Evaluating Digital Accessibility for Visually Impaired Users Through a WCAG-Based Review of a Federal University Website

Avaliando a Acessibilidade Digital para Usuários com Deficiência Visual por meio de uma Análise Baseada na WCAG de um Site de Universidade Federal

Evaluación de la Accesibilidad Digital para Usuarios con Discapacidad Visual mediante una Revisión Basada en WCAG del Sitio Web de una Universidad Federal

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digital accessibility, visual impaired users, information design, federal university website

Digital technology, as the design of user-system interactions, plays a fundamental role in promoting autonomy while improving the functional capabilities of individuals with visual impairments. In this context, this study aims to assess the accessibility of the website of a Federal University of Health Sciences, applying WCAG standards within a universal design framework, to identify key issues related to the perception of elements, functionality and efficiency of the interface and navigation, understanding of language and structure, and compatibility with various operating systems and technologies. The method was based on a qualitative research approach, guided by a critical perspective. The findings provide a list of practical recommendations that are generally geared towards developing a more inclusive digital environment in the educational sector.

acessibilidade digital, usuários com deficiência visual, design da informação, website de universidade federal.

A tecnologia digital, como design das interações entre usuário e sistema, desempenha um papel fundamental na promoção da autonomia, ao mesmo tempo em que aprimora as capacidades funcionais das pessoas com deficiência visual. Nesse sentido, este estudo tem como objetivo avaliar a acessibilidade do site de uma Universidade Federal de Ciências da Saúde, aplicando os padrões da WCAG, com uma abordagem de design universal, para identificar questões-chave relacionadas à percepção de elementos, funcionalidade e eficiência da interface e navegação, compreensão da linguagem e estrutura e compatibilidade com vários sistemas operacionais e tecnologias. O método baseou-se em uma abordagem qualitativa, orientada por uma perspectiva crítica. Os resultados evidenciam uma lista de recomendações práticas, geralmente voltadas para o desenvolvimento de um ambiente digital mais inclusivo no setor educacional.

accesibilidad digital, usuarios con discapacidad visual, diseño de la información, sitio web de una universidad federal

La tecnología digital, particularmente en el diseño de las interacciones entre el usuario y el sistema, desempeña un papel fundamental en la promoción de la autonomía, al mismo tiempo que mejora las capacidades funcionales de las personas con discapacidad visual. En este sentido, este estudio tiene como objetivo evaluar la accesibilidad del sitio web de una Universidad Federal de Ciencias de la Salud, aplicando los estándares WCAG dentro de un marco de diseño universal, para identificar problemas clave relacionados con la percepción de los elementos, la funcionalidad y la eficiencia de la interfaz y la

navegación, la comprensión del lenguaje y la estructura, y la compatibilidad con diversos sistemas operativos y tecnologías. El método se basó en un enfoque de investigación cualitativa, guiado por una perspectiva crítica. Los resultados proporcionan una lista de recomendaciones prácticas que, en general, están orientadas al desarrollo de un entorno digital más inclusivo en el sector educativo.

1 Introduction

In our increasingly digitized society, in which the majority of information is presented in visual media, digital platforms often fail to accommodate the needs of users with visual impairments (Porte & Trindade, 2021). Although supported by a set of laws and policies aimed at this group, there is still the need to ensure the integrity and permanence of spaces, since there are challenges in promoting their recognition in education and health (Silva & Pimentel, 2021). As a result, it ends up not only interfering with the level of functionality, learning, communication, and interactions but also affecting their socio-cultural participation. Thus, digital technology, particularly user-system interaction and its design, plays an intrinsic role in fostering autonomy and individuality while enhancing the functional abilities of people with visual impairments (Zen et al., 2023).

Given the consolidation of the internet as a hegemonic system and the evolution of information encoding methods, it becomes essential to develop new skills to keep up with these transformations (Jorente et al., 2019). The absence of specific policies and the lack of allocation of resources to ensure inclusion and accessibility, combined with the diversity of eye conditions, their varied causes, degrees of severity and progression rates, also highlights the complexity of this challenge and the need for more inclusive approaches (Bonsaksen et al., 2023). In this context, Universal Design (UD) serves as a framework for creating information technologies that ensure accessibility for all individuals, regardless of their abilities or limitations (Burgstahler, 2020). Aligned with Information Design (ID) principles and other guidelines such as the Web Content Accessibility Guidelines (WCAG), technologies can not only develop more inclusive digital environments that address diverse user needs, but to enhance usability and user satisfaction (Kurak et al., 2024).

