



## Evaluation of Accessibility of Randomly Selected Websites

Mohammed Ajuji<sup>1</sup>, Aliyu Abubakar<sup>1</sup>, Yaya Abubakar Adam<sup>2</sup> and Datti Useni Emmanuel<sup>3</sup>

<sup>1</sup>Department of Computer Science,  
Faculty of Science, Gombe State University, Gombe 760214, Nigeria

<sup>2</sup>Department of Computer Science,  
Federal College of Forestry, Jos, Nigeria

<sup>3</sup>Department of Computer Science, School of Science,  
Federal College of Education, Plateau, Nigeria

### ABSTRACT

The continuous evolution of web technologies since the advent of the World Wide Web (www) has transcendently enhanced the flexibility of interactions with increasingly varied and resourceful interfaces that supports dynamic web content. However, despite the increase in web interactivity, people with disabilities are still finding it difficult to access websites, due to non-compliance of most websites to the W3C guidelines. This research was carried out to evaluate websites' conformance to the Web Content Accessibility Guidelines. Ten websites were selected at random from different fields such as education, business, industry, and entertainment; which were evaluated using the TAW tool. The evaluation was based on the four general principles of WCAG 2.0: Operable, understandable, robust, and perceivable. Our finding discovered a lack of guidelines conformity by most if not all the selected websites.

### INTRODUCTION

All over the world and indeed in Nigeria, job opportunities, scholarships, and many more are advertised on the websites or internet due to their timely and command ability feature. However, lack of accessibility to these websites by both people with ability and disabilities (special needs) as a result of visual impairment, hearing impairment, physical impairment, and intellectual impairment has raised great concern. In recent times, an effort has been shifted to developing websites that can be accessible to all categories of people worldwide. Web Content Accessibility Guidelines (WCAG) outlined a set of standards that if properly adopted and applied shall give all categories of people equal chances to access web content. Adoption of these guidelines will make web content more accessible to a wider range of people with disabilities, including those with blindness and low vision, deafness and hearing loss, limited movement, speech disabilities, photosensitivity, and combinations of these. People with learning disabilities and cognitive limitations are also considered in the development of such guidelines to accommodate them all (WCAG, 2018).

Accessibility is essential for developers and organizations that want to create high-quality websites, thereby not excluding people from using

their products and services (W3C, 2019). The goal of web accessibility is to ensure that the information or services delivered through websites are available and can be used by the widest possible audience (Navarrete, 2014, as cited by Nuñez, 2019). Nigeria has recently established an act to ensure prohibition and maltreatment of persons with disabilities: "that a person with disability shall not be discriminated against on the ground of his disability by any person or institution in any manner or circumstance whatsoever". The Convention on the Rights of Persons with Disabilities states in article 24.5 that "parties shall ensure that persons with disabilities can access general tertiary education, vocational training, adult education and lifelong learning without discrimination and on an equal basis with others" (UN, 2018).

Are these guidelines adopted and applied when developing websites in Nigeria? This is the answer we intend to provide at the end of the study. Therefore, to provide a valid answer to the question, an automatic accessibility evaluation tool called the TAW tool is used to evaluate the selected target websites.

### ARTICLE INFO

#### Article History

Received: February, 2021

Received in revised form: March, 2021

Accepted: June, 2021

Published online: August, 2021

### KEYWORDS

Disability, www, TAW, Web Content, WCAG 2.0,

### LITERATURE REVIEW



Many studies were conducted in this area. In recent times, websites have become the most efficient way of sharing information with a large number of people of different backgrounds including those able and disable categories. The Web is undergoing a constant evolutionary process, which means it can now provide greater interactivity to the users through web applications with more sophisticated and dynamic interfaces (Fortes, 2019).

