying the BrainDraw technique, students received a short introduction of the research and the identified requirements. They also received some supporting materials: slides showing DSpace repositories so they could recognize some concepts like Communities and Collections; the high-priority requirements [20]; and Nielsen's ten usability heuristics [16].

The BrainDraw technique was started and each student drew an initial design. At the end of a minute, the participants handed her/his drawing to other student at her/his right side. After each paper had passed by each student twice, the drawings were analyzed within the groups and they supported a design proposal by the group. The three generated design proposals were analyzed to generate a low-fidelity prototype to the online digital library main page (Figure 1).
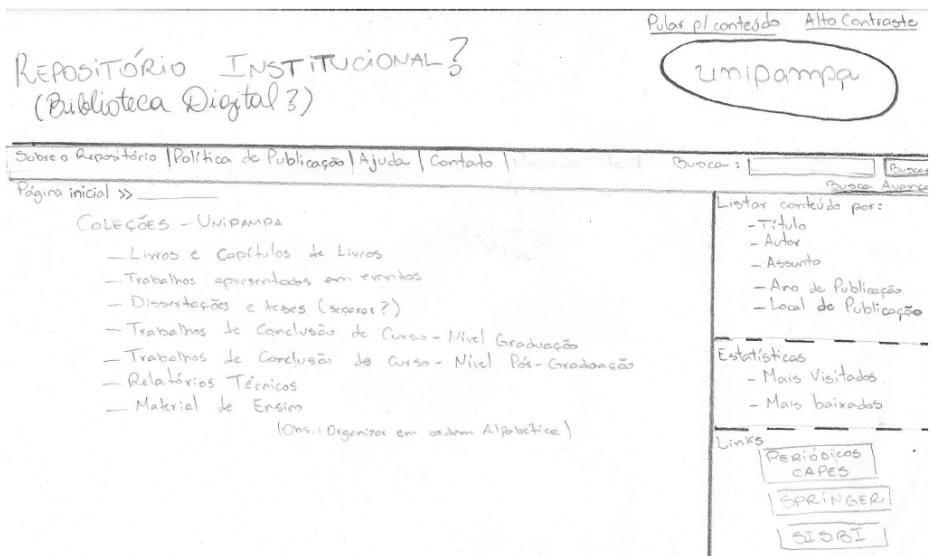
Fig. 1. Low-fidelity prototype subsidized by BrainDraw: main page structure and content to an online digital library [20]

Finally, a high-fidelity prototype (Figure 2) using DSpace software was produced to the online digital library taking into account the low-fidelity prototype, the infrastructure provided by DSpace system, and the identified requirements. The high-fidelity prototype is realistic enough to be assessed by experts and end-users, throughout different user interfaces techniques.

Fig. 2. High-fidelity prototype using DSpace system: main page structure and content proposal to UNIPAMPA online digital library [20]

During high-fidelity prototyping some accessibility problems – e.g., absence of header level 2 and the absence of the main language specification – were identified and solved. To conclude, a preliminary accessibility assessment was carried out by a junior HCI researcher supervised by an expert on web accessibility assessment. The assessment followed Web Accessibility Initiative (WAI) recommendations to preliminary review of web sites for accessibility [18].

A set of representative sampling of pages were selected, including main DSpace features, different layouts and functionalities (e.g., main page; search results; advanced search; navigation by author, title, subject, date and location; Community and Collections; a community page; a collection page; item visualization; and feedback form). Graphical and textual browsers (e.g., Firefox, Google Chrome, Opera, Lynx) as well as the NVDA screen reader supported the web content assessment – e.g., place of images, sequential equivalence. ASES semiautomatic tool helped to assess conformance level to e-government guidelines.

Although DSpace design follows web standards [20], the assessment pointed out the absence of labels to forms, the use of absolute font-size values instead of relative font-size values in CSS, and a poor use of the webpage title property. Such issues could compromise the use of online digital libraries by blind users and through small screen devices. Also, keyboard operation could be enhanced, providing skip links, direction links and access keys.

