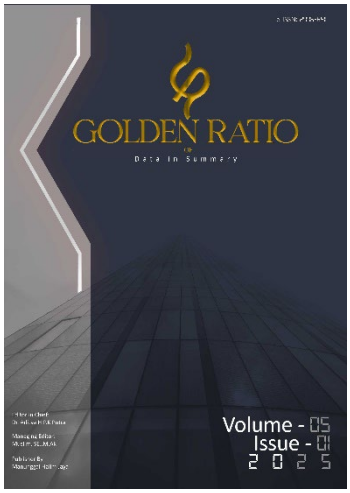
https://doi.org/10.52970/grdis.v5i1.896

Website: https://goldenratio.id/index.php/grdis

ISSN [Online]: 2776-6411



Received: December 08, 2024
Revised: January 07, 2025
Accepted: February 01, 2025

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DATA IN SUMMARY | COMPUTER SCIENCE

Web Accessibility: Designing User-Friendly Websites for Individuals with Visual Impairments

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Abstract: Web accessibility is crucial to creating an inclusive digital space, particularly for individuals with disabilities. This study aims to analyze the application of Web Content Accessibility Guidelines (WCAG) principles on the Tokopedia e-commerce platform and to develop a prototype website that optimally integrates accessibility elements. The research employs a qualitative approach with a case study method, including website analysis, assistive technology testing using the NVDA screen reader, and prototype website development based on Tailwind CSS. The results reveal that Tokopedia has implemented some accessibility elements, such as heading structures and alt text, but still has shortcomings in keyboard navigation, ARIA attributes, and product descriptions. The prototype website successfully addresses these issues by providing optimized keyboard navigation, comprehensive use of ARIA attributes, and informative product descriptions. Testing shows that the prototype website is not only accessible to visually impaired users but also enhances usability for the general audience. This study concludes that web accessibility can improve inclusivity and user comfort for all. The findings provide practical guidance for web developers to optimize accessibility design and create a more equitable digital experience. Therefore, this research contributes to the literature and web accessibility practices in Indonesia.

Keywords: Accessibility, Web, Friendly, Visually Impaired.

1. INTRODUCTION

Web accessibility has become a significant focus in the digital world, particularly in creating an inclusive internet for all users, including people with disabilities (Pebriyanti, 2020; Poerwanti, Makmun, and Dewantara 2024). Research by Rasyida (2022) and Fadli (2024) highlights the importance of accessibility in fostering equality in the digital space. Narenthiran et al. (2022) emphasize that inclusive design not only benefits people with disabilities but also enhances the overall user experience. This study underlines how accessibility principles, such as alt text, keyboard navigation, and clear heading structures, facilitate access for visually impaired users and other groups facing challenges in using the web.

Nielsen (1994) and Yates (2005) discuss usability as an integral component of good web design. Nielsen stresses that user-friendly websites not only ease access but also improve productivity and efficiency. This concept aligns with the Web Content Accessibility Guidelines (WCAG) published by the World Wide Web Consortium (W3C) in 2008. WCAG 2.0 serves as the primary foundation for creating websites that meet global accessibility standards, including for visually impaired users. Henry (2007) further underscores the importance of involving people with disabilities in the design and testing process of websites. By engaging users with special needs, developers can better understand the barriers they face and devise appropriate solutions. Additionally, Lazar & Stein (2017) argue that access to digital information is a human right, and the web must be designed to offer equal opportunities for all users.

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Nguyen's (2024) study on web accessibility in React applications focuses on a tutorial app for beginners. Web accessibility ensures applications are usable by everyone, including those with disabilities, in accordance with WCAG guidelines. The research involved manual testing and automated tools like Lighthouse, IBM Equal Access Checker, and Accessible Web RAMP. Addressed issues include semantic HTML, accessible forms, and form validation. Improvements included ARIA roles, proper label associations, and focus management. The results showed significant accessibility improvements and revealed that React tutorials often overlook accessibility practices. A combination of manual and automated testing proved crucial in achieving web accessibility.