A study by (Adepoju, 2016) documented that in Nigeria, most websites do not follow the guidelines set up by National Information Technology Development Agency (NITDA). The author evaluated the accessibility and performance of some websites owned by state governments in Nigeria using TAW and a site analyzer. The study aimed to test for their conformance with the Web Content Accessibility Guidelines (WCAG). Results from their study showed that none of the websites evaluated conforms to WCAG 2.0 standard guidelines. Moreover, the overall performance obtained shows that most websites tested are above average.

Similar research (Karaim, 2017) was conducted in Libya and discovered that the evaluated website had a significant number of usability problems. According to the study, more than half of the usability problems were rated as major and catastrophic. All websites failed accessibility evaluation using the TAW tool. Providing text alternatives for each non-text content element was the most frequently violated success criterion for Libyan government websites.

The accessibility of 21 Dubai e-Government websites was evaluated based on the WCAG 1.0 (Al Mourad, 2013). The research reveals that many Dubai e-Government sites did not meet the minimum W3C accessibility conformance level. The results indicate that the prevalent priority-1 accessibility barriers identified in the study were related to the absence of text equivalent for dynamic content to get updated when the dynamic content changes.

In Jordan for example, twenty-five e-government websites were evaluated to check accessibility for people with disabilities, but results showed that all tested websites did not address the issue of disability-accessibility and they have

many Web accessibility problems. Therefore, they are violating the e-government standard which says that all citizens must have equal access opportunities to all e-government recourses (Al-Radaideh, 2011).

Acosta-Vargas et al, (2017) conducted research on Quality Evaluation of Government Websites and reported thus; several non-compliance errors were found on the websites; by performing this evaluation, we have identified that there are major barriers for many users

#### Web Content Accessibility Guidelines (WCAG)

According to (Carvajal et al, 2018) The WCAG 2.0 is designed to protect the people's right to access information and this study proves the existence of barriers for the elderly and/or people with disabilities trying to access the websites of Chilean universities. It consists of a set of checkpoints that are required by web technologies to obey. They are organized under 4 principles as follows:

1. Principle 1: Perceivable Information and user interface components must be presentable to users in ways they can perceive.
2. Principle 2: Operable user interface components and navigation must be operable.
3. Principle 3: Understandable Information and the operation of the user interface must be understandable.
4. Principle 4: Robust Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies.

For each guideline, there are testable *success criteria*, which are at three levels: A, AA, and AAA. These are primary, secondary, and tertiary. Level A is a subset of Level AA. There are 25 criteria that one must meet to reach Level A. To reach Level AA you must meet 13 more criteria in addition to the 25 for Level A. Level AAA is the icing on the cake with 23 more criteria.

Table 1 presents the WCAG levels.

**Table 1:** WCAG levels

Conformance Level	Web Accessibility Checkpoints
-------------------	-------------------------------

Corresponding author: Ajuji, M. ✉ [majuji@gsu.edu.ng](mailto:majuji@gsu.edu.ng) ✉ Department of Computer Science, Faculty of Science, Gombe State University, Gombe. © 2021. Faculty of Tech. Education, ATBU Bauchi. All rights reserved



Primary (A)	Websites <b>must</b> be able to satisfy priority 1 checkpoints. This is the minimum (basic) W3C requirement that <b>must</b> be made. A Web content developer must satisfy this checkpoint. Satisfying this checkpoint is a basic requirement for some people to be able to use the websites.
Secondary (AA)	Websites <b>should</b> be able to satisfy priority 1 and 2 checkpoints; otherwise, some people will find it difficult to access information from the websites.
Tertiary (AAA)	Websites <b>may</b> be able to satisfy priority 1, 2, and 3 checkpoints; else some people will find it somehow difficult to access information from the website.

Many developers are not well-educated on these principles nor exposed to accessibility guidelines in their college preparations (Cao, 2019). However, there is a need for software teams to pay more attention to accessibility testing (Ardito et al, 2019). Therefore, website developers should be able to know all these guidelines/checkpoints very well and implement them on their websites, so that these will ensure access to all people with different abilities and disabilities to benefit from its dividend or use the websites to their optimum satisfaction.

