DIGITAL ACCESSIBILITY NEEDS FOR PEOPLE WITH DISABILITIES IN HIGHER EDUCATION

Radka Nacheva[1] , Jose Paulo da Costa[2]

[1] *Chief Assistant Professor, PhD, Informatics Department, University of Economics - Varna, Bulgaria*

E-mail: *r.nacheva@ue-varna.bg*

[2] *Professor, PhD, European Institute for Higher Studies, Department of Information Systems Technology and Management, Portugal*

E-mail: *paulo.costa@iees.pt*

JEL: C83, C88

Received: 10-05-2024

Accepted: 25-06-2024

Published: 30-06-2024

ABSTRACT

To accomplish the UN Sustainable Development Goals and provide possibilities for lifelong learning, digital accessibility is critical for the inclusion of individuals with special needs in higher education. The World Health Organization (WHO) is attempting to integrate those with disabilities into society, as in 2023, 16% of the world's population will have some form of disability. Students with disabilities can overcome obstacles that obstruct their online learning by adhering to accessibility standards and rules, such as the Web Content Accessibility Guidelines (WCAG) established by the World Wide Web Consortium (W3C). Based on industry-leading accessibility standards, **the purpose of this pap**er is to test the accessibility of digital learning resources for higher education purposes. The testing approach is applied to resources offered to computer science students, including PDF files and web content in an e-learning system. Limitations of this paper include the usage of tools for HTML and PDF documents for compatibility with WCAG and lecture notes compatibility with PDF/UA, as well as the number of tested resources.

Keywords: *web content accessibility, digital content accessibility, accessibility standards*

Citation: *Nacheva, R., da Costa, J. P. (2024) Digital accessibility needs for people with disabilities in higher education. Journal "Човешки ресурси & Технологии = HR & Technologies", Creative Space Association, 1, pp. 88 – 101.*

INTRODUCTION

Digital accessibility is a key aspect of the inclusion of people with special needs in higher education. Providing an accessible learning environment for all students with special needs is important to meeting the UN Sustainable Development Goals. For example, Goal 4 is focused on inclusive and equitable quality education and promoting lifelong learning opportunities, whereas Target 4.b focuses on the global expansion of the number of scholarships, for enrollment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programs (UN, 2024). On the other hand, the inclusion of people with disabilities is strongly advocated in Goals 8, 9, and 10. They promote the social and economic inclusion of all, regardless of age, sex, disability, race, ethnicity, origin, religion, or economic or other status.

At the global level, the World Health Organization (WHO) also works for the integration of people with disabilities in society, according to which, by 2023, 16% of the world's population will experience some form of disability (WHO, 2023). According to WHO Policy on Disability, WHO is dedicated to evaluating learning frameworks and will utilize the diverse experiences, expertise, and cultures within the UN system, Member States, and organizations of persons with disabilities to accelerate progress on disability inclusion, building on and contributing to other organizations' work (WHO, 2021).

For the inclusion of people with special needs in education, it is necessary to work not only at the global but also at the local level. According to Todoranova and Penchev (2023), in the conditions of COVID-19, the educational systems showed that they could be re-adjusted to a new mode of work in a very short time, but at the same time, educational resources had to be tailored to the individual needs of the various participants in the educational process, including those with disabilities. With digital content on the rise, the design and delivery of digital content and tools need to be done in the school environment to enable students with visual, hearing, cognitive, and physical disabilities to participate fully in academics. activities. Digital accessibility principles are based on equal access and opportunity, covering the design and implementation of accessible digital platforms, including learning management systems, digital textbooks, multimedia content, video lectures, educational games, and other educational technologies. That's why adherence to accessibility standards and guidelines, such as the Web Content Accessibility Guidelines (WCAG) set by the World Wide Web Consortium (W3C), can remove barriers that impede the learning process for students with disabilities on the Internet. Adherence to these recommendations is also important for the construction of

accessible e-learning platforms in higher education, through which technological progress can also be developed. Prioritizing digital accessibility is essential to creating an equitable academic environment that supports the success of every student. Understanding the specific needs and challenges faced by students with disabilities and implementing effective strategies are critical.

In this regard, **this article aims** to test the accessibility of digital learning resources for higher education purposes. The testing approach is applied to resources offered to computer science students, including PDF files and web content in an e-learning system.

To fulfill the objective some objectives followed:

- to study leading standards for accessibility of digital content;
- to test the accessibility of pages of a selected e-learning system and uploaded learning resources, as well as checking for errors and warnings according to WCAG and PDF/UA.

