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ANALYSIS OF WEB ACCESSIBILITY OF UKRAINIAN HIGHER EDUCATION INSTITUTIONS' WEBSITES

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Abstract. In today's digital world, website content accessibility for all users, including people with disabilities, is crucial. This paper examines the accessibility of web content on the websites of Ukrainian higher education institutions to assess their compliance with modern standards and requirements. The goal is to identify problematic aspects and develop strategies for improving the accessibility of educational web resources. The study covered data from the main pages of 372 higher education institution websites, whose addresses were obtained from the Unified State Electronic Database on Education ("USEDE"). The built-in accessibility enhancement tools used on these pages were analyzed. The paper also summarizes global experience in regulating web accessibility requirements. The analyzed regulatory documents include Web Content Accessibility Guidelines version 2.1 in their rules. Automated analysis tools WAVE and Axe were used to assess website compliance with the Guidelines. Results showed that the most common problems were insufficient highlighting of hyperlinks (characteristic of 84.8% of sites, Success criteria (SC) 2.4.4, 4.1.2), insufficient element contrast (84.6%, SC 1.4.3), lack of alternative text for images (42.9%; SC 1.1.1), and non-compliance with markup and semantics requirements. The conclusions present an analysis of the problems identified during the study, along with the authors' recommendations for addressing them. The analysis results were systematized and published on a specially created web resource. The authors plan to conduct similar studies on an ongoing basis. It is also necessary to pay attention to problems identified when using automatic analysis tools. The Axe tool identified 11.875 cases of element contrast issues, accounting for 24% of the total number of detected problems. However, this figure is not final, as it does not account for the full range of possible color perception violations and overlooks the contrast of elements against backgrounds with non-uniform colors.

Keywords: web accessibility, WCAG, accessible education, inclusiveness, webpage.

INTRODUCTION

The shift of a significant portion of daily activities online has become one of the defining trends of modern times. Digitalization has encompassed almost all aspects of human life, including using electronic services to obtain certificates through the Diia app, scheduling doctor appointments through the Helsi information system, submitting gas, water, and electricity meter readings, purchasing tickets, online banking, etc. These are just some examples that illustrate the depth of electronic services' integration into our lives. Parallel to this, the importance of these services' accessibility to the broadest possible range of users is increasing. World Health Organization statistics show that at least 2.2 billion people have vision impairments [1]. According to the European Union's official website, 100 million people in the EU live with various forms of disability [2], making them a significant portion of potential users of digital products and services. Ensuring the accessibility of these products and services not only complies with ethical standards of equality and inclusiveness but can also bring economic benefits to com-

panies by expanding their customer base. In Ukraine, where the number of people with special needs is increasing due to military actions, the relevance of digital accessibility is growing even more.

The author's research focuses on analyzing information services provided by higher education institutions through their web platforms, emphasizing the accessibility of these services. In the context of ensuring equal access to education, web accessibility of educational resources becomes particularly important, as inclusiveness ensures that every student, regardless of their special needs, will have comfortable learning conditions. According to the definition provided in the digital accessibility manual [3], web accessibility means designing and developing websites, web tools, and technologies in a way that makes them usable by people with disabilities. Web accessibility is a specific case of the broader concept of "digital accessibility", although sometimes both terms are used synonymously. Thus, studying barriers in accessing educational institution websites is key to identifying and overcoming obstacles to digital inclusion. This work aims to analyze the web accessibility of Ukrainian higher education institutions' websites based on data obtained from the Register of Educational Activity Entities of the Unified State Electronic Database on Education [4].

In the context of educational resources, attention to web accessibility is driven by both general humanistic factors, such as guaranteeing accessible education — equal access to information for all who desire it, promoting an inclusive environment, and purely practical considerations — enhancing reputation and expanding the circle of potential students. It's also worth considering "staying ahead of the curve". Several countries, including the USA, Great Britain, and European Union states, have already implemented legislation requiring compliance with minimum web accessibility standards for specific categories of websites. Given Ukraine's ambitions for European integration, the need to harmonize national legislation with international experience in this field is anticipated.