Analyses by Rahardjo (2007) and Hidayat et al (2024) highlight the low adoption rate of web accessibility principles in Indonesia. Their studies reveal that many government and public institution websites in Indonesia fail to meet WCAG standards, indicating a need for increased awareness and training for local web developers on the importance of inclusive design. In conclusion, accessibility principles are not only important from moral and ethical perspectives but also provide practical benefits for a broad range of users. These theories and studies underpin research on web accessibility (Lucas, Van Wee, and Maat 2016), including the development of a prototype website in this study. This aims to demonstrate that these principles can be effectively implemented across various types of websites. Using WCAG guidelines as the main theoretical framework, combined with Nielsen's usability theory and Henry's participatory approach, this research focuses not only on identifying challenges but also on offering concrete solutions that developers can implement to create an inclusive web experience.

2. RESEARCH DESIGN AND METHOD

This study employs a qualitative approach with a case study method to analyze the application of web accessibility principles (Amanda and Wijaya 2024; Assyakurrohim et al. 2023). The research focuses on Tokopedia, one of Indonesia's largest e-commerce platforms, to explore the extent of accessibility principles implemented and understand the challenges faced by visually impaired users when accessing it. This method was chosen for its flexibility in deeply analyzing issues while evaluating the effectiveness of proposed solutions. Data collection involved literature review, website analysis, assistive technology testing, and prototype website development. Key references included the Web Content Accessibility Guidelines (WCAG) from the World Wide Web Consortium (W3C) and related works on web accessibility, such as Nielsen (1994) in Usability Engineering and Henry (2004) in Just Ask: Integrating Accessibility Throughout Design. This approach facilitates understanding of relevant global standards in developing accessibility-friendly websites.

Accessibility evaluation of Tokopedia was conducted by analyzing aspects such as the use of alt text, heading structure, keyboard navigation, color contrast, and ARIA attribute implementation, complemented by testing with the NVDA screen reader. The analysis found strengths in heading structure and color contrast, but keyboard navigation and ARIA attribute usage were less optimal. For comparison, a prototype website was developed using the Tailwind CSS framework, integrating all WCAG principles consistently to create a more inclusive user experience. Data validity was enhanced through triangulation of various sources, including literature, website analysis, and direct testing. This approach ensures the reliability of the research findings, while the researcher's personal reflection as a visually impaired user adds valuable insight into the accessibility challenges faced by real users. A descriptive approach was used to detailed findings, providing a foundation for practical recommendations for web developers. This study not only identifies accessibility weaknesses in Tokopedia but also offers practical solutions through the prototype website. By implementing improved accessibility principles, websites can benefit not only individuals with disabilities but also enhance the general user experience. This research contributes to the web accessibility literature while serving as a practical guide for developers aiming to create a more inclusive digital space.

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3. RESULT AND DISCUSSION

3.1. Evaluation of Tokopedia Website Accessibility (https://www.tokopedia.com)

Analyzing Tokopedia's website accessibility provides an overview of how well this platform has implemented principles that are aligned with the Web Content Accessibility Guidelines (WCAG). One positively highlighted element is the consistent heading structure. This structure facilitates navigation for screen reader users across different sections of a page, allowing them to understand the hierarchy of information better. Organized headings provide a logical navigation framework, essential for visually impaired users to access content efficiently. The use of alt text for images is another aspect that has been well-implemented. Most images on Tokopedia include informative alternative descriptions, enabling screen reader users to understand the visual context of displayed images. This is particularly helpful for product images, where visual information often plays a key role in purchasing decisions. Additionally, the color contrast between text and background on Tokopedia is designed effectively, meeting WCAG 2.0 criteria for minimum color contrast. This ensures that users with low vision, who struggle to distinguish colors with low contrast, can read the text more comfortably. These design choices reflect an emphasis on usability alongside aesthetics. However, despite these strengths, significant shortcomings remain, particularly in keyboard navigation. Some interactive elements, such as dropdown menus and buttons, are not easily accessible without a mouse. Users relying on keyboard navigation often face difficulties due to the lack of clear visual focus indicators, crucial for highlighting active elements.