The development of websites that follow accessibility guidelines is recommended, since the interaction of visually impaired and other challenged users is only possible by using an AT tool such as screen readers.

#### **Web Accessibility Examples**

Properly designed websites and tools can be used by people with disabilities. However, currently many sites and tools are developed with accessibility barriers that make it difficult or impossible for some people to use them (W3C, 2019). Below are just a few examples.

#### **Alternative text for images**

Images should include equivalent alternative text (alt-text) in the mark-up/code. If alt text isn't provided for images, the image information is inaccessible, for example, to people who cannot see and use a screen reader that reads aloud the information on a page, including the alt text for the visual image. When equivalent alt text is provided, the information is available to people who are blind, as well as to people who turn off images (for example, in areas with expensive or low bandwidth). It is also available to technologies that cannot see images, such as search engines.

#### **Keyboard Input**

Some people cannot use a mouse, including many older users with limited fine motor control. An accessible website does not rely on the mouse; it makes all functionality available from a keyboard. Then people with disabilities can use assistive technologies that mimic the keyboard, such as speech.

#### **Transcripts for Audio**

Just as images are not available to people who cannot see, audio files are not available to people who cannot hear. Providing a text transcript makes the audio information accessible to people who are deaf or hard of hearing, as well as to search engines and other technologies that cannot hear. It is easy and relatively inexpensive for websites to provide transcripts. There are also transcription services that create text transcripts in HTML format.

#### **Making Websites and Tools Accessible**

Most of the basics of accessibility are easy to implement. However, if you are new to accessibility, it takes some time and effort to learn the common issues and solutions. Here are places to start: Accessibility Principles — introduces accessibility requirements and international standards. Some accessibility barriers are more complicated to avoid, and the solutions take more development time and effort. W3C WAI and other similar websites provide extensive resources to help, such as Tutorials and WCAG.

#### **METHODOLOGY**

This study uses two phases. The first phase focused on selecting an appropriate tool to analyze website accessibility based on the WCAG guidelines. Many different automatic accessibility tools are available to assess the accessibility of websites. These tools differ in many aspects including cost, goal (assessing or fixing



accessibility violations), interaction form (online or stand-alone), effectiveness, breadth and depth of accessibility reports, conformance guideline support all versions of WCAG, and conformance levels supported (A, AA, AAA). We selected the online TAW software accessibility testing tool. TAW is a free and widely accepted Java tool developed by the Spanish Centre for the development of Information and Communication Technologies in Asturias. The tool is based on the WCAG 2.1 guidelines and can test conformance against all the checkpoint levels. TAW enables the tester to specify one page (such as the home or index page) or the entire website pages for automated accessibility testing. For each accessibility checkpoint, TAW provides a detailed report of detected issues, as well as additional tagged warnings that require manual inspection and human judgment on the part of the tester. TAW generates three types of reports about the test results, namely TAW report, EARL (Evaluation and Report Language) report, and HTML summary report. The HTML summary report simply displays, in a tabular form, the frequency of errors for each identified accessibility issue. That is our concern. TAW report is an HTML document that visually displays (for each accessibility issue detected) the error description and the location using differently coloured icons, each representing a priority violation level (1-3). EARL report displays, in XML format, the accessibility test results according to the WCAG 2.1 guidelines. In the second phase of this study, we used the TAW web accessibility tool to probe the extent to which each of the 10 websites meets the three (A, AA, and AAA) WCAG 2.0 conformance levels. These accessibility conformance tests were conducted during the periods August, September, and October 2019. Therefore, our accessibility results might change since the last time we carried our testing. All accessibility checks were performed using Mozilla Firefox 69.0.2 (x64 en-US) running Microsoft Windows 8.1 operating system. We limited the accessibility evaluation to the homepage of each tested e-Government website to keep the scope of this study manageable.