In parallel with progress in the field of information and communication technologies, regulatory acts supporting the inclusion of people with disabilities are emerging in the legislative field. This encompasses both framework documents, exemplified by Article 9 of the United Nations Convention on the Rights of Persons with Disabilities [5], Article 26 of the EU Charter of Fundamental Rights [6], and more specific legislative implementation. It's worth noting the experience of the USA – Section 508 of the Rehabilitation Act [7], the EU – Web Accessibility Directive (2016/2102) [8], Great Britain – Equality Act 2010 [9], international standard ISO/IEC 40500:2012 "Information technology – W3C Web Content Accessibility Guidelines (WCAG) 2.0" [10], Ukraine – state standard for digital accessibility National Standard of Ukraine (DSTU) EN 301 549:2022 "Information Technologies. Accessibility requirements for ICT products and services" [11], which duplicated the European standard of the same name that includes Web Content Accessibility Guidelines version 2.1, which European legislation has been using for several years. Overall, all these documents include WCAG [12] in their list of rules. Therefore, when analyzing website accessibility, we will use the WCAG standard and tools to verify compliance.

CURRENT STATE

Web accessibility testing is a method for verifying the accessibility of digital content for all users, including those with physical limitations or cognitive impair-

ments. Such testing aims to ensure content accessibility through alternative interaction methods, not limited to traditional methods such as using a mouse or touchpad. The main principles of web accessibility include [13]:

- perception: the interface and information should be presented in a way that is accessible to the user. For example, text to background on the page or in images should have a contrast ratio of at least 4.5:1, and images should include a text description (alt-text);
- operability: navigation must be accessible and controllable through the user interface. For example, the ability to navigate to any element using a keyboard;
- understandability: control elements must be understandable and standardized within the resource;
- robustness: the user interface must ensure content accessibility for all users. This can usually be achieved with syntactically and semantically correct HTML markup and compliance with other related web specifications.

Within the framework of this study, the primary attention was paid to checking websites for compliance with perception criteria, as ensuring interface accessibility for different user groups is a key requirement of web development. Creating high-contrast content, proper use of alternative text for images, and other measures allow for making websites more accessible to people with various levels of vision and those who use assistive technologies. This creates an inclusive internet space where users can access information and interact with web resources comfortably and effectively.

To evaluate accessibility, different strategies are required: automated accessibility validators, manual verification, and expert evaluation. Website or application accessibility can be automatically assessed using several online tools. These tools can complete assessments of various WCAG versions at certain compliance levels and check specific aspects of accessibility, such as color contrast or the presence of necessary element attributes. Most criteria can be checked automatically. For example, "All non-text content that is presented to the user has a text alternative that serves the equivalent purpose" (Success criterion (SC) 1.1.1). However, certain aspects require manual verification beyond automated tests, as they concern the completeness of WCAG guidelines compliance. The most common web accessibility evaluation tools include WAVE, Axe, TAW, and Web Accessibility Inspector [14].

Most accessibility testing tools perform various types of checks. For example, WAVE [15], developed by WebAIM, is a browser toolbar that allows analyzing accessibility without storing data on a server. This tool identifies the need for manual checks of ARIA (Accessible Rich Internet Applications) elements, considering descriptive and precise values, adequate use of states, roles, properties, as well as correct use of tab indices and active regions. The Axe tool [16], created by Deque Systems, is also designed to help website developers identify and resolve accessibility issues on their sites according to WCAG recommendations. TAW [17], developed by CTIC Centro Tecnologico, is an automated accessibility testing tool that meets WCAG 1.0 and 2.0 criteria. It identifies accessibility issues and provides targeted recommendations for resolving them. Accessibility Inspector [18] tests desktop application accessibility, pointing out elements with issues after entering a URL or file path. It is compatible with Windows and Mac OS X.