The use of ARIA attributes on complex elements such as forms, dropdown menus, and models is also limited. ARIA attributes, including roles, states, and properties, can assist assistive technologies in recognizing and interpreting web elements not fully supported by standard HTML. The inadequate implementation of ARIA attributes reduces the usability for visually impaired users. Furthermore, forms like login and search forms also pose issues. Many input field labels are not correctly linked using HTML attributes like for and id. As a result, screen readers cannot accurately convey the purpose of each input field, forcing users to guess, which can lead to frustration.

These issues with keyboard navigation and forms highlight that Tokopedia still has room for improvement in creating a more inclusive digital experience. These barriers diminish the convenience for visually impaired users and limit their access to the platform's services. Considering the importance of e-commerce in supporting the independence of people with disabilities, addressing these issues should be a top priority. While Tokopedia has made significant strides toward web accessibility with elements that adhere to WCAG standards, the shortcomings in keyboard navigation and ARIA attribute usage indicate the need for further enhancements. Better implementation of accessibility principles will not only benefit users with disabilities but also improve the overall user experience. This evaluation recommends that Tokopedia's developers focus on refining these critical elements to create a truly inclusive platform.

3.2. User Experience with Assistive Technology

Direct testing using the NVDA screen reader provided more profound insights into the experience of visually impaired users navigating the Tokopedia website. A positive finding was the consistent and clear heading structure, which allows for directed navigation between sections on a page. Organized headings give users a hierarchical view of the page content, enabling them to locate the information they need without reading the entire content linearly. However, brief product descriptions emerged as a significant drawback. Detailed and informative product descriptions are essential for visually impaired users since they cannot rely on images to understand product characteristics. Unfortunately, Tokopedia's product descriptions often provide only general information, such as product name and price, without offering more details about specifications or unique features.

Another significant issue was the suboptimal keyboard navigation. Crucial elements like purchase buttons, dropdown menus, and category links were challenging to access with a keyboard. Screen reader users who rely solely on keyboard navigation often encounter difficulties due to the lack of visual focus indicators, which help identify active elements. This not only slows navigation but also creates confusion.

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The screen reader testing also revealed that some interactive elements on Tokopedia, such as search forms and models, were not designed with assistive technologies in mind. For instance, specific labels on input fields were not adequately connected to form elements, making it difficult for screen reader users to understand the purpose of each field. Consequently, users had to guess what information to input, leading to a confusing experience. Additionally, some visual elements like dropdown menus lacked screen reader-friendly alternatives. While these elements are accessible to regular users with a mouse, visually impaired users often struggle to navigate these menus due to insufficient assistive technology support, such as proper ARIA attributes. These issues exacerbate user experience challenges, particularly when attempting essential actions like filtering products or completing transactions. Overall, this testing indicates that while Tokopedia has made efforts to improve accessibility, significant barriers must be addressed to create a more inclusive experience for visually impaired users. Enhancing keyboard navigation, providing more detailed product descriptions, and optimizing interactive elements for assistive technology are critical steps that need prioritization. By overcoming these barriers, Tokopedia can improve user experience and offer more equitable services to all user groups.

3.3. Development of the Prototype Website (https://toko-online-v1-o.vercel.app)

This study's prototype website was designed to meet Web Content Accessibility Guidelines (WCAG) standards. Key accessibility principles, such as keyboard navigation, alt text usage for all images, and optimal color contrast, were consistently applied in the website design. Keyboard navigation enables users who rely on assistive technologies to quickly move between sections and interactive elements without needing a mouse. Informative alt text for images also provides visual descriptions accessible to screen reader users, ensuring no critical information is missed.

