Promoting Accessibility for Visually Impaired Users through Formative Audiovisual Content

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ABSTRACT

Nowadays, web pages and the web make it possible to integrate a huge diversity of resources and services, providing users with new experiences of interaction and participation in different domains. For most users, the use of websites does not entail great difficulties, but for individuals with special needs, namely visual impairments, this type of task becomes complex and makes it difficult or even impossible for the blind or visually impaired population to enjoy and take advantage of this type of services. Therefore, these resources and services must be accessible to the entire population. In this sense, this study appears as a contribution to simplifying the experience of access and use of visually impaired users in the context of web pages, from the creation of tutorials in audiovisual format with accessibility solutions that help this audience navigate Portuguese governmental websites.

CCS CONCEPTS

• **Human-centered computing** → Accessibility; Empirical studies in accessibility; Accessibility; Accessibility design and evaluation methods; Interaction design; Interaction design process and methods; User centred design; • **Information systems** → World Wide Web.

KEYWORDS

web accessibility, inclusion, visual impairment, audiovisual, tutorials

1 INTRODUCTION

Sight is one of the most appreciated and valued senses by human beings because, among other reasons, it allows learning most primarily through observation [3]. In a world in constant evolution, and in which the Internet and technology are gaining more and more strength as the preferred means of communication in daily life, these means must be accessible to the entire population. New technologies, especially in the fields of communication and information, allow access to work tools and sources of information whose use would have been unimaginable relatively recently. The ease, speed, and extinction of geographical barriers make it possible to access the most diverse types of channels that enhance knowledge, conviviality, and leisure [5].

The determining factor for the growth of the Internet appeared with the Word Wide Web (WWW), or simply Web, which is a worldwide system of hypertext and multimedia pages, accessible on any computer with an Internet connection through browsers [5].

For people with autonomy conditioned by architectural barriers, difficulties, disabilities and/or numerous disadvantages in access to information, which prevent them from knowing and living this "new" normality, this is freedom only dreamt of [5]. Particularly people with sight limitations are inhibited or prevented from using entirely information and communication technologies, such as websites. In this sense, the development of means that promote better access to webpages by people with blindness or low vision is very useful because this will allow Visually Impaired Users (VIU) to carry out several types of activities and functionalities, access large sets of information, establish contacts, exchange information, find new forms of entertainment and leisure, expand their relationships and open their horizons in the same way as the population that can access this type of content without any kind of difficulty [7]. Therefore, the development of inclusion strategies is essential, to produce an increase in the capabilities in the participation of this public in different domains, as well as the creation of accessibility solutions that help the navigation and exploration of users with special needs in the digital platforms currently available. Furthermore, it is important that a large part of websites, especially governmental websites, and information websites, have accessibility features.

In this direction, this study aims to simplify the experience of access and use of VIU in the context of web pages, from the creation of tutorials in audiovisual format, which contain accessibility solutions, and help this audience navigate Portuguese governmental websites and digital platforms. Through the clear and simple transmission of this accessible training content, it is intended that the VIU acquire the necessary skills for better access and navigation on, in this case, Portuguese websites. In addition to this, this study explores the Portuguese paradigm around web accessibility. Thus, the main objectives of this research project are the conceptualization, design of the audiovisual composition (tutorial videos) and their respective validation.

Therefore, it was in this scenario that the starting question of this study was formulated: **What requirements should tutorials in audiovisual format have to improve access to websites for people with blindness and low vision?**

2 THEORETICAL BACKGROUND

Technological developments have led to the emergence of universal access concerns and the purpose of making content accessible to all individuals. All web resources need to integrate accessibility features that allow users with functional limitations to use them by themselves or with the use of assistive technologies, so that all individuals can understand, navigate and interact with the web [10].

The concern with web accessibility is transversal to the various areas of society, especially in the areas of education, information, health, and services [6]. Thus, the platforms of private and government entities that concern these and other areas should be concerned with providing fully accessible pages to all citizens. Given that Portugal has many online public services, it is essential that their use can truly be made by all citizens equally, including those with disabilities who interact with computers or mobile devices through assistive technologies.

In 2014, the European Commission conducted a study of 372 websites from 31 countries whose results show that none of the selected Portuguese public administration websites met the minimum requirements for WCAG 2.0, although in the overall assessment the country was slightly above the European average [4].

The web contributes to a widening of content sharing and enables different and creative learning processes [8]. The media, especially social media, such as YouTube, can be very important aid tools in transferring data and information [3], also increasing the opportunities to obtain knowledge.