REVIEW OF GLOBAL EXPERIENCE IN WEB ACCESSIBILITY

The article's authors [19] analyzed web accessibility in higher education in Great Britain. Considering WCAG 2.0 requirements, they examined the accessibility of the home pages of 66 research universities included in the SCImago international ranking. Three automated web accessibility tools were used for this purpose: TAW, WAVE, and EIII Page Checker. In total, the study examined 120 research universities. It was found that the most common violations were related to the lack of text alternatives for non-text content, contrast errors, and the need to optimize web pages using modern technologies and tools. In particular, color contrast errors between text and background were detected on 74.2% of the examined university home pages.

In the work [20], the authors conducted a comparative analysis of Turkish university websites regarding accessibility, usability, performance, and readability. The URL data of websites for verification were collected from the Turkish Higher Education Council (THEC) website. The sample covered 186 universities, among which five were vocational schools and seven were inactive or offline. Thus, 179 Turkish universities were evaluated using AChecker for compliance with WCAG 2.0 criteria. The biggest problems were at conformance level A. Private university sites showed worse conformance results at AA and AAA levels than public universities. Of 110 public university sites, only 10 complied with all three conformance levels. Only four of 69 private university sites met levels A, AA, and AAA. The most common problem on the sites was the lack of appropriate alternative text: this error was found on 69% of public university sites and 55% of private university sites.

Several studies in Ukraine have examined website accessibility using various methods and tools. For instance, in the work [21], documentary analysis and webpage verification methods using the WAVE tool were employed. The authors investigated library web content accessibility and established that most web pages do not comply with WCAG 2.0 and WCAG 2.1 standards. It was found that no large-scale study of library content accessibility had been conducted in Ukraine. A review of 22 regional universal scientific library sites showed that none meets WCAG 2.0 requirements, and the lack of attention to optimizing domestic library web content has effectively resulted in information inaccessibility. Additionally, 177 national library sites were checked, revealing that most use tools to engage people with special needs.

The article [22] presents the results of a study on the accessibility of Ukrainian higher education institutions' websites according to WCAG 2.1 guidelines, using the WAVE tool to identify and systematize accessibility issues. The study analyzed 299 home pages of higher education institution sites. The author proposes dividing all errors into six types, considering the criticality of the problem as a coefficient of a generalized metric for ranking resources. The metric is based on the ratio of problematic elements to the total number of elements in the category. However, more detailed information is not provided. The study emphasizes that the level of compliance of the studied sites with accessibility standards, even at the basic level, is low.

DATA COLLECTION FOR ANALYSIS

This work aims to analyze and evaluate the accessibility level of Ukrainian higher education institutions' websites to determine their compliance with modern stan-

dards and web accessibility requirements. The main tasks include identifying factors affecting web resource accessibility for different target audiences, including people with disabilities, and analyzing the implementation of adaptive design and other technologies that facilitate website access.

The list of higher education institutions was exported from the info.edbo.gov.ua website [4]. As of January 24, 2024, the list contained 571 entries, from which 134 entries of institutions that did not have website addresses specified or were categorized as revoked were removed. The address list was verified at the next stage using the regular expression `^((http|https)://)?[A-z0-9./]+$` revealed eight entries with errors such as typos, substituting Latin letters with Cyrillic ones, and others. The identified errors were corrected. After this, a crafted script checked the site availability via HTTP/HTTPS protocols with and without the www prefix. Preference was given to the version that responded with HTTP code 200 "OK". The new address was saved for sites that responded with codes 301/302/308 (temporary and permanent redirects). Such processing is necessary since not all sites in the registry have a specified protocol, and some sites are inaccessible via the protocol/prefix specified in the database or their combination. Inaccessible sites (domain name not found — 16 cases, timeout exceeded — 3 cases) or duplicated were filtered out. In 8 cases, sites were specified with HTTPS protocol and "www" prefix, but SSL certificates for these domain names were not created; these errors were corrected. After processing, 385 addresses remained on the list. However, even after processing, the data quality remains insufficient because some sites displayed server configuration error pages, were empty, showed hosting pages, or informed about domain registration expiration. Content analysis also revealed that some sites listed in the Registry function as e-shops and online casinos.