4   Results and Discussion

The literature review and the case study showed the necessity of proposing some guidelines to support the design and maintenance of accessible online digital libraries at Universities. These guidelines are organized in the following three categories:

general accessibility issues, DSpace user interface accessibility, and online digital library content accessibility (Table 2).

Table 2. Guidelines to support the implementation and the maintenance of accessible online digital libraries

Guidelines Category	Guidelines
General accessibility issues	Follow web accessibility standards and guidelines
	Provide skip links
	Provide direction links
	Provide access keys
	Validate the design with end-users
DSpace user interface accessibility	Provide informative and descriptive titles to webpages
	Identify the language adopted in a webpage
	Respect the logical sequence of headers
	Provide labels on forms
	Adopt relative values in CSS
Online digital library content accessibility	Post accessible videos
	Provide alternatives to audio
	Provide alternatives to images
	Publish accessible PDF files

Besides supporting the design and maintenance of online digital libraries, these guidelines aim at promoting DSpace system accessibility. It should be observed since the beginning of developing a new online digital library. It also should be taken into account when adding or updating content.

General guidelines can be applied to web based systems as well as to online digital libraries. These guidelines point out keyboard operation, web standards and accessibility guidelines, and the importance of assessment with users.

DSpace system is a reference to online digital libraries deployment at Brazilian Universities. In relation to guidelines to this system, changes should be made on it to avoid accessibility errors. These changes would allow some people with disabilities (e.g., users who are blind, users who have low vision, etc.), screen reader's users, and small screen users adopting online digital libraries built up DSpace system.

Content publication guidelines should be considered when producing and publishing the content, so it is flexible enough to different users. There are specific guidelines to produce accessible videos, audio, images and PDF files. Table 3 summarizes them.

These specific guidelines should be observed when producing content which is flexible enough to suit to different user needs on equal basis.

Table 3. Specific guidelines to promote online digital library content accessibility

Guideline	Description
Post accessible videos	Features that allow users to watch videos without sound or access to images and movements should be offered to make them widely accessible. E.g., captions are useful to users who are hard of hearing or who are in noisy environments; sign language window is useful for people who are deaf; audio description is useful for people who are blind, who have low vision or who have their vision busy with another activity. Local culture issues should also be taken into account when providing sign language window – e.g., Brazil has its own sign language that is known as LIBRAS.
Provide alternatives to audio	A text transcription to the audio should be provided so people who are deaf or hard of hearing could access its content. Whenever possible, sign language transcription should be provided to the audio material once many people who are deaf have a sign language as their first language.
Provide alternatives to images	Images inside a document should be properly described. Users who are blind and textual browser users could take benefit of this caution. W3C Accessibility Guidelines [24] and e-MAG [3] provide guidance on how to provide alternative texts to images. An alternative text should replace the meaning of an image in the context in which it is used.
Publish accessible PDF files	Documents – like technical reports, monographs, theses, etc. – should be properly structured within a text processor (e.g., Microsoft Word, LibreOffice Writer). This can be done applying styles to headings, lists, tables, etc. before converting them to PDF [16]. A tagged PDF improves accessibility to screen reader's users and to different screen sizes.

5   Conclusions

Online digital library systems are very common at Universities [8], [11], [20] to organize their publications and to support learning. On the other hand, universal access should be taken into account throughout their development so the needs of people with disabilities could be considered since the early beginning of requirement elicitation in an inclusive design approach, influencing design decisions.

W3C accessibility guidelines as well as end-user participation – e.g., students, teachers, University staff, and people outside University –, including people with disabilities, play an important role in the design of web systems for all. However, they have been neglected when building online digital libraries at Brazilian Universities. This paper presents some guidelines to address this problem.

The pilot prototype suggested in this research could support the further deployment of an online digital library at UNIPAMPA, Brazil. Its design considered contributions from end-users during requirement elicitation and Web Accessibility Guidelines [3], [4]. In the next steps, it should also be assessed by real users – including people with disabilities – as part of an iterative and inclusive design approach.

An important outcome of this case study is that eLearning staff is more aware about the necessity of information accessibility and it has influenced their practices.