Since the need to use the other senses as forms of perception is imposed on the VIU, to capture the data collected from the environment and transform them into information and knowledge, the existence of videos and audiovisual content that are not adapted to these forms and senses are considered barriers in communications [11]. In this sense, it is important to consider alternative ways of access (full or partial) to audiovisual content by VIU. Thus, it becomes essential to think about the existing accessibility techniques for audiovisual content when producing any type of such content. Audio description (AD) emerges as one of the accessible communication alternatives. Aiming to facilitate the access of VIU to audiovisual content or static images, this resource consists of a semiotic translation that transforms visual information into verbal [9], through the narration of what can be seen (visual elements, relevant information, etc.). AD is a "*resource of image narration that can be applied in the audiovisual medium, television, in the theatre, in shows, in museums, and in all environments that present visual content*" (Villela, 2017, p. 16) [12]. This translation medium opens greater possibilities for access to culture and information, contributing to cultural, social, and school inclusion [9].

Another alternative to improve the accessibility of visually impaired individuals to audiovisual content is the magnification or adjustment of the text size. Since people with low vision have visual residues, it is recommended to take advantage of the little vision they have, replacing software with auditory resources with visual resources, expanding icons and font sizes to sizes above 24 points, sans serifs and italics [13]. Reading assistance can also be done through high contrast between foreground and background colours, for example, or brightness contrast between black and white. As for the spacing between letters, words, and lines, it must be enough to make them distinct from each other. In addition, the amount of text displayed must be considered, as it is neither viable nor pleasant to watch an image with a lot of text associated. Finally, the text present in accessible audiovisual content must be clear and intuitive [2].

3 METHODOLOGY

The present study is qualitative, with an exploratory approach. The methodology of this study is divided into three interrelated stages. The first corresponds to the identification of the research context and target audience, thus recognizing the difficulties and needs of VIU, both as consumers of audiovisual content and audio description services, and as users of digital platforms and webpages. This first stage ends with the identification of the guiding principles for the creation of formative videos on accessibility solutions aimed at the blind and low-vision audience. In the second stage, the structure of the formative tutorials with web accessibility solutions was conceptualized and developed, integrating the necessary specifications for the perception of the content by the target audience based on the principles identified in the first stage. Finally, the last stage includes the testing and evaluation of the structure of the audiovisual compositions built in the second stage, through the participation of a group of VIU, which allowed an understanding of whether the structured content meets the needs of this audience.

3.1 Characterization of the study participants

For the characterization phase of the study participants, 12 visually impaired people were selected (people with blindness and low vision). In this way, and aiming at the instrumentalization of this research, a semi-structured interview was used in this phase – applied with the purpose of knowing the target audience and understanding their difficulties and needs in interacting with websites and audiovisual content. In this interview questions were asked regarding personal data and characterization of visual impairment, Internet access patterns, accessibility issues on websites and how they navigate them and associated difficulties.

3.2 Development of video tutorials

For the tutorial development stage, the results obtained in the interviews conducted in the previous stage were considered. Answers to questions such as *"What websites would be interesting for you to learn and deepen with these tutorials?"*, were crucial to define which digital platforms would be addressed in the training videos. So, because online public services are very useful for society in general and important for the Portuguese citizen, as they allow them to perform several tasks in various areas of life autonomously, we chose to address the most relevant websites used by citizens to meet social and tax obligations: the Finance Portal and the Social Security Portal – websites that only meet the minimum accessibility

requirements (not fully accessible). On the other hand, another relevant piece of information provided by several interviewees with low vision, which is in line with the literature, is related to the importance of using the contrast between black and white for a better understanding of what is on the screen. Having said that, after the analysis of the answers, research and recognition of the websites mentioned were made to verify the lack of accessibility and find solutions to the difficulty in navigating and understanding the contents of each website with support technologies, namely screen readers (NVDA).

After this analysis and considering that each type of visual impairment has different specificities, it was decided to divide the content of the tutorials into two strands: i) accessibility solutions for people with blindness, and ii) web accessibility solutions for people with low vision.

In this way, and integrating these two aspects into the chosen platforms, the content of the tutorials is organized into two major categories (blindness and low vision), in each category has accessibility solutions for the Finance Portal and the Social Security website:

- Tutorials for people with blindness - Accessibility solutions on government websites:
○ Accessibility solutions on the Finance Portal.
○ Accessibility solutions on the Social Security website.
- Tutorials for people with low vision - Accessibility solutions for government websites:
○ Accessibility solutions on the Finance Portal.
○ Accessibility solutions on the Social Security website.