For sites that were accessible during the period from February 1, 2024, to February 2, 2024, a full-page screenshot was automatically taken in Firefox browser, the page's HTML code was saved for further analysis, and a list of text blocks was preserved, extended with coordinates on the page and HTML attributes. The Firefox browser was chosen due to its capability to take screenshots of the entire page. For all sites, the window width was 1349 pixels.

CHECKING FOR TOOLS FOR PEOPLE WITH VISUAL IMPAIRMENTS

Through visual analysis of website screenshots, those that contained easily identifiable adaptation tools for people with visual impairments in the visible part of the full-screen browser mode were selected. Among those analyzed, only 25 sites had such tools. For example, Fig. 1 shows 200×200 pixel page fragments at 100% scale containing special adaptation tools.

Among the examined tools for implementing webpage adaptation functionality, four cases revealed the use of the POJO plugin [23], three used VBI technology [24], and specialized extensions for WordPress, Joomla, and Drupal. In four cases, the sources and authorship of the script could not be established. In most cases (20 from 25) the tool allows changing font size and switching the page to black and white or high contrast mode; in 4 cases — only font size can be changed, and in one case (West Ukrainian National University) — the page image can only be converted to grayscale.

a *b* *c* *d* *e* *f*

Fig. 1. Typical designations of adaptation tools on the example of sites of the Open International University of Human Development "Ukraine" (*a*); National University of Civil Defense of Ukraine (*b*); West Donbas Institute of Interregional Academy of Personnel Management (*c*); Dnipropetrovsk State University of Internal Affairs (*d*); Mariupol State University (*e*); Kherson State University (*f*)

During the analysis, cases were also recorded where plugin use made the site unreadable due to text block overlapping (Ivan Franko National University of Lviv), an inactive button labeled "ДЛЯ ЛЮДЕЙ З ПОРУШЕННЯМ ЗОРУ"("FOR PEOPLE WITH VISUAL IMPAIRMENTS", Ivano-Frankivsk National Medical University), plugin configuration error (text "[bvi text = "Button

visually impaired"]" at Zhytomyr Institute of Economics and Humanities — a separate structural unit of the Open International University of Human Development "Ukraine").

We positively evaluate cases of application or inclusion in the technical requirements for university website development of specialized tools, although their implementation was not correct in all cases. The capabilities provided by such extensions, such as font enlargement and contrast schemes, can be implemented using standard tools or browser extensions, allowing people to adapt them to their own needs. Using plugins is appropriate when access to the site repeatedly occurs from unprepared devices, such as computers in classrooms or public places. This scenario is more characteristic of the university's internal resources, such as distance learning systems, electronic cabinets, schedules, etc., which are not objects of this study. Considering the above, adapting the entire site to WCAG recommendations is more appropriate than applying separate extensions. Such verification was performed at the next stage.

DISCUSSION AND FURTHER RESEARCH DIRECTIONS

In today's digital world, websites must be accessible to all users, including people with disabilities. To assess the state of web accessibility of Ukrainian higher education institutions' main pages, WAVE and Axe were used as automated tools for checking WCAG compliance.

WAVE Web Accessibility Evaluation Tool

For web accessibility analysis, 377 home pages of Ukrainian higher education institutions were selected. Each page underwent verification using WAVE, and the obtained results were recorded in a table containing information about the educational institution's name, verification status, number of WCAG violations, number of contrast errors, and number of ARIA elements on the page. This analysis method provided a high degree of automation and objectivity in determining the web accessibility level of university pages, providing objective data for further scientific study and development of web accessibility improvement strategies.

When analyzing the results, we would like to draw special attention to three indicators: the total number of violations, the most common violation (insufficient element contrast), and the use of ARIA elements. The number of WCAG violations indicates the level of failure of basic web accessibility principles. The study found that the following higher education institutions' websites had the most WCAG failures: International European University — 322 violations, Sumy Applied College of Construction and Architecture — 286, Odesa National Economic University — 277. The number of contrast failures helps determine how convenient it is for people with various visual impairments to use the website. The following educational institutions had the most contrast failures: Chortkiv Educational and Scientific Institute of Entrepreneurship and Business WUNU — 212 violations, National Forestry University of Ukraine — 197, Mykolaiv National Agrarian University — 190. Assessment of the number of ARIA elements shows how effectively technologies are used to facilitate website perception for users

with disabilities. The following websites had the most ARIA elements: Bila Tserkva Institute of Continuous Professional Education — 925, Lviv State University of Physical Culture named after Ivan Boberskyi — 864, Vasyl Stus Donetsk National University — 835.