Limitations of this paper consist of the usage of tools for analyzing HTML documents for compatibility with WCAG and lecture notes for compatibility with PDF/UA. WAVE Web Accessibility Evaluation Tool and PDF Accessibility Checker are applied. When applying other techniques and tools, a difference in the generated results is possible. On the other hand, testing was performed on web content created with the Moodle platform as well as published 60 PDF files in three learning courses on this platform.

1. LITERATURE REVIEW

To fulfill the first formulated aim, it is necessary to conduct a literature review of digital content accessibility standards. Guidelines for leading global importance are also explored in this paper. In the first place, we associate digital accessibility with web content accessibility. Internationally recognized are the Web Content Accessibility Guidelines (WCAG), developed by the W3C (Nkang, 2023; Shah, 2023; Nielsen, 2021). They are aimed at making web content accessible to all users, including those with disabilities. WCAG have 3 levels of conformance: A (basic web accessibility features), AA (common barriers for disabled users), and AAA (highest level of web accessibility), which emphasize four principles of importance: perceivable, operable, understandable, and robust content for various user agents, as well as assistive technologies (Campbell et. al., 2023). Perceivable is related to information and user interface components presentation in ways that users can perceive, such as text alternatives, captions, and assistive technologies. Operable refers to all user interface components and navigation that need to be operable, with the functionality available from a keyboard, user time,

and easy navigation. Understandable is targeted to readable, predictable, and error-free user interface components and navigation. Robust means web content is robust enough to be reliably interpreted by various user agents, including assistive technologies, and should be compatible with current and future tools. However, WCAG face challenges such as complexity, implementation costs, and subjectivity in interpretation. Despite that, their impact on users is significant, as it enhances accessibility, broadens user experience, and ensures stable web application architectures based on internationally recognized standards compliance. WCAG 2.0 is the basis of the standard ISO/IEC 40500. In practice, the ISO standard duplicates WCAG.

In addition to WCAG, W3C also develops two other standards for the accessibility of web content - Authoring Tool Accessibility Guidelines (ATAG) and Accessible Rich Internet Applications (WAI-ARIA). WAI-ARIA is a framework for web content accessibility, consisting of roles, states, and properties (Diggs et. al., 2023). These components provide semantic information about user interface elements and their interactions, allowing assistive technologies to interpret them. Roles define UI elements' types and purposes, states represent dynamic properties, and properties provide additional information about UI elements. WAI-ARIA enhances assistive technology compatibility by providing semantic information for web content interpretation and interaction (Diggs et. al., 2023). It enhances user experience for people with disabilities by providing clear feedback on UI components' behavior.

On the other side, ATAG is a set of guidelines aimed at making the authoring tool user interface accessible. It consists of two parts: Part A, which focuses on the overall accessibility of the tool, and Part B, which addresses the support provided by the tool to help authors produce accessible content (Richards et. al., 2015). The guidelines cover various aspects of accessibility, including keyboard accessibility, accommodating screen readers, and compatibility with assistive technologies. Part A also includes editing-view accessibility, which ensures that views for creating and editing content are accessible, including alternative text for images, keyboard navigation, and customization options (Richards et. al., 2015). Part B supports the production of accessible content, providing prompts, alerts, and guidance throughout the content creation process (Richards et. al., 2015). It encourages authors to adopt accessible authoring practices through training, templates, and documentation. Part B manages accessible templates and content, promoting the creation of accessible content.

Section 508 of the Rehabilitation Act in the United States is another well-known formal document for ensuring digital accessibility. It requires federal agencies and organizations receiving federal funding in the USA to provide access to electronic and information technology

for persons with disabilities (General Services Administration, 2023). Updates to Section 508 support greater compliance with the Web Content Accessibility Guidelines (WCAG) 2.0 Level AA, ensuring consistency and clarity in accessibility requirements across digital platforms and technologies (General Services Administration, 2023). According to Section 508 standards, to ensure that technology is accessible to people with disabilities, it must focus on functional performance criteria. This necessitates providing alternatives for visual and auditory information, ensuring keyboard accessibility, and avoiding aggressive visual content-inducing seizures (eg in people with epilepsy). The standard also defines the technical requirements for hardware, software, web-based applications, and telecommunications products.