This is a generally accepted approach that yields acceptable results. Moreover, it is reasonable to presume that accessibility issues emerging from the homepage assessment are likely to propagate to other web pages. For example, Vigo et al (2009) demonstrated that homepages have a more similar error profile than

any other web page on a given website. Further, the homepage plays the role of the index to other hyperlinked documents within the website and is the façade that shapes the end user's first impression upon visiting the website.

### **Websites Evaluated**

In this study, ten websites were evaluated using an automated testing tool, according to the checkpoints provided by WCAG 2.0. The following are the websites with their uniform resource locator (URL).

1. Study Portal - <https://study.com>
2. Npower - <https://www.npower.gov.ng/>
3. University of Maiduguri - [www.unimaid.edu.ng](http://www.unimaid.edu.ng)
4. Institute of Education Sciences - <https://eric.ed.gov/>
5. JUMIA - <https://www.jumia.com.ng/>
6. Petroleum Technology Development Fund Scholarship - <https://scholarship.ptdf.gov.ng/>
7. PDF Drive - <https://www.pdfdrive.com/>
8. Coursera - <https://www.coursera.org/>
9. National Open University of Nigeria Massive Open Online Course <https://www.nounmooc.org/>
10. Federal Ministry of Education - [www.education.gov.ng](http://www.education.gov.ng)

### **RESULTS AND DISCUSSION**

Table 2 presents the summarised results from the study portal. This website is designed purposely for studies with over 26,500 video lessons and other resources (study.com, 2019). Which as the site states, one is guaranteed to find whatever he/she want to study for all discipline; Science, Mathematics, English, social science, history, psychology, etc. According to our findings, the website has perceivable, operable, understandable, and robust problems; these could not allow relative accessibility for all people with or without challenges.

The results for the Npower website was displayed in table 3. This website is designed to pilot a social investment program organized and funded by the Federal Government of Nigeria; to reduce the number of its teaming jobless youths, by providing them with skills that would make them productive. Studies revealed that the website has not fully complied with the general principles as shown in the table above.

The University is established in 1975 and has over 20,000 undergraduate students



(unimaid.gov.ng, 2019). The website has problems relating to all the principles except for understandable which have zero problems and warnings. The result is presented in table 4.

For the Institute of Education Sciences, the result is presented in table 5. It is an academic website that is used to search educational resources like a journal, conference proceedings, papers, etc. our finding reveals that it has no operable problem but has problems with the remaining principles.

Jumia is an online shopping site that sells all types of products. Customers search and order whatever product they want, it makes things available at the customer's fingers. Accessibility test shows that the site is not free from the problems of perceivable, operable, understandable, and robust. See table 6 for the outcome of the evaluation

Table 7 shows a result for a scholarship portal used to advertise and manage scholars and available scholarships so that interested and qualified candidates could apply and get the opportunity to be selected for various degrees; Bachelor, Master, and PhD for both local and overseas institutions. Findings revealed that the website has conformed to all the guidelines principles except the operable principles.

pdfdrive.com is a search engine for PDF files. As of today, it boasts 88,893,132 e-books for downloads for free. No download limits are placed. This awesome opportunity needs to be beneficial to all categories of people (able and disable). But

our study shows that the website has problems and warning with all the principles. See table 8 for the results of the assessment.

Coursera is an education platform that partners with top universities and organizations worldwide, to offer courses online for anyone to take, for free. As reported by TAW the website has seventy-one problems of perceivable, understandable, and robust as shown in table 9 (coursera.org, 2019).

National Open University of Nigeria Massive Online Course is also an academic website. It operates purely online, no physical contact between staff and students is required. The programs aimed to reduce if not eradicate illiteracy of the populace by providing free courses that are relevant to the need of society, for example, the Media and Information Literacy course. This kind of website is important as it educates/informs people. After testing the website using AA technologies Analysis Level, we found that it successfully passed all the checkpoints except a single perceivable problem. The result is presented in table 10.

Table 11 shows result obtained from the website of the ministry that controls all the activities of education in the country. Scholarships and other related matters are found on this website. As a result, it should be designed in such a way that all persons could access it without difficulties. Research shows that the website has not passed any of the four principles.

