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Evaluation of Web Accessibility of Higher Education Institutions in Region III Philippines Using Automated Tools

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Abstract:- An essential component of attaining full educational inclusion is web accessibility. It is essential to the current trend of creating online knowledge and learning. In response to the need for inclusive and equitable quality education and promotion of lifelong learning, this study evaluates the accessibility of websites across several Higher Education Institutions (HEIs) using the WAVE tool and the IBM Equal Accessibility Checker, with both tools adhering to WCAG 2.2 guidelines. The analysis identified key accessibility issues, including prevalent errors such as "linked image missing alternative text," "missing form label," and "missing alternative text." These issues significantly impact users, particularly those reliant on keyboard and screen reader technologies. Additionally, the evaluation revealed systemic problems across HEIs, such as inadequate text contrast, unlabelled images, redundant link texts, and misconfigured form elements. Disparities in compliance were noted, with some institutions demonstrating higher violation rates and others showing fewer issues but requiring ongoing improvements. The findings underscore the urgent need for tailored interventions to enhance web accessibility, ensuring that educational resources are inclusive and accessible to all users.

Keywords*: Web Accessibility, WCAG 2.2, Wave Tool, IBM Equal Access Accessibility Checker, HEI.*

1. Introduction

The Web was created with the intention of being universally accessible, allowing everyone to access it regardless of their hardware, software, language, culture, location, or physical and mental abilities.[1] As of July 2024, approximately 5.45 billion individuals, representing 67.1% of the global population, were active internet users. This substantial figure highlights that internet users now constitute a "supermajority," with more than twice as many people connected to the internet as those who are not. The number of internet users continues to increase, with data showing a growth of 167 million users over the past year.[2] As of 23 September 2018, all British higher education institutions were mandated by law to update their websites, online courses, and network resources to align with current Web Accessibility standards. [3] In Singapore, while businesses and organizations are not legally required to adhere to the WCAG, the Digital Service Standard (DSS) aligns with Level AA of WCAG 2.1 and mandates that government agencies integrate these standards into their digital services.[4] Compliance with WCAG is widely regarded as a universal standard for web accessibility, though the extent of enforcement and emphasis varies across different nations. Countries such as China, Japan, South Korea, India, and Israel have implemented policies to ensure adherence to WCAG requirements or their regional equivalents within Asia.[5]

In the Philippines, the current population is 115,951,775 as of August 12, 2024[6], based on Department of Health (DOH) data as of August 5, 2024 there are 1,938,911 disability cases in the country and 234,527 case in the Region III[7]. To improve internet accessibility for individuals with disabilities in the Philippines, various initiatives were introduced, including the formation of the Philippine Web Accessibility Group (PWAG). After receiving a government mandate to establish a web accessibility ad hoc group and completing the “Webmasters Interface Workshop” in Cebu City in May 2006, a team of web designers held their inaugural informal meeting at the

National Council on Disability Affairs conference Hall on August 11, 2006, where they formally named the group PWAG. Directed by the National Computer Center's Commission on Information and Communications Technology (NCC-CICT) and the Department of Social Welfare and Development's National Council on Disability Affairs (DSWD-NCDA), PWAG is tasked with overseeing and implementing accessible ICT programs in the Philippines.[8]

Since the internet has replaced other information sources and web resources, accessibility has become a crucial concern in the current situation. Web accessibility is a gauge of simplicity. With this, a person with a disability would be able to live comfortably to access web resources in a way like how a regular user might you could. An essential component of attaining full educational inclusion is web accessibility. This study evaluates the web accessibility of the websites in Higher Education Institutions in Region III Philippines using WAVE, and IBM Equal Access Accessibility Checker that uses the WCAG 2.2 guidelines.

2. Methods and Methodology:

A. Web Accessibility

International frameworks have long recognized access to information (ATI) as a basic human right that should be enjoyed by all people, including those who are disabled. However, the full realization of this right for persons with disabilities remains a significant challenge, particularly in the digital realm.[9] To address these challenges, various guidelines have been developed to ensure website accessibility, with the Web Content Accessibility Guidelines (WCAG) being among the most influential. Non-compliance with WCAG can severely impact user experience, regardless of users' physical or cognitive abilities.[10]

The evolution of WCAG reflects the growing complexity and diversity of web technologies. WCAG 1.0, introduced in 1999 by the W3C, served as the first standard for evaluating website accessibility.[11] This was followed by WCAG 2.0, which became a W3C recommendation in December 2008, offering testable, technology-neutral requirements designed to accommodate the expanding range of web technologies.[12] WCAG 2.1, introduced in June 2018, further extended these guidelines, providing additional recommendations to enhance accessibility and ensure the long-term applicability of accessibility efforts.[13] Most recently, WCAG 2.2 has built upon its predecessors, offering a comprehensive set of guidelines aimed at improving access for individuals with a wide range of disabilities, including those related to vision, hearing, movement, and cognition.