After organizing the content in this way, we proceeded to structure the content covered in each chapter of each tutorial, to allow the construction of structured, organized, and concise scripts. These scripts are the guides to producing the tutorials and contain all the relevant information that is narrated throughout the videos. This information is divided into chapters within each category (low vision and blindness) and is organized as follows:

- Video tutorials intended for blind people (describe the actions using the screen reader and shortcut keys):
  1. Introduction
  2. The keyboard
  3. Shortcut keys
  4. The interface - Finance Portal
  5. The interface - Social Security Portal
  6. Finance Portal - Filling out an IRS declaration
  7. Finance Portal - Issuing invoices and green receipts
  8. Finance Portal - Checking and validating invoices (*e-fatura*)
  9. Social Security - Obtaining the annual income declaration for IRS purposes
  10. Social Security - Check discounts
- Video tutorials for people with low vision (describe the actions using the screen magnifier):
  1. Introduction.
  2. Screen Magnifiers
  3. The interface - Finance Portal
  4. The interface - Social Security Portal
  5. Finance Portal - Filling out an IRS declaration
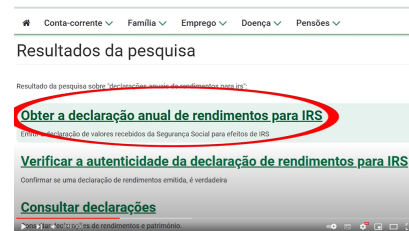
Figure 1: Frame from one of the produced videos, which shows the integration of images corresponding to the step-by-step of several tasks and operations. (YouTube ®)
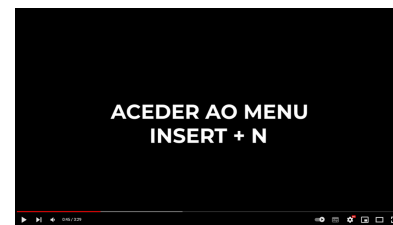

Figure 2: Frame from one of the videos produced, integrating one of the specifications necessary for the understanding of the low vision audience (contrast between letters and background). (YouTube ®)

  6. Finance Portal - Issuing invoices and green receipts
  7. Finance Portal - Checking and validating invoices (*e-fatura*)
  8. Social Security - Obtaining the annual income declaration for IRS purposes
  9. Social Security – Check discounts

After the scripts were produced, a voice narrating the content of the scripts was recorded clearly and perceptibly, using a voice recorder, to obtain several recordings that concern the detailed description of each task or procedure that the VIU can or should do. Later, these recordings are used as background sound for the tutorials, to guide the VIU through the content.

Only after this, it was possible to start producing the tutorials with accessibility solutions. This product was made from the insertion (in the video editing software Adobe Premiere Pro) of the recorded audio content and images and videos corresponding to the step-by-step descriptions of the tasks and actions that are being explained in the narrations (Figure 1), and their manipulation. All the content inserted in the tutorials sought to meet the needs and preferences of the VIU gathered in the interviews phase and throughout the literature (Figure 2).

After the tutorials' production phase was completed, they were hosted on YouTube and organized into two playlists: one for each category of visual impairment (blindness and low vision). This way, each of these playlists contains the content related to accessibility solutions in the two major Portuguese governmental portals, according to their visual impairment (Figure 3). In the case of blind people, all playlist content is related to accessibility solutions using a screen reader. In the case of individuals with low vision, they
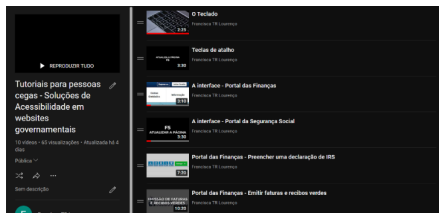
Figure 3: Playlist referring to audiovisual content available on YouTube for people with blindness. (YouTube ®)

can access, through the playlist intended for them, a set of contents related to accessibility solutions related to the use of screen magnification resources.

It is important to note that the YouTube links related to the audiovisual content produced in this study are not disclosed, due to the need to preserve the anonymity of the study authors, associated with the blind review of this phase of paper submission.

3.3 Evaluation of video tutorials

At this point of the research, the videos produced were presented to the participants, and of the 12 individuals who participated in the first phase of data collection, only 7 showed interest and kept in touch until the end of the research, and then participated in this process of viewing the tutorials designed and their evaluation by filling out a questionnaire.