**Table 2:** Study portal

S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	145	14	28	823
2	Warnings	160	106	66	77
3	Not reviewed	4	8	4	0

**Table 3:** Npower

S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	22	5	0	4
2	Warnings	32	9	18	247
3	Not reviewed	4	8	4	0

**Table 4:** University of Maiduguri

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	26	8	0	48
2	Warnings	154	65	0	67
3	Not reviewed	4	6	5	1

**Table 5:** Institute of education sciences

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
--------	----------------	-------------	----------	----------------	--------





1	Problems	21	0	11	10
2	Warnings	7	6	12	1
3	Not reviewed	4	8	5	0

**Table 6:** Jumia

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	29	32	3	2
2	Warnings	73	111	12	0
3	Not reviewed	4	8	4	0

**Table 7:** Petroleum Technology Development Fund Scholarship

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	0	4	0	0
2	Warnings	13	7	0	0
3	Not reviewed	4	8	5	1

**Table 8:** PDF Drive

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	59	14	5	36
2	Warnings	120	49	24	0
3	Not reviewed	4	6	5	0

**Table 9:** Coursera

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	3	0	2	67
2	Warnings	45	25	6	23
3	Not reviewed	4	9	4	0

**Table 10:** National Open University of Nigeria Massive Online Course

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	1	0	0	0
2	Warnings	4	4	0	0
3	Not reviewed	4	8	5	1

**Table 11:** Federal Ministry of Education

A. S/N	Summary Report	Perceivable	Operable	Understandable	Robust
1	Problems	48	12	6	42
2	Warnings	187	64	18	871
3	Not reviewed	3	6	5	0

## CONCLUSION

This study has aimed to evaluate the degree of accessibility to which the randomly selected websites meet the WCAG 2.0 regulations. Various automatic tools are available but TAW was used to this end. Based on the understanding of the TAW Summary Reports above, none of the websites has the best accessibility that hundred per cent conforms to the guidelines. Only two per cent of the evaluated websites have no basic problem of Non-text Content; which is to provide

users with a text alternative that serves the equivalent purpose of non-text content. This has shown that many people especially the disabled cannot comfortably use the web; even the basic things like filling forms for admissions, job vacancies, and scholarships, buying and selling, etc. No one must be deliberately denied access to the web, therefore web developers and organizations should make sure that their website conforms to acceptable principles and guidelines so that everybody can use the web comfortably.



The study also discovered federal government agencies whose mandate among which is to provide human capital development suffers a lack of WCAG conformity in its website. This poses a great concern for discrimination towards people with accessibility difficulties. Similarly, the Federal education ministry and public universities' websites were also part of the study, non-conformity was discovered. Website accessibility has become a major source of concern to both the government and private sector globally. Government shall put in place policies that will make everybody have an equal chance of accessing resources online like e-learning platforms and public enlightenment campaigns.