While WCAG 2.2 represents a significant advancement in web accessibility, it acknowledges that not all user needs can be fully addressed by these guidelines. Nevertheless, WCAG 2.2 ensures that content conforming to its standards also aligns with WCAG 2.0 and 2.1. The W3C recommends the adoption of WCAG 2.2 to maximize the future relevance and effectiveness of web accessibility initiatives, while also maintaining the validity of earlier versions. This progression underscores the ongoing commitment to enhancing digital inclusivity and ensuring that the right to access information is fully realized for all individuals, particularly those with disabilities.[14]

A.1 Automated Web Accessibility Evaluation Tools

The automation of accessibility evaluation processes is a key focus in accessibility research, offering significant benefits despite its limitations. While automated tools cannot fully replace human evaluation, they are valuable in providing support to developers and evaluators, thereby significantly reducing the time and effort needed for comprehensive assessments.[15] Various tools are available for evaluating the accessibility of web pages, including browser plugins such as the IBM Equal Access Accessibility Checker and online resources like the free WAVE tool.

The IBM Equal Access Accessibility Checker browser extension represents a significant asset in an accessibility testing toolkit, offering the capability to scan multiple pages and generate foundational reports. Its ease of use facilitates quick audits, and it effectively identifies a comparable range of issues to other leading tools, including some content issues typically missed by automated systems. The extension's open-source nature and IBM's ongoing maintenance contribute to its continual improvement. A notable feature of this tool is its ability to scan

numerous pages and compile the results into a comprehensive report, which streamlines the audit process by aggregating and summarizing findings from a representative sample of web pages[16] as shown in the figure 1.

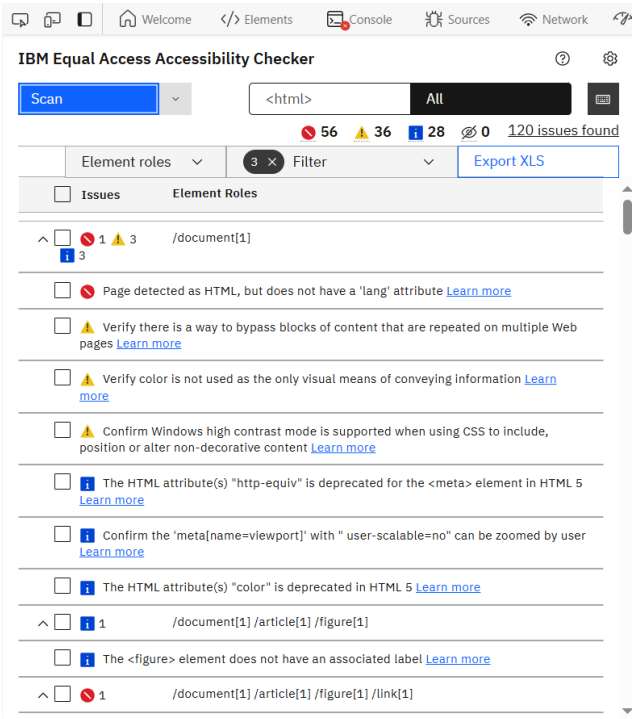


Figure 1 Screenshot of IBM Equal Access Accessibility Checker extension

In addition to utilizing the IBM Equal Access Accessibility Checker for evaluating Higher Education Institutions' (HEIs) websites, the WAVE web accessibility evaluation tool was employed for similar assessments. WAVE effectively identified various types of errors, including Simple Errors, Alerts, Features, Structural Elements, HTML5 and ARIA errors, and Contrast Errors[17] as shown in figure 2. Additionally, WAVE enhances accessibility evaluation by incorporating extensive tests that address a wide range of compliance issues, including those outlined in Section 508 and WCAG 2.2 guidelines[18]. However, some issues were not detected by automated tools, necessitating manual evaluation to address potential problems that required human intervention for resolution. This approach highlights the importance of combining automated and manual testing methods to achieve comprehensive web accessibility evaluations.

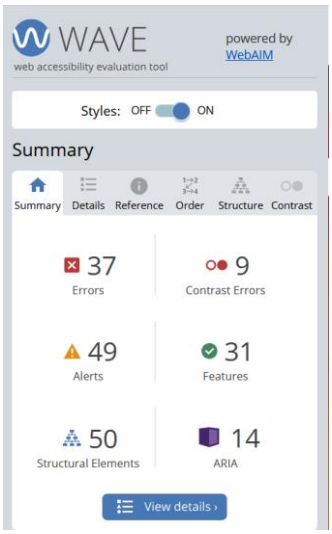


Figure 2. Screenshot of WAVE Accessibility Tool

A.2 Dataset

The Philippines is geographically segmented into three (3) major areas: Luzon, Visayas, and Mindanao, and is further divided into eighteen (18) regions and eighty-one (81) provinces. In Region 3, which comprises seven (7) provinces, the researchers employed a random sampling method to select one (1) Higher Education Institution (HEI) website per province. The details of the selected HEIs and their respective provinces are presented in Table 1.