Along with the YouTube link that directs them to the tutorials, the participants were sent a questionnaire with closed-ended questions and evaluation questions to fill out after viewing the content, to evaluate the tutorials and their usability. The application of a questionnaire in this evaluation phase is due to the need to achieve an organized and structured data collection.

4 RESULTS

In the first phase of data collection, it was observed that 66.7% of the participants are blind and 33.3% have low vision, and all these individuals use assistive technologies as an aid to navigation on the computer and/or internet, whether the resources of screen magnification or screen reading software. Regarding the age of these participants, 8.4% were between 18 and 25 years old, 33.3% were between 26 and 40 years old, 25% were between 40 and 50 years old, and 33.3% were over 50 years old. Furthermore, it was found that 100% of the respondents use YouTube to watch various types of audiovisual resources or other types of social networks (Facebook or WhatsApp), although some do not consider these platforms to be completely accessible. Of all the participants who use these social networks, it was observed that 91.7% use video resources to obtain knowledge within varied areas (online courses, training, or even cooking or sewing).

After collecting this data, producing the video tutorials, and presenting them to the study participants, it was observed that at this stage 57.1% of the participants were blind and 42.9% had low vision. Regarding the analysis of the video tutorials, all participants consider the websites chosen relevant, as well as the information covered in the tutorials. The respondents also added that, *"they are platforms used with some frequency in our daily lives" "in which we*

need to navigate to download documents or consult information", and that *"all people should be able and know how to use"*.

Regarding people's understanding of the videos, while watching them, 98.6% of the participants estimated, on a scale from 1 (did not understand at all) to 5 (understood very well), that the level of understanding was maximum in all videos, due to factors such as *"the detailed explanation"*, *"the clarity and accuracy of the information provided"*, the *"selected contents and quality of the information provided"*, particularly regarding the NVDA screen reader, *"voice with good diction"*, *"easy and simplified explanation", "audio"* and *"indication of the location of the buttons on the screen"*. On the other hand, the level of understanding of 14.3% of respondents was only good (Table 1), in that, for a better understanding, *"indications on how to activate checkboxes"* were useful.

Regarding the ease of interaction, all participants revealed that the level of effort when interacting with the tutorials on the YouTube platform was null (Table 1), as well as in the evaluation of the effectiveness of the transmission of information, in which 100% of the respondents consider it very effective. This positive feedback is related to aspects such as *"clear explanation"*, *"simple and detailed explanation of the contents"* and *"shortcut keys that facilitate interaction with the pages"*, as well as the description of the location of the information combined with the knowledge, they already have regarding the websites covered. In terms of usefulness, 71.4% of the participants evaluated the tutorials as very useful, and the remaining percentage considered them only useful (Table 1).

Regarding the influence of the tutorials, participants rated the probability that they would watch the tutorials again to assist them in performing some specific tasks of the websites covered, with 14.3% of the respondents revealing that the likelihood of watching these tutorials again is moderate; 28.6% revealing that the same likelihood is high, and 57.1% indicating that they are very likely to watch all or at least some of the formative videos again.

In a tightly answered question, participants were asked what they would improve about the videos they watched. Some subjects mentioned that they would not improve or add any kind of change; others suggest broadcasting new content every week, and finally, they refer to the speed of the narration (*"a little slow"*). Finally, all participants revealed that they would recommend the set of tutorials viewed.

5 DISCUSSION

With this study, it was possible to conclude that accessibility for VIU as a factor of inclusion, according to the research participants and the literature review carried out, still needs some improvement actions to be considered adequate, especially regarding government portals. In this type of portal, and especially in the portals chosen for the focus of the tutorial videos, in which the participation and interaction of citizens are, nowadays, almost inevitable, it is essential to provide and/or implement accessibility and inclusion solutions to include all types of public and allow them to perform tasks required by the Portuguese state.

However, the presentation of the proposal for digital inclusion of UVI through accessible tutorials to the sample of the second phase of data collection of this study generated very positive results. With this, we conclude that this may be a solution that, if better

Table 1: Feedback from the evaluation of the tutorials by the VIU participants in the study

Scale 1-5	Level of understanding	Facility of interaction	Effectiveness of information transmission	Utility	Probability of watching again
1 (very bad)	0% of participants	0%	0%	0%	0%
2 (bad)	0%	0%	0%	0%	0%
3 (reasonable)	0%	0%	0%	0%	14,3%
4 (good)	28,6%	0%	0%	28,6%	28,6%
5 (very good)	71,4%	100%	100%	71,4%	57,1%

disseminated and deepened, could be a viable resource for blind and low-vision users who browse the web using a screen reader or magnifier software, to obtain knowledge regarding the Portuguese government portals and even other types of public platforms.