Considering previous studies, our research centers on evaluating the accessibility of the website of a Federal University of Health Sciences, applying WCAG standards (Web Accessibility Initiative [WAI], 2025), with a UD approach, to identify critical issues in elements such as perception, interface functionality, language clarity, and compatibility with various systems. By conducting a detailed analysis, we gain a deeper understanding of the platform's design and various interactions between the user and the system, the effectiveness and efficiency of the interface, and the capability to easily and accurately understand its content (Petterson, 2010), and adaptation techniques that may hinder access for visually impaired users while addressing multiple needs.

This study is aligned with essential themes of information design, especially in communication and media, as it not only promotes accessibility and inclusion for people with visual impairments in online platforms, but also strengthens equity and autonomy by

implementing WCAG guidelines that help in more dynamic and engaging learning (Sloan, 2006). It is also aligned with health, since it contributes to physical, cognitive and mental well-being. By exploring the intersection of design, technology and accessibility, our work aims to contribute to broader discussions around the creation of more inclusive digital systems which enable more equal access for all.

2 Theoretical Framework

2.1 Universal Design

Universal Design (UD) is a concept that targets designing spaces, goods, and services that can be accessed and utilized by every human being, regardless of their abilities or disabilities (Mace, 1988). The theory operates based on the premise of equity, inclusion, and simplicity to ensure that individuals with diverse needs interact equally with their spaces. In the ID context, web accessibility research highlights persistent problems in interoperability and usability among digital platforms (Ferati et al., 2016). In platform development, focus is skewed toward aesthetics and sensory appeal rather than looking for a general balance between accessibility factors (Seva et al., 2017). To address this issue, Shoaib et al. (2023) designed an app with high customization rates, including variable color, size, and shape, in an attempt to enhance user control and flexibility. Rojbi et al. (2023) also explored various ways of optimizing the use of images on screens, providing alternatives that maximize accessibility without compromising content. However, as Abdelaal and Al-Thani (2023) reveal, quite a mental strain is often required to navigate sites or add-ons with numerous tabs and complex features.

To enable the application of theory into practice, seven principles were established that help transform essential properties of UD into design requirements. According to Mace (1988), these are: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use.

UD emphasizes the strengths and potential of the individual, shifting the focus from disabilities or societal expectations. It highlights the importance of providing access to content, the learning process, and the resulting outcomes, advocating for environments that empower everyone to interact and succeed based on their unique ability (Joshi, 2016). By using UD as a teaching approach, educators can address students' diverse needs. With a variety of resources that enables the planning and representation of different materials, this methodology stimulates students' ability to plan, create strategies, and demonstrate their learning, while also enhancing their motivation and participation in activities and fostering an inclusive and dynamic learning environment (Almeqdad et al., 2023).

Although individuals with visual impairments encounter challenges related to technological accessibility, initiatives like UD have provided valuable guidance for the development of information technologies (Burgstahler, 2020). By integrating the holistic approaches of information systems and design, this approach facilitates the development of inclusive and

accessible technological solutions that embrace the principles of usability and flexibility (Paul, 2010). These practices were soon applied to the design of hardware and software, leading to the creation of initiatives like WCAG, which offer a unified framework for developing accessible digital technologies, guiding designers and developers to anticipate the users' needs and ensure autonomy and independence.

2.2 Web Content Accessibility Guidelines and Visual Impairment

The Web Content Accessibility Guidelines (WCAG) are a set of internationally recognized standards developed by the World Wide Web Consortium (W3C) to ensure that web content is accessible to all users, including those with disabilities (W3C, 2023). Whether it be hardware, software, language, location, or ability, these guidelines aim to develop resources to improve web accessibility evaluation processes and tools while supporting education and outreach efforts. Currently, the standards consist of versions 2.0, 2.1, and the recently released 2.2, all of which offer a robust framework for web developers, content producers, and organizations to make their digital platforms more accessible. Moreover, the WCAG standards are based on four core principles that content must follow to ensure it offers accessibility: perceivable, operable, understandable, and robust (POUR) (W3C, 2025).