Table 1. Higher Education Institutions in Region III indicating their province

HEI	Province
HEI 1	AURORA
HEI 2	BATAAN
HEI 3	BULACAN
HEI 4	NUEVA ECIJA
HEI 5	PAMPANGA
HEI 6	TARLAC
HEI 7	ZAMBALES

To maintain the confidentiality of the institutions, they were anonymized and designated as HEI1 through HEI7 in Table 1.

A.3 Actual Evaluation Process

To start the evaluation process with IBM Equal Access Accessibility Checker, open a web browser and type the HEI website URL, (1) write click the webpage click inspect then (2) click the Accessibility Assessment and click the scan button to start the accessibility assessment as shown in figure 3.

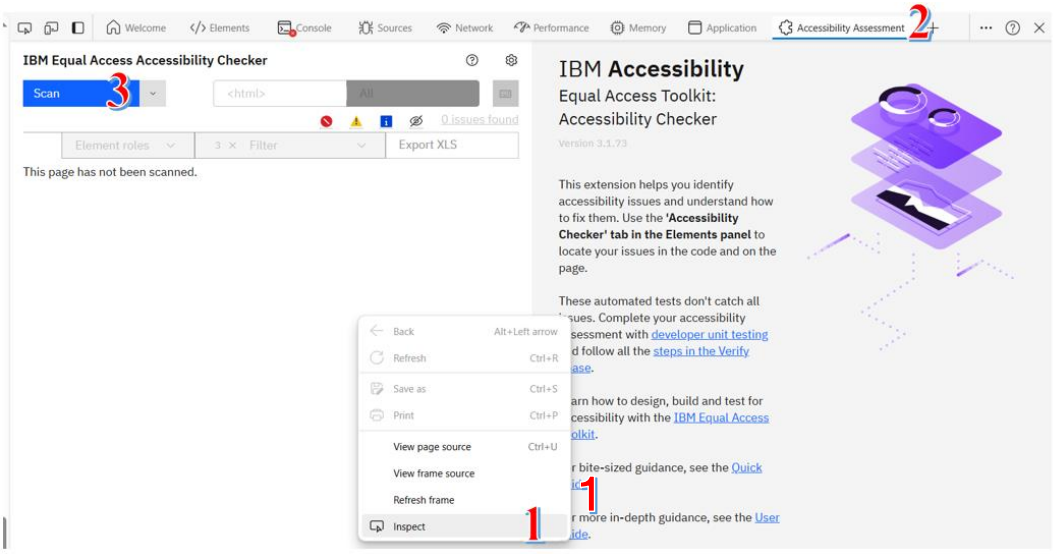


Figure 3. Screenshot of IBM Equal Access Accessibility Checker Scanning Process

Upon completion of the scan, the tool produces a comprehensive summary and an in-depth report. This report enables users to thoroughly examine specific violation details, including the severity of each issue, the location of the affected elements, and recommended corrective actions. These recommendations are supplemented with illustrative examples, as shown in Figures 4(a), Figure 4(b) and 4(c). Additionally, the results can be exported in XLS format for further analysis.