One key innovation in the prototype's development was using ARIA attributes on interactive elements like dropdown menus and modals. ARIA attributes ensure that assistive technologies recognize and interpret these elements. For example, attributes such as aria-expanded indicate whether a menu is open or closed, while aria-labelled by links visual elements with their descriptions. This implementation significantly enhances the user experience, particularly for visually impaired users relying on screen readers. While prioritizing functionality, the prototype website maintained a simple and clean aesthetic. This demonstrates that implementing accessibility principles does not compromise a website's visual appeal. The combination of intuitive design and high accessibility creates a more inclusive experience, benefiting not only users with disabilities but also general users who may have specific access preferences, such as using devices with small screens or operating in low-light conditions.

Testing results showed that the prototype website provided a much better user experience than websites not designed for accessibility. Efficient navigation allowed users to find information quickly, while high color contrast ensured text readability in various lighting conditions. The website's responsive design ensured compatibility across devices such as computers, tablets, and smartphones, maintaining a consistent user experience. In conclusion, this prototype website demonstrates that with proper planning and implementation, accessibility principles can be integrated comprehensively without sacrificing design quality or functionality. This model is a reference for other developers who are creating more inclusive and user-friendly websites. By prioritizing accessibility, websites meet the needs of specific user groups and broaden their audience reach, adding value for all stakeholders.

3.4. Comparison of Tokopedia and the Prototype Website

A comparison between Tokopedia and the prototype website highlights fundamental differences in implementing accessibility principles. While Tokopedia has adopted some accessibility elements, such as an organized heading structure and alt text for images, it still faces several shortcomings. A significant issue is the lack of full keyboard navigation support. Many interactive elements, such as dropdown menus and buttons, are difficult to access without a mouse, posing challenges for visually impaired users or those relying on keyboard navigation. In contrast, the prototype website developed in this study successfully addressed these issues by providing fully functional keyboard navigation. Every interactive element includes clear visual focus indicators, enabling users to identify the active

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element. This implementation not only enhances accessibility for visually impaired users but also simplifies navigation for general users who prefer using keyboards.

The use of ARIA attributes also sets the two websites apart. While Tokopedia implements ARIA attributes sparingly, limiting the usability of features with assistive technologies like screen readers, the prototype website extensively and effectively applies ARIA attributes. Elements such as dropdown menus, modals, and forms are equipped with attributes like aria-labeled and aria-expanded, ensuring they are fully accessible and comprehensible to screen reader users. This demonstrates that effective ARIA attribute implementation can significantly improve user experience.

Product descriptions on Tokopedia also represent a key weakness. The information is often too brief and lacks important details, such as specifications or unique features, creating significant challenges for visually impaired users who cannot rely on images. In contrast, the prototype website ensures that every product is accompanied by detailed and relevant descriptions, enabling users to make more informed decisions. Overall, the prototype website offers a tangible example of how accessibility principles can be comprehensively integrated without compromising user experience quality. This model demonstrates that inclusive design not only allows users with disabilities to access content equitably but also improves usability for all users. While Tokopedia has made efforts to enhance accessibility, further improvements are needed, particularly in keyboard navigation, ARIA attribute usage, and product descriptions, to deliver a truly inclusive digital experience.

4. CONCLUSION

This study highlights the importance of web accessibility in creating an inclusive digital space, particularly for individuals with disabilities. A case study on Tokopedia reveals that while elements such as heading structure and alt text have been implemented, shortcomings in keyboard navigation, ARIA attribute usage, and product descriptions still pose significant barriers for visually impaired users. These shortcomings reduce user comfort and accessibility to the services offered. Conversely, the prototype website developed in this study successfully integrates the principles of the Web Content Accessibility Guidelines (WCAG) comprehensively. Optimal keyboard navigation, informative product descriptions, and effective use of ARIA attributes significantly enhance the user experience for both visually impaired and general users. Thus, improved accessibility implementation, as demonstrated by the prototype website, can serve as a practical solution. These findings provide developers with a guide to improving accessibility and creating an equitable digital experience for all users.

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