Generalized data on the number of violations found on websites using WAVE are shown in Fig. 2. The graph is limited to 130 failures because larger values are isolated cases. The absolute number of failures in the indicator itself is not very informative because it does not consider their criticality and the total number of elements on the page. Moreover, the absolute number may be inaccurate since the tool can analyze specific categories of problems and may include false positive and false negative results in the report. However, any value greater than 0 indicates the presence of problematic elements on the site that need to be fixed. Many problems may suggest that web accessibility principles were not considered during site design. The distinction between "minor" and "significant" numbers of errors is subjective and depends on the nature of the errors and the site's content.

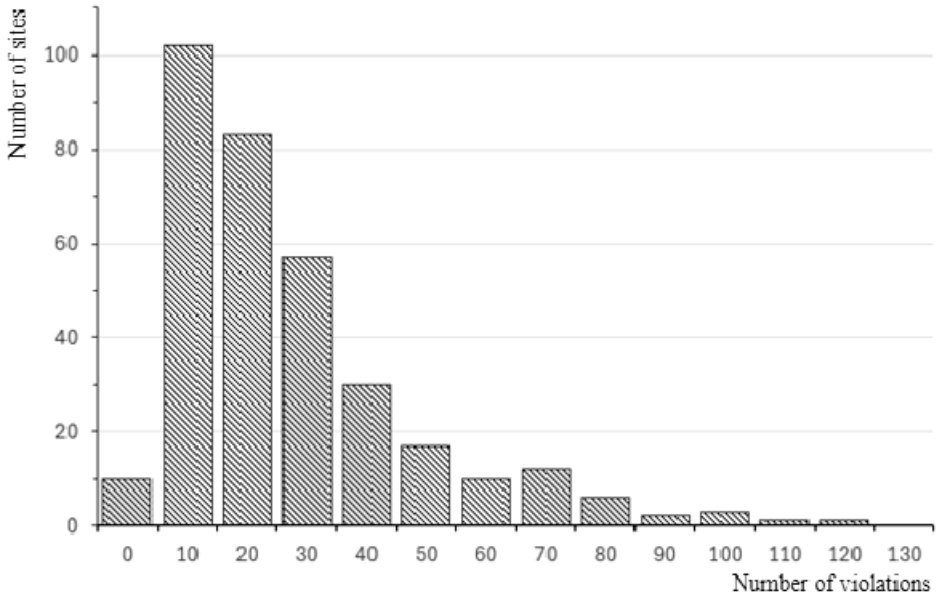

Fig. 2. Distribution of sites by number of accessibility errors (according to WAVE data)

Axe Web Accessibility Evaluation Tool

Using Axe allows automatic analysis of 15 out of 32 WCAG 2.1 criteria at compatibility level A and 4 out of 24 at level AA, reducing the response for each criterion to the categories "Passed," "Violation," and "Cannot be Applied" (for example, if the site does not contain elements of a specific category). The list of errors and remarks is generated as a separate report. Generalized statistics on typical problems and their prevalence on the studied sites are shown in Table, Fig. 3. The relative value (%) is the percentage of errors in the category based on the total number of errors or sites from the total number of sites in study. The analysis also considered rules classified as "Best Practice".