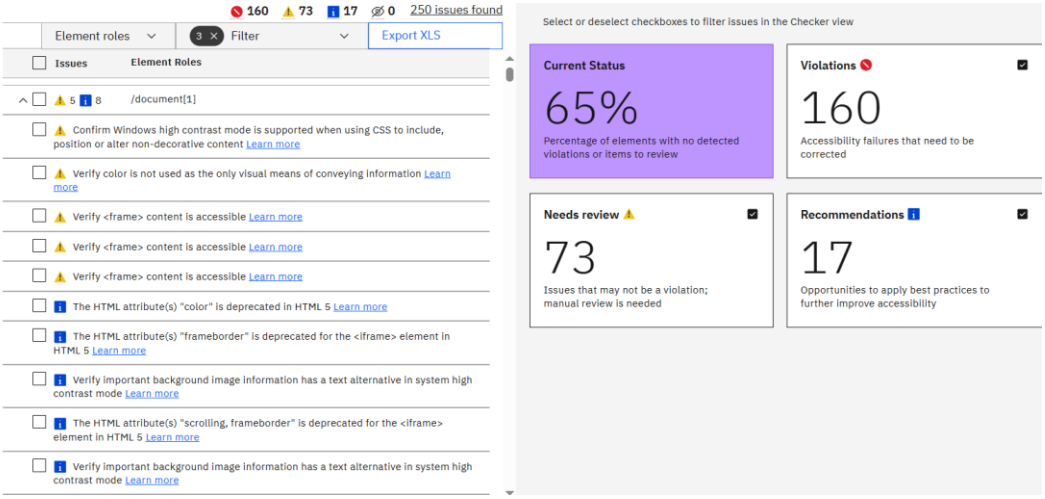


Figure 4(a). Screenshot of IBM Equal Accessibility Checker Scan Summary Result

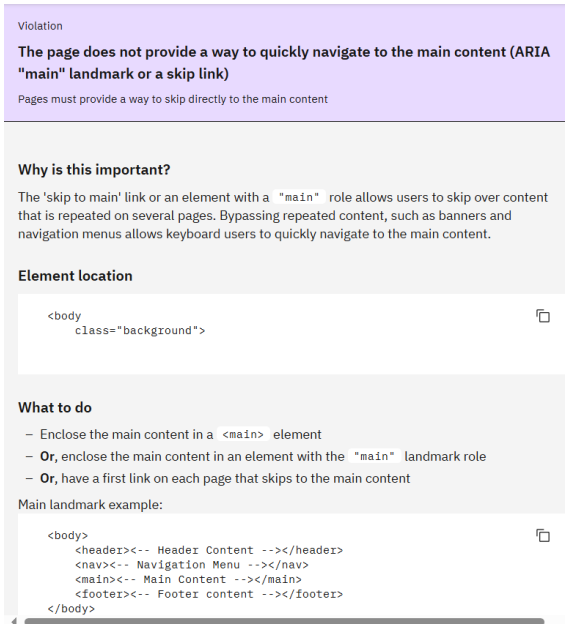
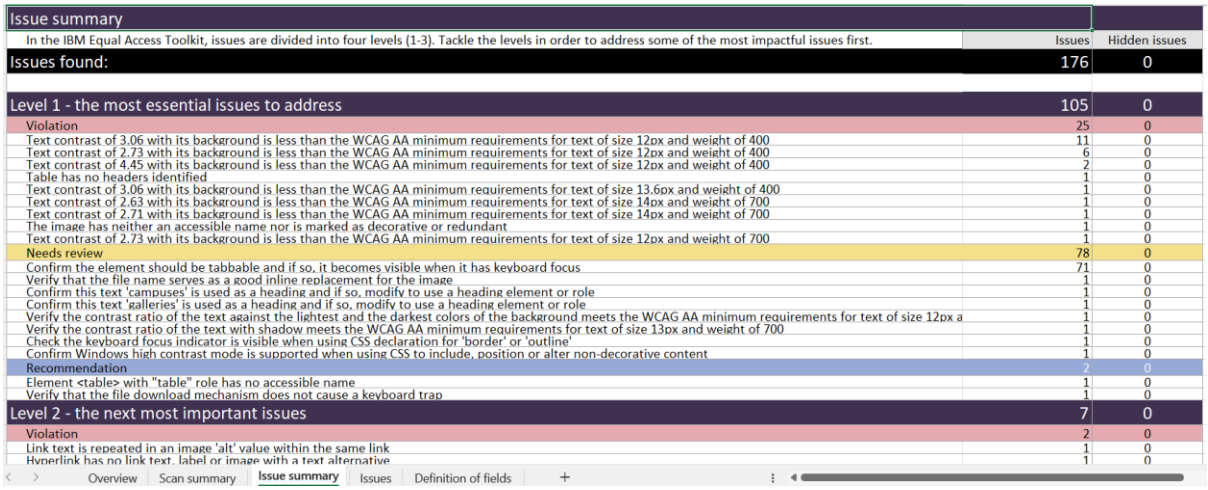


Figure 4(b) Screenshot of IBM Equal Accessibility Checker Detailed Results



Issue summary		
In the IBM Equal Access Toolkit, issues are divided into four levels (1-3). Tackle the levels in order to address some of the most impactful issues first.	Issues	Hidden issues
Issues found:	176	0
Level 1 - the most essential issues to address	105	0
Violation	25	0
Text contrast of 3.06 with its background is less than the WCAG AA minimum requirements for text of size 12px and weight of 400	11	0
Text contrast of 2.73 with its background is less than the WCAG AA minimum requirements for text of size 12px and weight of 400	6	0
Text contrast of 4.45 with its background is less than the WCAG AA minimum requirements for text of size 12px and weight of 400	2	0
Table has no headers identified	1	0
Text contrast of 3.06 with its background is less than the WCAG AA minimum requirements for text of size 13.6px and weight of 400	1	0
Text contrast of 2.63 with its background is less than the WCAG AA minimum requirements for text of size 14px and weight of 700	1	0
Text contrast of 2.71 with its background is less than the WCAG AA minimum requirements for text of size 14px and weight of 700	1	0
The image has neither an accessible name nor is marked as decorative or redundant	1	0
Text contrast of 2.73 with its background is less than the WCAG AA minimum requirements for text of size 12px and weight of 700	1	0
Needs review	78	0
Confirm the element should be tabbable and if so, it becomes visible when it has keyboard focus	71	0
Verify that the file name serves as a good inline replacement for the image	1	0
Confirm this text 'campuses' is used as a heading and if so, modify to use a heading element or role	1	0
Confirm this text 'galleries' is used as a heading and if so, modify to use a heading element or role	1	0
Verify the contrast ratio of the text against the lightest and the darkest colors of the background meets the WCAG AA minimum requirements for text of size 12px a	1	0
Verify the contrast ratio of the text with shadow meets the WCAG AA minimum requirements for text of size 13px and weight of 700	1	0
Check the keyboard focus indicator is visible when using CSS declaration for 'border' or 'outline'	1	0
Confirm Windows high contrast mode is supported when using CSS to include, position or alter non-decorative content	1	0
Recommendation	2	0
Element <table> with "table" role has no accessible name	1	0
Verify that the file download mechanism does not cause a keyboard trap	1	0
Level 2 - the next most important issues	7	0
Violation	2	0
Link text is repeated in an image 'alt' value within the same link	1	0
Hyperlink has no link text, label or image with a text alternative	1	0