Another digital accessibility standard is ISO Standard 14289, also known as PDF for Universal Access (PDF/UA). It defines the technical requirements for accessible PDFs which was approved in 2012 and offers clear technical requirements for developers, implementers, service providers, and procurers (PDF/UA Foundation, 2024). PDF/UA provides guaranteed compatibility for relevant software, hardware, and digital documents, as long as they comply with the standard. It also serves as a basis for machine checks, with 108 machine-verified success criteria defined in the Matterhorn Protocol (PDF/UA Foundation, 2024). PDF/UA documents deliver the best possible user experience for people with disabilities and mobile device users. It complements the Web Content Accessibility Guidelines (WCAG) and fully addresses the PDF format, ensuring future-proof presentation with rich semantics and machine-readability (PDF/UA Foundation, 2024). PDF/UA is now widely accepted and referenced in legislation, focusing on technical accessibility and equal access to content for all users, regardless of disability.

The most popular among web developers is undoubtedly WCAG among the three W3C guidelines. Most web content accessibility testing tools are based on WCAG. On the other hand, Section 508 is popular in the US precisely because it is regulated by law.

From the literature review, it can be concluded that the best combination for providing digital learning content is between PDF/UA and WCAG. On the one hand, the accessibility of the web content will be ensured, and on the other hand, the PDF documents with lecture notes will be given to the students.

2. METHOD

2.1. Research Material

The Moodle e-learning platform, version 4.5dev for the Windows operating system (Moodle 4.4.1+ Build: 20240719), was used as a basis for testing the research procedure. It works with XAMPP web server version 8.2.4-0, for x64 versions of Microsoft's operating system. MariaDB Server 11.4.2 is the release of the relational database. We installed the Boost Union theme (version 4.4-r1-2024) on Moodle.

A total of 60 PDF files from 3 courses designed for teaching computer science students were tested - 10 files from lectures and 10 from practical classes for each course. The files were created by the authors of this article and are used in courses in which they participate in the fields of operating systems (OS), user experience design (UXD), and web technologies (WT).

2.2.Research Design

Approaches to test and / or evaluate the accessibility of digital learning content have been proposed by various scholars and research teams, including Todoranova (2024), Pierrès, Schmitt-Koopmann and Darvishy (2024), Darvishy et al. (2023), Rajkumar et al. (2020), Acosta-Vargas et al. (2020). Based on the approaches proposed by the cited authors, in this article, we propose an approach that consists of the following stages (Fig. 1): Digital Learning Resources Retrieval; Digital Accessibility Testing; and Expert Evaluation.

Fig. 1. Stages of Research Procedure

Source: Own Elaboration

Digital Learning Resources Retrieval: At this stage, the retrieval of learning resources is done. A sample of web content and lecture notes files is formed, which form the local database of digital content that is the subject of research. Web content is usually offered to students through e-learning platforms such as Moodle, Blackboard, Google Classroom, and

similar, where all course materials are published. Usually in the form of HTML pages that can be published within the courses, books, glossaries, and other related materials, through which the learning content can be offered in an interactive way to the students. Most often Lecture notes files are in PDF, DOC/X, XLS/X, PPT/X, video lectures, and other formats according to the purposes of the courses. The form of learning content can be different and is not limited to files and HTML pages. Games, mobile apps, and more can be added to support the learning process.

Digital Accessibility Testing: this stage is related to checking the retrieved learning content for compatibility with international standards for the accessibility of digital content. In this paper, we direct the focus of the research on testing the training content for WCAG and PDF/UA compliance. These are the two main accessibility standards that are followed internationally.

Expert Evaluation: this is the last phase of the research procedure. The expert assessment is firstly associated with an analysis of the types of errors that were detected by the testing tools used at the previous stage. Based on the analysis, recommendations are made for improving the accessibility of digital educational content.

3. RESULTS AND DISCUSSION

At the *Digital Learning Resources Retrieval stage* of the research procedure, we made a local installation of the latest version of the Moodle platform as described in 2.1. Research Material. We prepared three courses to be used to deliver digital learning content in the fields of OS, UXD, and WT. The structure of the courses includes 4 sections - Requirements, Lecture notes, Practical classes, and References. In the first section, the following resources are published: Glossary, Announcements (discussion forum), and Page (an HTML page with short text with requirements for forming course evaluations).

In the Lecture notes and Practical classes sections, 10 PDF files have been added, each with a title, a short description (one sentence that appears on the course page), and tags. In the References section, 10 URLs have been added, for which a name, short description, and tags have also been defined. All PDF files are used in the classes of computer science students. The files do not have an identical structure or an identical number of pages.