References

1. Bevan, N.: Quality in use for all. In: Stephanidis, C. (ed.) User Interfaces for all: concepts, methods, and tools, pp. 353–370. Lawrence Erlbaum, New Jersey (2001)
2. Bonacin, R., Melo, A.M., Simoni, C.A.C., Baranauskas, M.C.C.: Accessibility and interoperability in e-government systems: outlining an inclusive development process. Universal Access in the Information Society 9(1), 17–33 (2010)
3. Brasil. Ministério do Planejamento, Orçamento e Gestão. Secretaria de Logística e Tecnologia da Informação. e-MAG Modelo de Acessibilidade de Governo Eletrônico. V. 3.0. MP/SLTI, Brasília (2011)
4. Brasiliana USP, `http://www.brasiliana.usp.br/`
5. Colette, N., Abascal, J. (eds.): Inclusive Design Guidelines for HCI. CRC Press (2001)
6. United Nations. Convention on the Rights of Persons with Disabilities (2006), `http://www.un.org/disabilities/convention/conventionfull.shtml`
7. Corradi, J.A.M., Vidotti, S.A.B.G.: Elementos de Acessibilidade em Ambientes Informacionais Digitais: bibliotecas digitais e inclusão social. In: Seminário Internacional de Bibliotecas Digitais. USP, São Paulo (2007)
8. Cusin, C.A., Vidotti, S.A.B.G.: Acessibilidade Web em Bibliotecas Digitais Universitárias. In: Seminário Nacional em Bibliotecas Universitárias, São Paulo (2008)
9. DAISY Demystified, `http://www.daisy.org/daisypedia/daisy-demystified`
10. Decree 5.622/2005, `http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/decreto/d5296.htm`
11. DSpace – Repositórios Digitais, `http://dspace.ibict.br/`
12. Lira, G.A.: Biblioteca Nacional: desenvolvimento do modelo brasileiro de biblioteca acessível para pessoas com deficiência e idosos. Inclusão Social, 2, 2 (abr./set), 10-13 (2007)
13. Melo, A.M., Baranauskas, M.C.C.: An Inclusive Approach to Cooperative Evaluation of Web User Interfaces. In: Eighth International Conference on Enterprise Information Systems. Paphos (2006)
14. Moreira, S.M.B.L.: Acessibilidade a informação aos deficientes visuais na Biblioteca Central Clodoaldo Beckmann da UFPA. In: Simpósio Nacional de Bibliotecas Universitárias, São Paulo (2008)
15. Muller, M.J., Haslwanter, J.H., Dayton, T.: Participatory Practices in the Sofware Lifecycle. In: Helaner, M.G., Landauer, T.K., Prabhu, P.V. (eds.) Handbook of Human-Computer Interaction, 2nd edn., pp. 255–297. Elsevier, Amsterdam (1997)
16. PDF Accessibility Overview, `http://www.adobe.com/accessibility/products/acrobat/pdf/acrobat-xi-pdf-accessibility-overview.pdf`

17. Preece, J., Rogers, Y., Sharp, H.: Interaction Design: beyond human-computer interaction. John Wiley & Sons (2002)
18. Preliminary Review of Web Sites for Accessibility,
    `http://www.w3.org/WAI/eval/preliminary.html`
19. Projeto MecDaisy, `http://intervox.nce.ufrj.br/mecdaisy/`
20. Reck, J.G.S.: Bibliotecas Digitais Acessíveis: promovendo o acesso à informação com recursos da informática. UNIPAMPA, Alegrete (2010)
21. Silva, J.G., Hohemberger, R., Melo, A.M.: Biblioteca Digital Inclusiva no Ensino Superior. In: Brazilian Symposium of Human Factors on Computer Systems, Belo Horizonte (2010)
22. Sommerville, I.: Software Engineering, 8th edn. Addison-Wesley (2006)
23. The Principles of Universal Design, `http://www.ncsu.edu/project/design-projects/udi/center-for-universal-design/the-principles-of-universal-design/`
24. Web Content Accessibility Guidelines (WCAG) 2.0,
    `http://www.w3.org/TR/WCAG20/`