Figure 4(c) Screenshot of Exported XLS format IBM Equal Accessibility Checker Results

To utilize the WAVE tool, users can navigate to the website at wave.webaim.org and input the HEI's website address into the designated text box to initiate the scan. Alternatively, users may download the browser plugin, right-click on the HEI's website, select "Wave this page," and the evaluation process will commence automatically as shown in Figure 5(a) and Figure 5(b) showing the results and locations where the errors found.

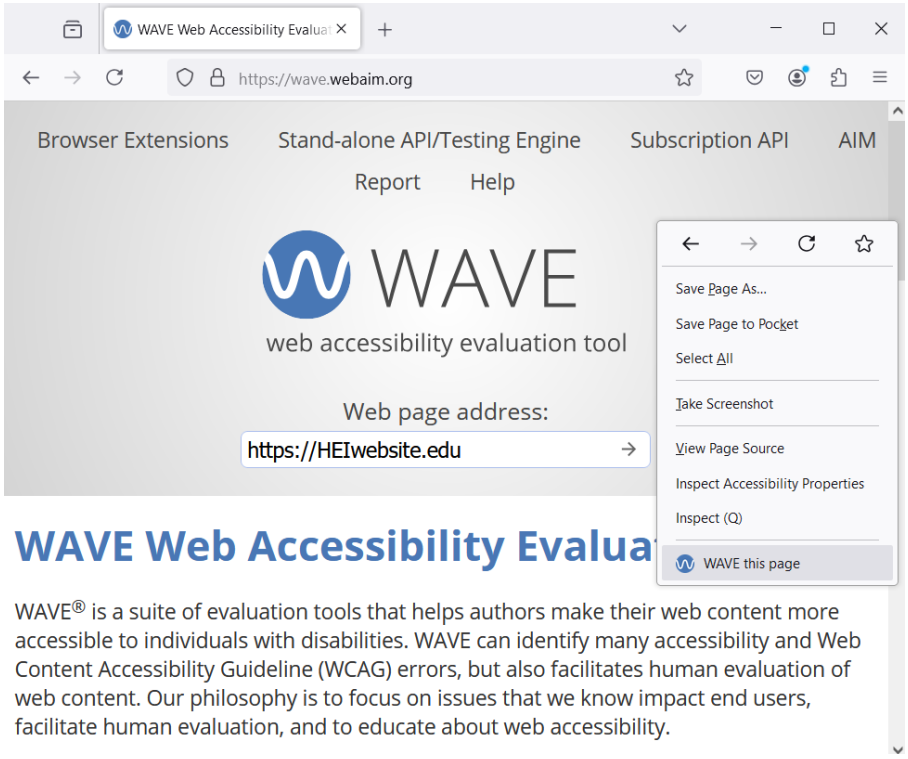


Figure 5(a) Screenshot of WAVE online evaluation tool

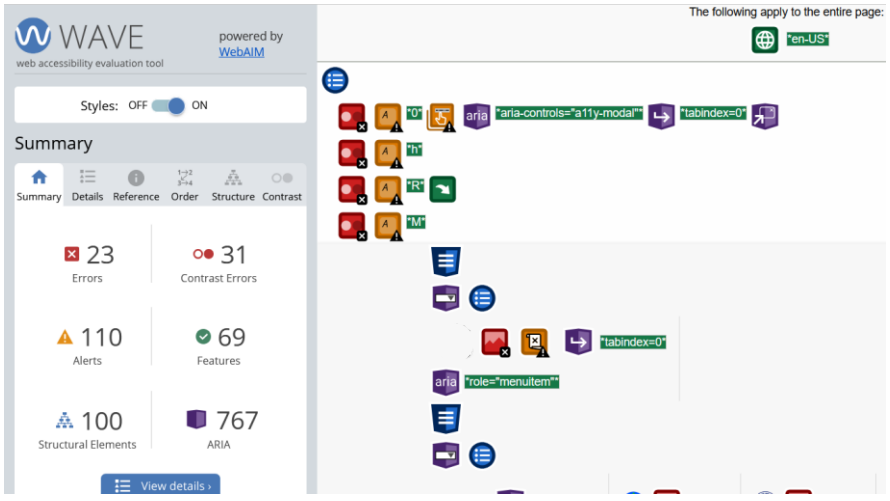


Figure 5(b) Screenshot of WAVE evaluation results

3. Results and Discussions

The following observations were made by the researchers upon completing the accessibility assessment using the selected tools. The evaluation results from the WAVE tool reveal that the most prevalent error identified across the assessed HEI websites is "linked image missing alternative text," followed by "missing form label" and "missing alternative text," as illustrated in Figure 6.

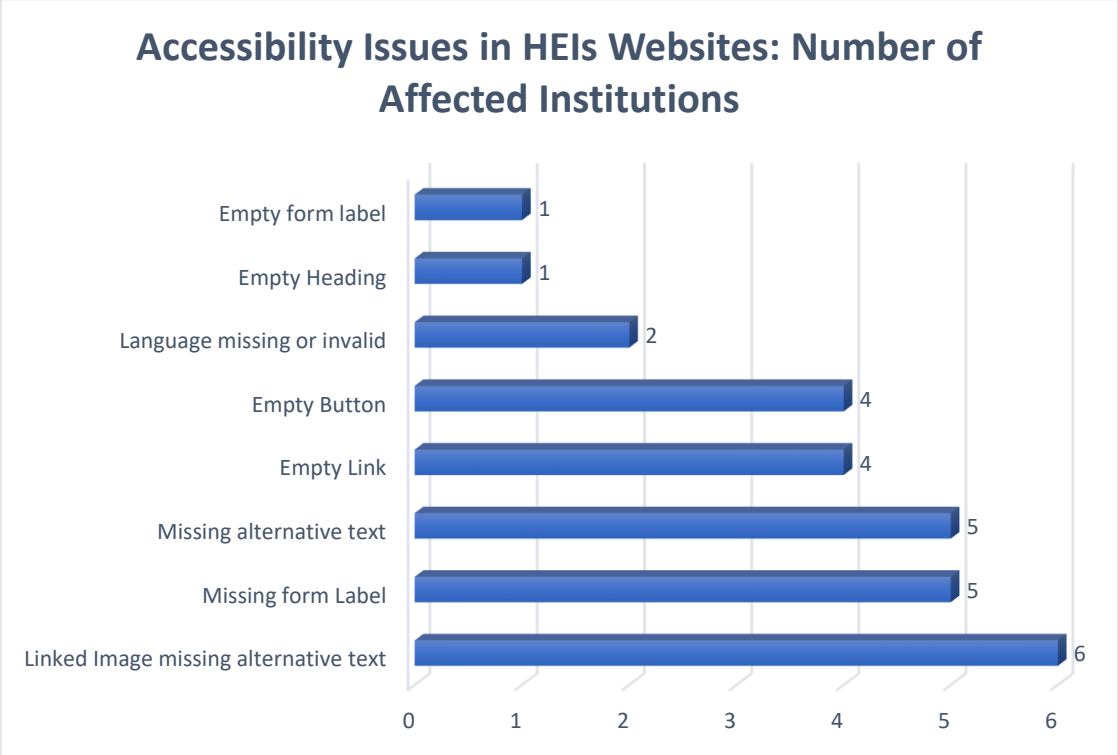


Figure 6. WAVE errors summary of HEIs website

The accessibility evaluation identified several critical issues affecting the usability of the websites assessed. Key problems included links and buttons lacking descriptive text, which impedes users' understanding of their functions and introduces confusion, particularly for keyboard and screen reader users. Additionally, missing alt attributes in images and empty form labels rendered content inaccessible or unclear. The absence of a specified language for the document or invalid lang attributes further complicates content interpretation and automatic translation. Empty headings similarly hinder navigation, affecting users reliant on these elements to orient themselves.

Moreover, the evaluation revealed consistent errors across all HEI websites, including inadequate text-to-background contrast, redundant links, and improper use of ARIA attributes. Specifically, adjacent links leading to the same URL create unnecessary navigation for users, and aria-label or aria-labelledby attributes are often incorrectly implemented. Elements designated with role="button" must function as true buttons, and many elements lacked adequate contrast, which is crucial for users with low vision. These findings highlight the need for comprehensive improvements in alternative text, form labels, and ARIA implementations to enhance overall website accessibility.