Ensuring digital accessibility requires significant resources and efforts from organizations and institutions, a process hindered by factors such as the shortage of specialized professionals in the field, the lack of well-structured guides and manuals, the need for up-to-date assistive technologies and equipment, the implementation of continuous testing, and compliance with current standards and legislation (Abu Addous, Zalisham & Basir, 2016). Even when institutional inclusion policies are developed in accordance with WCAG, challenges related to the comprehensibility and interpretation of these guidelines still persist (Brajnik, 2010). For people with visual impairments, full compliance with accessibility criteria by a platform does not, by itself, guarantee an adequate experience, since the absence of considerations regarding cultural, social, and linguistic aspects may compromise its effectiveness (Ferati et al., 2014).

Recognizing the different types of visual impairments and their effects on individuals is essential for effectively addressing this widespread health issue, as the challenges posed by vision loss are not limited to sensory limitations but are often amplified by physical, environmental, and social barriers (Hashemi et al., 2024). In addition, some technologies are not intuitive or adaptable enough to meet the needs of diverse users, particularly when technology is rigidly matched to specific constraints in educational settings (Leijen et al., 2021). In this sense, blindness, low vision, and color blindness each present unique challenges, degrees of severity, progression rates, education levels and literacy and understanding their differences is crucial in designing accessible environments and technologies.

In this study, we pay special attention to the elements that encompass the visual system and that can affect vision. Aspects such as visual acuity, contrast sensitivity, color vision, field of view, depth perception and light sensitivity are explored (World Health Organization [WHO],

2019), as well as the way they are explored throughout the digital platform. Such aspects lead to the analysis of elements such as visual perception and distinction, page adaptation and organization, interaction, readability and compatibility with different operating systems, some of which are addressed by WCAG. In this way, different visual conditions can be analyzed according to accessibility while meeting the principles of informational design.

3 Method

This study was founded on a qualitative approach, guided by a critical perspective. We employed a case study methodology that enabled an in-depth investigation of the website's current accessibility features according to the seven principles of Universal Design (Mace, 1988). Web Content Accessibility Guidelines (WCAG) (W3C, 2024) constituted the basis of our analysis, drawing directly on the World Wide Web Consortium's (W3C) guidelines for determining the accessibility of web content. Even though there was a draft to address accessibility requirements of individuals with low vision, submitted by W3C (2016), it was not taken into account for this study as it was not finalized and updated.

The data collection process involved a detailed evaluation of the website's accessibility features using both direct observation and specialized digital tools. A systematic check was first carried out with a checklist created by Vorm (2023), which served as an effective pointer to major accessibility problems. The following checklist was supplemented by utilizing tools such as the Web Aim Contrast Checker (2025), to test color contrast ratios within various sections of the website and thereby ensure WCAG contrast standards. The Color Blind Vision Simulator (2025) was also utilized to simulate how color vision deficiency users perceive the website, allowing us to identify areas where color choices could hinder accessibility.

This study examines fundamental elements of accessibility, which encompass the arrangement of information and the interface, alongside its perception, functionality, comprehension and compatibility, taking into account links, images, typography, color schemes, video content, keyboard navigation, alternative text, spacing, structural organization and overall volume of information. The emphasis was placed not just on problem identification but also on developing practical solutions based on WCAG guidelines. The qualitative data collected during the study was examined using thematic analysis (Braun & Clark, 2006) to find recurring patterns and key gaps. The findings were then synthesized to produce a list of practical recommendations that are generally geared towards developing a more inclusive digital environment in the educational sector.

4 Results and Discussion

The analysis of the website based on the seven UD principles and the guidelines proposed by WCAG led to the grouping of the following categories.