#### REFERENCES

- A. Bai, V. Stray, and H. Mork, "What Methods Software Teams Prefer When Testing Web Accessibility," *Advances in Human-Computer Interaction Volume 2019*, Article ID 3271475, 14 pages, Hindawi, 2019.
- Acosta-Vargas, P., Lujan-Mora, S., & Salvador-Ullauri, L. (2017). "Quality evaluation of government websites". 2017 Fourth International Conference on e-Democracy & e-Government (ICEDEG). doi:10.1109/icedeg.2017.7962507
- Basel Al Mourad and Faouzi Kamoun (2013), "Accessibility Evaluation of Dubai e-Government Websites: Findings and Implications" *Journal of E-Government Studies and Best Practices*, Vol. 2013 (2013), Article ID 978647, DOI: 10.5171/2013. 978647.
- Berners-Lee T, Fischetti M (2000) *Weaving the web: the original design and ultimate destiny of the World Wide Web by its inventor*, 1st edition. Harper Business, New York
- Ardito, C., Buono, P., Caivano, D., Costabile, M. F., and Lanzilotti, R. (2014) "Investigating and promoting UX practice in industry: an experimental study," *International Journal of Human-Computer Studies*, vol. 72, no. 6, pp. 542–551, 2014.
- Carvajal, C. M., Piqueras R. F. and Mérida, J. F. C. (2018), "Evaluation of Web Accessibility of Higher Education Institutions in Chile" *Canadian Center of Science and Education*, doi:10.5539/ies.v11n12p140
- URL:  
<https://doi.org/10.5539/ies.v11n12p140>
- Connor, J. O. (2012) *Pro HTML5 accessibility*, 1st edn. A press, New York  
[https://en.wikipedia.org/wiki/Disability\\_in\\_Nigeria](https://en.wikipedia.org/wiki/Disability_in_Nigeria) - Retrieved 5th Oct, 2019  
<https://www.worldbank.org/en/topic/disability> - Accessed 5th Oct 02, 2019
- Karaim, N. A., and Inal, Y. I. (2017), "Usability and accessibility evaluation of Libyan government Websites" *Springer-Verlag GmbH Germany 2017 Univ Access Inf Soc* DOI 10.1007/s10209-017-0575-3
- Naftali M, Watanabe, W, Sloan, D (2010) *W4A 2010: a web accessibility conference report from the GoogleW4A student award winners*. *SIGWEB News*1:1–1:5. <https://doi.org/10.1145/18362911836292>
- O'Reilly, T. (2005) *what is web 2.0*. <http://oreilly.com/web2/archive/what-is-web-20.html>
- Petrie H, Savva A, Power, C. (2015) "Towards a unified definition of web accessibility". In: *Proceedings of the 12th web for all-conference, W4A '15*. ACM, New York, pp 35:1–35:13. <http://dl.acm.org/citation.cfm?id=2746653>
- Bias, R. G. and C.-M. Karat, (2005) "Justifying cost-justifying usability," in *Cost-Justifying Usability*, pp. 1–16, Elsevier, 2nd edition, 2005.
- R. P. de M. Fortes, H. L. Antonelli and W. M. Watanabe (2019) "Dynamic Web Content" *Springer-Verlag London Ltd.*, part of *Springer Nature 2019 Y. Yesilada and S. Harper (eds.), Web Accessibility*, Human-Computer Interaction Series, [https://doi.org/10.1007/978-1-4471-7440-0\\_21](https://doi.org/10.1007/978-1-4471-7440-0_21)
- Adepoju, S. A. and Shehu, I. S. (2016), "Accessibility Evaluation and Performance Analysis of e-Government Websites in Nigeria", *Journal of Advances in Information Technology Vol. 7, No. 1, February 2016*
- Cao, S. and Loiacono, E. (2019), "The State of the Awareness of Web Accessibility Guidelines of Student Website and App Developers". *Springer Nature Switzerland AG 2019. G. Meiselwitz (Ed.): HCII 2019, LNCS 11578*, pp. 32–



42, 2019. [https://doi.org/10.1007/978-3-030-21902-4\\_3](https://doi.org/10.1007/978-3-030-21902-4_3)

Halbach, T. and Fuglerud, K. S. (2019) "On assessing the costs and benefits of universal design of ICT," *Studies in Health Technology and Informatics*, vol. 229, pp. 662–672, 2016.

W3C: Accessibility (2019).

<https://www.w3.org/standards/webdesign/accessibility> Accessed 5th Oct, 2019

Web Content Accessibility Guidelines (WCAG) 2.0, W3C Recommendation 11 December 2008

<http://www.w3.org/TR/2008/RECWCAG20-20081211/>

Ramiro G, A, T. Rocha, J. Martins, F. Branco, M. Au-Yong- Oliveira (2017) "Evaluation of e-commerce websites accessibility and usability: an e-commerce platform analysis with the inclusion of blind users", Springer-Verlag GmbH Germany 2017. Univ Access Univ Access Inf Soc DOI 10.1007/s10209-017-0557-5