The analysis of the table data reveals significant disparities across seven Higher Education Institutions (HEIs) regarding compliance with standards, as evaluated by the IBM Equal Accessibility Checker. HEI4 exhibits the highest violation rate, particularly in Level 1, with 439 recorded violations, indicating a substantial need for remediation to ensure accessibility. Conversely, HEI1 shows a comparatively low number of issues at Level 1, with 95 violations, suggesting that even institutions with fewer problems require ongoing scrutiny and potential improvements. Notably, HEI2, despite a considerable number of needs review cases (106 at Level 1), demonstrates a high volume of recommendations (108 at Level 3), implying the presence of mechanisms to address accessibility challenges effectively. This variation in violation counts across levels underscores the necessity for tailored interventions across HEIs to enhance overall compliance with accessibility standards, thereby ensuring equal access to educational resources and facilities for all stakeholders as illustrated in figure 7.

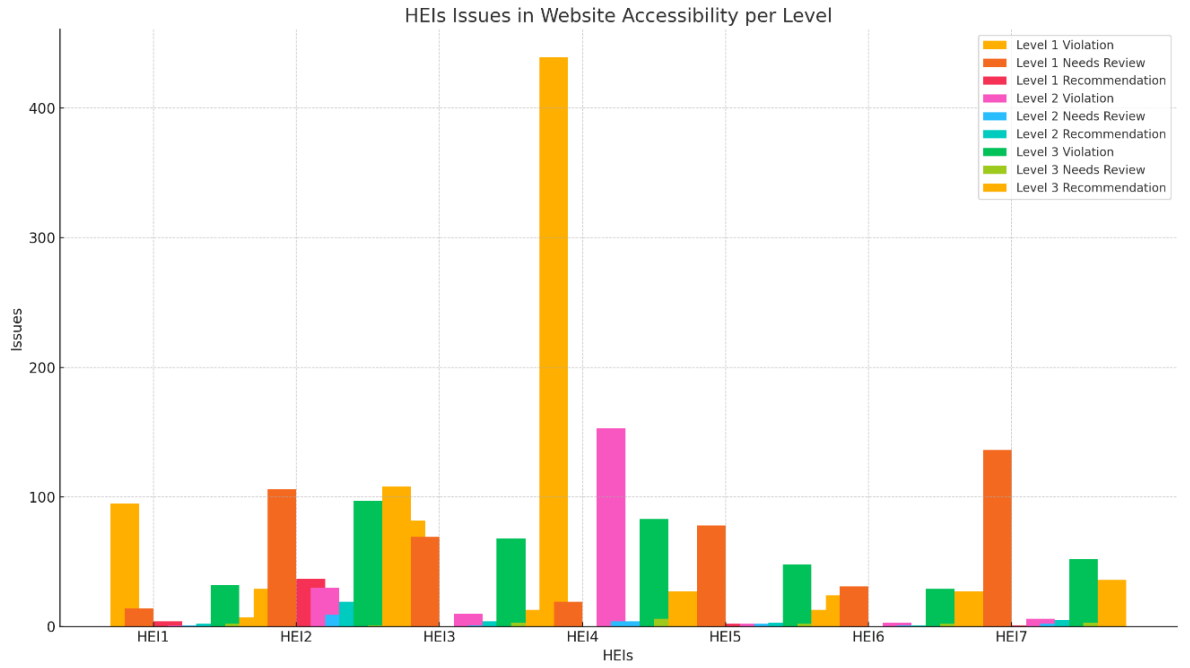


Figure 7. Distribution of Issues by Higher Education Institutions (HEIs)

Furthermore, the evaluation of websites across these HEIs highlights widespread accessibility violations, emphasizing a systemic need for improvement. Common issues identified include inadequate text contrast falling below WCAG AA standards, lack of identified table headers, and images lacking accessible names or being improperly marked as decorative, which significantly hinder the experience for users with visual impairments. Additionally, redundancy in link text within image 'alt' attributes and improperly categorized content outside of landmark elements complicate navigation further. Misconfigured form elements, such as buttons without associated labels and incorrect 'for' attributes, exacerbate these accessibility challenges. The presence of multiple elements with non-unique "contentinfo" roles, alongside the absence of valid 'lang' attributes on HTML pages, highlights significant compliance gaps. Collectively, these findings reinforce the urgent necessity for HEIs to enhance their web accessibility practices, fostering a more inclusive digital environment that supports all users effectively.

4. Conclusion

The findings from the accessibility evaluation underscore several critical issues affecting the usability of websites across the assessed Higher Education Institutions (HEIs). The WAVE tool's results indicated that the most frequent errors include "linked image missing alternative text," "missing form label," and "missing alternative text," highlighting significant gaps in content accessibility. These issues, combined with the absence of proper language specifications, empty headings, and inadequate form labels, contribute to substantial barriers for keyboard and screen reader users.