Statistics of typical web accessibility problems on HEI website pages based on Axe reports

Type of Violation	Number of Violations		Prevalence (number of sites)		WCAG Criterion
Links must be visually distinguished from surrounding text through styling or contrast.	23977	48.81%	319	84.84%	2.4.4, 4.1.2
Elements must meet minimum contrast ratio requirements	11875	24.17%	318	84.57%	1.4.3
Images must provide alternative text	7865	16.01%	159	42.29%	1.1.1
Buttons must have descriptive text	1295	2.64%	78	20.74%	4.1.2
Frames must have descriptive titles	528	1.07%	82	21.81%	4.1.2
Form elements must have associated labels	520	1.06%	39	10.37%	4.1.2
Links must be distinguishable by means other than color	502	1.02%	92	24.47%	1.4.1
Elements must only use valid ARIA attributes	390	0.79%	76	20.21%	4.1.2
Hidden ARIA elements must not be focusable nor contain focusable elements	311	0.63%	31	8.24%	4.1.2
List items ( ) must be contained within or parent elements	224	0.46%	24	6.38%	1.3.1

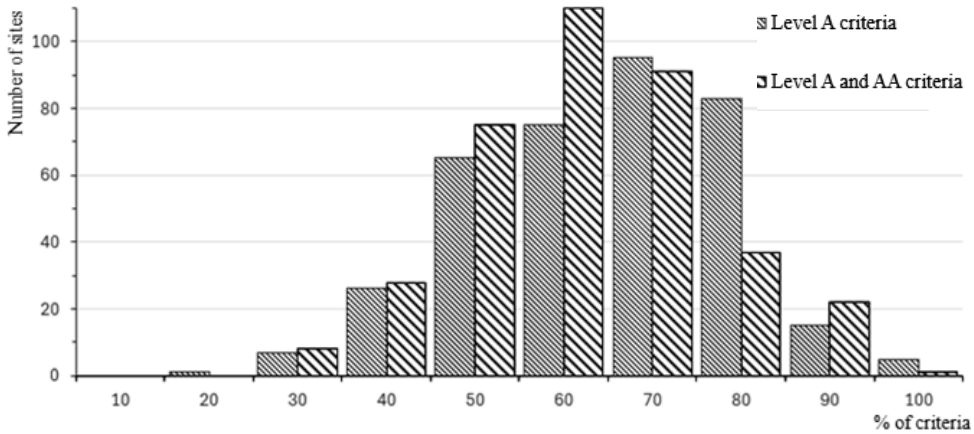

Fig. 3. Distribution of sites by percentage of WCAG criteria compliance, Axe analysis

Based on the results of the analysis, further research directions were identified.

1. Standard promotion and raising awareness about web accessibility criteria are essential. The Web Accessibility HUB website [25] created by us already contains the results presented in the article and will be updated with future analytics.

2. Improvement of automatic website verification tools. Analysis of reports revealed the following problems:

- Contrast issues rank second in prevalence (24.17% of all detected problems found on 84.5% of sites). Existing tools have deficiencies in determining the contrast ratio for text that is part of an image or placed on a non-uniform background. Also, automated tools do not investigate the relationship between color perception and object contrast.
- Reports obtained by automated verification tools contained Type I and Type II errors, mainly when checking the semantics of ARIA labels and role attribute settings [26]. Based on the collected information, we created a dataset on

Kaggle [27], which will be used to develop tools based on artificial intelligence and machine vision. This will improve the quality of automatic detection of such problems.

3. Development of synthetic pages to identify deficiencies in automatic failures detection tools. As part of this research, specific test pages and additional rules for axe-core have been developed. These findings will be published in the paper "Detection and Prevention of Accessibility Cloaking Attacks", which is currently being prepared for publication.

CONCLUSION

Effective implementation of web resource accessibility in higher education institutions requires a comprehensive approach in the context of accessible education, which includes technical aspects, legislative support, as well as educational activities. Along with improving the technical and legislative aspects of web accessibility, it is necessary to focus on increasing society's awareness of this issue. Spreading information about the importance of web accessibility and its significance for different user groups can draw more attention to the problem and strengthen support for necessary measures.

The study of web accessibility of Ukrainian higher education institutions' websites revealed some significant problems concerning non-compliance with basic WCAG standards and criteria. Analysis using WAVE and Axe tools showed that the most common violations are contrast problems, lack of alternative texts for images, and incorrect use of ARIA labels. Such identified violations indicate the need to improve web resources to adapt them for users with various visual impairments and ensure general information accessibility.