The evaluation methodology of the developed tutorials generated a set of results that allowed the analysis of the accessibility, usability, and influence of the training content, as well as the possibility of communicating proposals, suggestions, and observations for its improvement. On the other hand, this methodology also responded to the initial objectives of the research, namely the conceptualization, design of the audiovisual training content and its respective validation. Thus, it is understood that the research objectives were achieved, so far:

- The target audience was studied, identifying, and characterizing their difficulties and needs as consumers of web pages and audiovisual content, determining the guiding principles for the preparation of training videos on accessibility solutions.
- A structure of the training content was conceptualized and developed based on the guiding principles collected and where all the necessary specifications for the understanding of the transmitted content are integrated.
- The audiovisual content produced was tested and evaluated in front of a group of VIUs.

In this sense, the research question mentioned in the introduction of this paper was answered through the literature review, the study of the target audience and the evaluation of the audiovisual content produced. Answering this question, the requirements that audiovisual tutorials should have to improve the access of VIU to websites are:

- Meet the VIU opinions and statements about web accessibility.
- Use, throughout the tutorials, the assistive technologies that VIU use. In the case of people with blindness, a screen reader, and in the case of people with low vision, screen magnification resources.
- Develop the tutorials using a computer and use the computer throughout the tutorials, since all participants use computers to access websites.
- Consider the examples of inaccessible websites mentioned by the study participants and their improvement solutions.
- Use visual and textual elements, so as not to forget the audience with low vision. Make use of contrast and magnification, whether in visual or textual components, because this use is

of high importance for a clear understanding of the content by people with low vision.
- Describing all the events and actions that occur throughout the tutorials, in a paused and detailed manner.
- Storing the content on platforms already known and used by VIU, if possible.

6 CONCLUSIONS AND FUTURE WORK

This research presented a solution consisting of a set of tutorials in audiovisual format, which enabled the participation of visually impaired people on governmental websites, to allow them to perform their social and fiscal obligations more autonomously.

Besides the contributions already mentioned, it is important to highlight the possibilities of continuing the work proposed in this paper. The combination of the authors' personal reflection with the suggestions and observations pointed out by the participants of the study, originated a set of questions that allow for new perspectives of interesting future work.

Firstly, to obtain more reliable and transparent results, it would be beneficial to increase the number of participants throughout the study, but mainly in the evaluation phase of the formative content. Secondly, regarding the content of the tutorials, and considering the perspective of the users who evaluated the videos provided, it would be beneficial to remove the background music from the introduction video, as it *"gets in the way of listening to the content"*. In addition, it was suggested that it is important to mention at the end of the videos that the content has ended by adding some sound that refers the user to the end of the content or simply by stating that the video has ended.

According to the results obtained after watching the tutorials, it was reported that *"the speed of the narration is a factor to be improved"*, and that *"if we watch the videos several times it gets a little boring, and since it is in the video, the narration/description could be faster, since there is always the possibility of going back if we don't understand something"*. Thus, the narration of the content described throughout the videos is also a factor for improvement.

On the other hand, it was suggested that there should be *"the transmission of new contents on a weekly basis"*. Considering a perspective of future work, it would be relevant and interesting to study this hypothesis to start developing the same type of content as this research, but weekly. So, every week a different video about the same website or different websites could be hosted on the platform, but always with new accessibility solutions. Besides this, another suggestion is to approach different types of digital platforms and explain, also in tutorial form, how the navigation of

websites from different sectors, besides governmental ones, works. Allied to this, it would also be useful to implement these tutorials in a specific section of the platforms and websites addressed.

Finally, and considering that audiovisual content is easily accessible to VIU, using a complete and detailed description, with a clear and perceptible tone of voice, and without noise, in the authors' perspective, it is considered useful to use audiovisual content as a means of transmitting knowledge, whether in government portals, online commerce, distance learning, communication platforms, social networks, games, school or university websites, etc. The development of audiovisual content by people without visual impairments, or even, eventually, by VIU, with the transmission of real content from various areas (meeting, of course, all accessibility requirements), combined with its subsequent dissemination, is an initiative of great interest and utility.

Thus, it is hoped that the reflections generated in this research may encourage readers to produce audiovisual content and disseminate useful and true knowledge that minimizes communication barriers in audiovisual production and transmission. Furthermore, it would be important to provide training to students and professionals involved in the production and distribution of audiovisual content, whether in schools and/or universities or even in companies in this field.

ACKNOWLEDGMENTS

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