Table 1: Summary of the Institution's Website

Principles of Universal Design	**WCAG 2.0 Guidelines**	**Findings**
Equitable Use: Design is useful and marketable to people with diverse abilities.	1.2.6 Sign Language	Sign language feature is offered
	1.3 Adaptable	Adjustable to different needs through buttons and interface
	3.1 Readable	Complex terms and words with difficult pronunciation
Flexibility in Use: Design accommodates a wide range of individual preferences and abilities.	1.4.8 Visual Presentation	Foreground and background colors can be selected by the user; text is not justified; text can be resized and line spacing is correct
	2.2 Enough Time	Provide users enough time to read and use content.
	2.4 Navigation	Offers customization options; adapts to the user's pace
Simple and Intuitive Use: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills or current concentration level.	2.1.2 No Keyboard Trap	Too much information, which takes the focus away from the objective
	2.4.2 Page Titled	Describes topics or purpose in its name
	2.4.6 Headings and Labels	Describes topics or purpose in its name
	2.4.7 Focus Visible	Buttons are highlighted when using keyboard navigation
	3.1 Readable	Some difficult words, terms and abbreviations are used
	3.2 Predictable	No new tabs are created, no context switching
Perceptible Information: Design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.	1.1.1 Non-text Content	Alternative text is available for only some images
	1.3.3 Sensory Characteristics	Could consider exploring other formats rather than naming
	1.4.1 Use of Color	Text and colors are not enough to distinguish information
	1.4.3 Contrast (Minimum)	Some colors have a contrast ratio lower than 4.5:1
	1.4.4 Resize Text	Does not lose readability when zooming
	1.4.6 Contrast (Enhanced)	Colors have no contrast
	2.4.4 Link Purpose (In Context)	Links are not noticeable
Tolerance for Error: Design minimizes hazards and the adverse consequences of accidental or unintended actions.	2.1.2 No Keyboard Trap	Exit methods are necessary to resume navigation

Low Physical Effort: Design can be used efficiently and comfortably and with a minimum of fatigue	1.3.6 Identify Purpose	Programmatically identifies sections of the page that helps navigation
	2.1.1 Keyboard	Buttons like “Tab” have to be pressed several times to go to the next information
	2.4.1 Bypass Blocks	There is a missing button that takes you to the top of the page
	2.4.3 Focus Order	Follows sequences and relationships within the content
	2.4.9 Link Purpose (Link Only)	Each link is explicitly stated
	3.2.4 Consistent Identification	Subtle address bar, almost invisible
Size and Space for Approach and Use: Appropriate size and space are provided for approach, reach, manipulation and use regardless of the user’s body size, posture or mobility	4.1 Compatible	May present compatibility issues with different operating systems and interfaces

It was possible to see that its system was intuitive and easy to use from the beginning. The website allows navigation to any section via the header, which is organized into color-coded categories that unfold into subcategories, offering text size adjustments and contrast buttons to change the page colors. Most of its images are informative and decorative, reinforcing the university’s visual identity and the content presented.

Analyzing perceptibility, the first principle of the WCAG guidelines, we noticed that some points are in compliance. Images are valuable resources as they help in the understanding and processing of ideas. However, not all images found on the website have alternative text, especially new images. In this context, an approach that uses a detailed description in text next to the image could be adopted, or even include an image or link right after the image with a more specific description of the content. Another alternative would be to incorporate the text and the image in the same code, making it easier for keyboard users or those using assistive technology to navigate. Time-based media features as well as other audio, video and subtitle features were not found, resulting in reliance only on voice features used by the screen readers and making this aspect even more crucial to assist learning.

Through landmark functions, the website programmatically identifies sections of the page that aid navigation, separating them into header, main menu, banner, main page and footer. The content also does not restrict its view and functionality to a single type of orientation, making itself open to possibilities of zooming and switching to portrait and landscape in different operating systems. The same applies to text and buttons, where it is possible to zoom up to 200% without losing content or readability, but there is no clear distinction between the elements, using only colors and rectangular shapes. Different shapes or incorporating textures into buttons are some of the alternatives.

However, colors pose a problem, as there are shades of red-green and green-blue in the platform that can be difficult to distinguish for people with color blindness. Another point noted was the use of dark and light gray tones to differentiate information, which could hinder navigation. Using the WebAim Contrast Checker and the Color Blind Filter tool with the platform's color codes, text and the white background to verify the minimum of contrast 4.5:1 we realized that not all hues meet the required standards. Positively, providing options to adjust brightness, saturation, or customize colors, along with implementing patterns or textures in addition to color, can significantly enhance contrast, navigation, and overall accessibility. Figure 1 illustrates the relation between colors and different types of color blindness, as well their contrast rates.

Figure 1: Perception of Website Colors

For people with low vision or other eye conditions, the "Contrast" button at the top of the page enables users to switch from a white background with black text to a black background with yellow text. The navy blue elements are converted to white, while the header buttons change to black. The text retains its original size and is underlined when hovered over. This provides additional visual cues to aid navigation. However, in order to include more people, other colors could be offered, since not everyone sees shades of yellow and black with the same clarity (Shoiab et al., 2023). Additionally, buttons on the homepage that lead to other sections become white with dark gray, underlined text.