The analysis results were systematized and published on the authors' specially created web resource.

REFERENCES

1. J.D. Steinmetz et al., "Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: an analysis for the Global Burden of Disease Study," *Lancet Glob. Health*, vol. 9, no. 2, pp. e144-e160, Feb. 2021. doi: 10.1016/S2214-109X(20)30489-7
2. "Web Accessibility," *European Commission. Shaping Europe's digital future*. Accessed on: Jan. 7, 2025. [Online]. Available: https://digital-strategy.ec.europa.eu/en/policies/web-accessibility
3. D. Popov, "Brief Digital Accessibility Manual," *Diia. Digital Education*. Kyiv, 2023. [Online]. Available: https://www.undp.org/uk/ukraine/publications/brief-guide-on-digital-accessibility
4. *Higher Education Institutions | Register of Educational Activity Subjects*. [Online]. Available: https://registry.edbo.gov.ua/
5. "Convention on the Rights of Persons with Disabilities - Manual for Human Rights Education with Young people," *Council of Europe*. [Online]. Available: https://www.coe.int/en/web/compass/convention-on-the-rights-of-persons-with-disabilities
6. K. Chupina, *Youth and Disabilities EU and CoE policy framework*. [Online]. Available: https://pjp-eu.coe.int/documents/42128013/47261683/Youth_and_Disabilities_CoE-EC_policy_framework_KC_final.pdf/1ae78341-b755-4b73-9c0a-eda22cc7f08f
7. "Section 508 of the Rehabilitation Act of 1973*," U.S. Congress*. [Online]. Available: https://www.section508.gov/manage/laws-and-policies/

8. "Directive (EU) 2016/2102 on the accessibility of the websites and mobile applications of public sector bodies," *The European Parliament and the Council of the European Union*, Oct. 26, 2016. [Online]. Available: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L2102
9. "Equality Act 2010," *legislation.gov.uk.* [Online]. Available: https://www.legislation.gov.uk/ukpga/2010/15/contents
10. "Information technology — W3C Web Content Accessibility Guidelines (WCAG) 2.0." *ISO/IEC 40500:2012*. [Online]. Available: https://www.iso.org/standard/ 58625.html
11. "Ukrainian developers will be able to create more online resources accessible for people with visual or hearing impairments. International WCAG 2.1 guidelines translated into Ukrainian for the first time," *Ministry of Digital Transformation of Ukraine*. [Online]. Available: https://thedigital.gov.ua/news/ukrainski-rozrobniki-zmozhut-stvoryuvati-bilshe-onlayn-resursiv-dostupnikh-dlya-lyudey-z-porushennyam-zoru-chi-slukhu
12. "Web Content Accessibility Guidelines (WCAG) 2.1." *W3C*. [Online]. Available: https://www.w3.org/TR/WCAG21/
13. "Accessibility Principles," *State Websites Design System*. [Online]. Available: https://design.gov.ua/ua/principy-dostupnosti
14. "11 Best Website Accessibility Testing Tools for 2022," *UI-licious*. [Online]. Available: https://uilicious.com/blog/best-website-accessibility-testing-tools/
15. "Web Accessibility Evaluation Tools – WAVE," *WebAIM* [Online]. Available: https://wave.webaim.org/
16. "axe: Accessibility Testing Tools and Software," *Deque Systems*. [Online]. Available: https://www.deque.com/axe/
17. "Web accessibility and W3C standardization services," *TAW*. [Online]. Available: https://www.tawdis.net/
18. "Accessibility Inspector," *Mozilla Firefox Source Docs documentation*. [Online]. Available: https://firefox-source-docs.mozilla.org/devtools-user/accessibility_inspector/
19. S. Alim, "Web accessibility of the top research-intensive universities in the UK," *SAGE Open*, vol. 11, no. 4, pp. 1–9, Oct. 2021. doi: 10.1177/21582440211056614
20. Y. Akgül, "Accessibility, usability, quality performance, and readability evaluation of university websites of Turkey: A comparative study of state and private universities," *Universal Access Inf. Soc.*, Apr. 2020. doi: 10.1007/s10209-020-00715-w
21. O.Y. Marina, S.O. Marin, "Versions of WCAG and accessibility of library web-content," *Visnyk of Kharkiv State Academy of Culture*, no. 56, Dec. 2019. doi: 10.31516/2410-5333.056.08
22. R.S. Savitskyi, "Accessibility of web portals of educational institutions of Ukraine," *Tech. Engineering*, no. 1(91), pp. 172–177, Jul. 2023. http://doi:10.26642/ten-2023-1(91)-172-177
23. "One click accessibility," *Pojo.me*. Accessed on: Jan. 7, 2025. [Online]. Available: https://pojo.me/plugins/accessibility
24. "Veks/buttonButton visually impaired," *GitHub*. Accessed on: Jan. 7, 2025. [Online]. Available: https://github.com/veks/button-visually-impaired-javascript
25. B. Kuzikov, *Web Accessibility HUB*. Accessed: Jan. 7, 2025. [Online]. Available: https://web-accessibility.sumdu.edu.ua
26. P. Tytov, B. Kuzikov, "Formation of the training sample of the information system for assessing the compliance of sites with web accessibility requirements," in *Proc. Informatics, Mathematics, Automation (IMA-2024)*, *Sumy, Ukraine, Apr. 26, 2024*, pp. 172–173.
27. P. Tytov, "Aria elements," *Kaggle*. [Online]. Available: https://www.kaggle.com/datasets/tytovpavel/aria-elements