Furthermore, the analysis of data from the IBM Equal Accessibility Checker reveals considerable variability in compliance among the HEIs. HEI4, in particular, faces the highest rate of violations, emphasizing an urgent need for targeted remediation efforts. Conversely, HEI1, despite having fewer issues, still requires ongoing vigilance to address potential accessibility concerns. HEI2, while demonstrating a higher volume of recommendations, indicates an active engagement in addressing accessibility challenges.

The evaluation also identified systemic issues across HEIs, including insufficient text contrast, unlabelled images, redundant link texts, and misconfigured form elements. These findings highlight a pervasive need for comprehensive improvements in web accessibility practices. Addressing these issues is crucial for ensuring that all users, particularly those with visual impairments or other disabilities, can effectively access and navigate educational resources. The results underscore the importance of tailored interventions to enhance overall

compliance with accessibility standards, thereby promoting a more inclusive digital environment for all stakeholders.

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References

[1] S. L. Henry and L. Mcgee, “Accessibility.” Accessed: Aug. 01, 2024. [Online]. Available: https://www.w3.org/mission/accessibility/
[2] Kepios, “Digital Around the World.” Accessed: Aug. 01, 2024. [Online]. Available: https://datareportal.com/global-digital-overview
[3] N. Christensen, “UK Universities and Web Accessibility.” Accessed: Aug. 02, 2024. [Online]. Available: https://littleforest.co.uk/uk-universities-and-web-accessibility/
[4] G. Singapore, “Web Content Accessibility Guidelines (WCAG) 2.1.” Accessed: Jul. 30, 2024. [Online]. Available: https://www.developer.tech.gov.sg/guidelines/standards-and-best-practices/wcag-2-1.html
[5] N. Isa and M. Batakovic, “WCAG 2.1 Compliance: Web Content Accessibility Guidelines.” Accessed: Jul. 30, 2024. [Online]. Available: https://bestwebsiteaccessibility.com/wcag-compliance/
[6] Worldometer, “Philippines Population.” Accessed: Aug. 12, 2024. [Online]. Available: https://www.worldometers.info/world-population/philippines-population/
[7] NCDA, “Disability Cases.” Accessed: Aug. 12, 2024. [Online]. Available: https://ncda.gov.ph/
[8] PWAG, “About Philippine Web Accessibility Group.” Accessed: Jul. 29, 2024. [Online]. Available: https://www.pwag.org/about-pwag/
[9] UNESCO, “ATI and disability rights.” Accessed: Jul. 25, 2024. [Online]. Available: https://www.unesco.org/reports/access-to-information/2021/en/ati-disability
[10] C. Chatziemmanouil, Themistoklis Katsanos, “Accessibility Academy: Interactive Learning of the WCAG 2.1 Web Accessibility Guidelines,” *2024 IEEE Glob. Eng. Educ. Conf.*, pp. 1–7, 2024, doi: 10.1109/EDUCON60312.2024.10578915.
[11] E. Accessibility, “WCAG 101: Understanding the Web Content Accessibility Guidelines.” Accessed: Aug. 01, 2024. [Online]. Available: https://www.wcag.com/resource/what-is-wcag/
[12] L. Guarino Reid and A. Snow-Weaver, “WCAG 2.0 for designers: Beyond screen readers and captions,” *Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics)*, vol. 5616 LNCS, no. PART 3, pp. 674–682, 2009, doi: 10.1007/978-3-642-02713-0_71.
[13] A. Ismail and K. S. Kuppusamy, “Web accessibility investigation and identification of major issues of higher education websites with statistical measures: A case study of college websites,” *J. King Saud Univ. - Comput. Inf. Sci.*, vol. 34, no. 3, pp. 901–911, 2022, doi: 10.1016/j.jksuci.2019.03.011.
[14] W3C, “Web Content Accessibility Guidelines (WCAG) 2.2.” Accessed: Aug. 01, 2024. [Online]. Available: https://www.w3.org/TR/WCAG22/
[15] J. Abascal, M. Arrue, and X. Valencia, *Tools for Web Accessibility Evaluation*. Springer London, 2019. doi: 10.1007/978-1-4471-7440-0_26.
[16] D. Whisman, “IBM Equal Access: Automated Accessibility Tool Review.” Accessed: Aug. 04, 2024. [Online]. Available: https://sparkbox.com/foundry/ibm_equal_access_evaluation_tool_website_accessibility_audit_website_accessibility_checker
[17] A. Ismail and K. S. Kuppusamy, “Accessibility of Indian universities’ homepages: An exploratory study,” *J. King Saud Univ. - Comput. Inf. Sci.*, vol. 30, no. 2, pp. 268–278, 2018, doi: 10.1016/j.jksuci.2016.06.006.
[18] WebAIM, “WAVE Help.” Accessed: Aug. 02, 2024. [Online]. Available: https://wave.webaim.org/help