Its general visual presentation is structured with the content centered on the page, with the text aligned to the left and other elements, such as images, summaries, and links, on the right side to help navigation.Navigation between pages is done via large buttons, covering a significant portion of the screen. Normal text can be increased or decreased using "A+" and "A-" buttons located at the top of the page. However, the selected fonts may pose issues related to character ambiguity and reading flow, such as the similarity between the letters “Q” and “O” (WebAIM, 2020) as well as exceeding 80 characters per line.

Regarding the operability, keyboard navigation is limited to some pages, with problems using *Tab*, requiring many keystrokes to go to the next information, jumping from the header to the footer or sometimes getting stuck in certain parts due to lack of optimization and tagged content. For this purpose, bypass blocks are extremely valuable, as they add links that direct you to different parts of the site or ignore specific sections, making navigation more efficient. Usability issues could also be addressed by properly configuring site settings, as some buttons are currently misaligned or improperly set up. On the other hand, time has no session time limit or other restrictions and titles, headings and labels are clearly described with content presented in a logical way and easy to follow order. Links are only distinguished by variants in color, but its purpose is clearly described within the link itself.

As for readability and compatibility, the university's website contains some terms that are difficult to understand, including abbreviations and expressions that are not always explained, as well as words with complicated pronunciation. In this sense, the definition of words or phrases could be incorporated using inline definitions in the text itself or providing a glossary page at the end of the section. To aid navigation and constant identification, the site also features an address bar that displays the navigation path, allowing users to navigate forward and backward, but it is not very visible even using the contrast button. In general, it may present compatibility issues with some programs, as problems in their programming, labeling and sessions have been found.

We also recommend the inclusion of an "Accessibility Options" button on the website’s homepage. This button could direct users to a dedicated accessibility page that outlines the features available, provides explanations of WCAG compliance, and includes a feedback mechanism for users to report accessibility issues or suggest improvements. Such a page would not only raise awareness about accessibility features but also encourage user engagement in the continuous improvement of the website.

Integrating these changes will not only align the website with international accessibility standards but also demonstrate the institution’s commitment to inclusivity. This holistic approach addresses both digital and physical accessibility, thereby ensuring that current and prospective students with disabilities can navigate and access university resources more effectively.

5 Conclusion and final considerations

The findings of this study highlight some accessibility gaps within the current website of the federal university, particularly on challenges related to navigation, visibility of links, buttons and texts, image descriptions, lack of audiovisual content and low color contrast. We identified specific areas where improvements are needed to align the digital platform with international accessibility standards and principles of ID. The proposed solutions include improving the visibility of elements through colors with greater saturation and brightness, in addition to the use of patterns and textures; ensuring varied textual alternatives for images; optimizing the structure and programming of the website; offering more customization options to meet different needs; and making the language more accessible and understandable for different levels of education. Therefore, aspects related to user-system interaction, the effectiveness and efficiency of the interface and the ease of understanding the content are considered to enhance the experience and learning. While the new interface components and enhancements have not yet been implemented, ongoing efforts are underway to integrate these solutions into the university's digital infrastructure in the near future.

Despite these efforts, it is important to acknowledge the limitations of the current study. As our analysis primarily focused on technical evaluation using accessibility tools and the perspective of design, we have not yet quantified the impact of these changes on actual user experiences or applied programming principles. To address this gap, future work will involve implementing the proposed accessibility features and gathering feedback directly from users and other professionals in the area. The study did not undertake an in-depth examination of compatibility with various operating systems and assistive technologies, such as those addressed in the most recent WCAG 2.2 guidelines, which consequently limits the comprehensiveness of its recommendations.

Furthermore, collecting quantitative data on user satisfaction and usability post-implementation will allow us to measure the impact of these changes more accurately. This approach will not only validate the effectiveness of our current solutions but also introduce ongoing refinements to the website's accessibility features. By continuously engaging with users and incorporating their feedback, we aim to foster an inclusive digital environment that evolves to meet diverse user needs.

Our ultimate goal is to ensure that the university's digital platform fully supports accessibility for all users. This commitment to continuous improvement aligns with our broader mission to promote digital inclusivity across online platforms.

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