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АНАЛІЗ ВЕБДОСТУПНОСТІ САЙТІВ УКРАЇНСЬКИХ ЗАКЛАДІВ ВИЩОЇ ОСВІТИ / Б.О. Кузіков, П.О. Титов, О.А. Шовкопляс

Анотація. У сучасному цифровому світі доступність контенту веб-сайтів для всіх користувачів, у тому числі людей з обмеженими можливостями, є надзвичайно важливою. У роботі досліджується доступність вебконтенту на сайтах закладів вищої освіти України з метою оцінки їх відповідності сучасним стандартам та вимогам. Кінцевою метою є виявлення проблемних аспектів та розроблення стратегій для покращення доступності освітніх вебресурсів. Дослідження охопило дані щодо головних сторінок 372 сайтів закладів вищої освіти, адреси яких отримано із Єдиної державної електронної бази з питань освіти. Проаналізовано вбудовані засоби підвищення доступності, використані на цих сторінках. Узагальнено світовий досвід регулювання вимог до вебдоступності. Проаналізовано нормативні документи, які включають у перелік своїх правил Настанови з доступності вебвмісту версії 2.1. Для оцінювання відповідності вебсайтів Настановам використано автоматизовані інструменти аналізу WAVE та Axe. Результати показали, що найбільш поширеними проблемами були: недостатнє виділення гіперпосилань (характерно для 84,8% сайтів, критерій 2.4.4, 4.1.2 Настанов), недостатній контраст елементів (84,6%, критерій 1.4.3 Настанов), відсутність альтернативного тексту для зображень (42,9%; критерій 1.1.1 Настанов), недотримання вимог до розмітки та семантики. Висновки містять аналіз проблем, виявлених у ході дослідження, та рекомендації авторів щодо методів їх вирішення. Результати аналізу систематизовано й опубліковано на спеціально створеному вебресурсі. Автори планують здійснювати подібні дослідження на постійній основі. Необхідно звернути увагу на проблеми, виявлені при використанні інструментів автоматичного аналізу. Інструмент Axe ідентифікував 11875 випадків проблем із контрастністю елементів, що становить 24% від загальної кількості виявлених проблем. Проте ця цифра не є остаточною, оскільки не враховується повне коло можливих порушень кольоросприняття та ігнорується контрастність елементів на фоні з нерівномірним кольором.

Ключові слова: вебдоступність, WCAG, доступна освіта, інклюзивність, вебсторінка.