In the next phase of the research procedure - *Digital Accessibility Testing*, the PDF files were tested using the PDF Accessibility Checker tool. It is an automated PDF/UA and WCAG

standards compliance validation tool (PDF/UA Foundation, 2024). Statistical methods and statistical data are usually used for the analysis of quantitative studies (Mileva, Petrov, Yankov, Vasilev, and Petrova, 2021). Descriptive statistics are often used for this purpose (Vasilev and Milkova, 2022), and therefore in this paper, we report the mean and standard deviation of the sample.

The generated errors and alerts, which are described in the tables below, are only consistent with the PDF/UA and WCAG standards. This article does not describe the standards in detail. A complete list of recommendations is described in (Campbell et. al., 2023) and (ISO, 2008).

Table 1 shows a summary of the test results of the files aimed at training in the field of operating systems. The mean of errors and alerts by file types and standards is given.

Table 1

Mean (M) and Standard Deviation (SD) for the OS Course Files

Indicator	OS Lectures	OS Practical classes
Pages	M=30.36; SD=8.87	M=23.4; SD=4.5
WCAG Errors	M=1.82; SD=1.78	M=2.18; SD= 1.47
WCAG Alerts	M=2.38; SD= 3.02	M=2.63; SD=2.83
PDF/UA Errors	M=2.62; SD=1.59	M=2.73; SD=1.95
PDF/UA Alerts	M=1; SD=1.12	M=1.25; SD=1.04

Source: Own Elaboration

The average number of pages of lecture notes is about 30, and of practical classes - 23. A greater number of errors and alerts according to the test of both the WCAG standard and the PDF/UA standard are observed in the files of practical classes. The most common errors that the PDF Accessibility Checker tool reports are related to the lack of alternative texts and bounding boxes for figures, lack of identifiers of multimedia elements, and insufficient contrast between text and background when light shades of text are used in page titles. As alerts, it was reported that the "Sect" structure element was used as a root element and inappropriate use of a "Figure" structure element.

The average test results of the PDF files used in user experience design learning are given in Table 2.

Table 2

Mean (M) and Standard Deviation (SD) for the UXD Course Files

Indicator	UXD Lectures	UXD Practical classes
Pages	M=13.3; SD=2.5	M=15.65; SD=3.95
WCAG Errors	M=2.8; SD=1.55	M=2.44; SD=1.13
WCAG Alerts	M=1; SD=0.82	M=0.86; SD=0.69
PDF/UA Errors	M=2.86; SD=1.77	M=3.29; SD=1.71
PDF/UA Alerts	M=1.17; SD=1.47	M=1.29; SD=1.6

Source: Own Elaboration

In this direction, the length of the files is smaller - on average 13 pages are lecture notes, and 15 pages of the practical classes. When testing the files for compliance with the WCAG standard, more errors and alerts are displayed for lecture notes. Tests for compliance with the PDF/UA standard show the opposite - practical class files have a higher average number of errors and alerts. Again, as with the OS files tests, the most common errors are related to missing text alternatives and missing bounding boxes on images, missing PDF/UA identifiers, and insufficient text contrast in page titles. The most common alerts for these files are related to the inappropriate use of a "Figure" structure element.

Table 3 contains the test results of the PDF files that are used for web technology-related courses.

Table 3

Mean (M) and Standard Deviation (SD) for the WT Course Files

Indicator	WT Lectures	WT Practical classes
Pages	M=17.1; SD=3.81	M=19.3; SD=3.53
WCAG Errors	M=3.11; SD=3.06	M=3.22; SD=3.03
WCAG Alerts	M=0.45; SD=0.69	M=0.82; SD=0.98
PDF/UA Errors	M=1.56; SD=2	M=1.56; SD=1.59
PDF/UA Alerts	M=0.78; SD=0.83	M=1; SD=1

Source: Own Elaboration

It is observed that more errors are found in WCAG tests compared to PDF/UA. Again, more problems for practical class files were reported. With the WT files, in addition to the above-mentioned errors for missing alternative texts and bounding boxes in the images, errors in the formatting of tabular content, fonts are not embedded, and unreadable links are also reported. The content of this group of files is more special, as it is technically oriented - it

contains programming code and examples from the field of front-end development frameworks, including HTML and CSS code, and URLs, both hierarchically and tabularly formatted.

A positive impression from the tests is that overall, the contents of all files are well structured. Important structural elements for screen readers are used, such as well-formed paragraphs and headings in different sizes. The characters are Unicode compatible. The readability of the text is overall excellent with the minor exceptions described above. Natural language (English) is used with appropriate sentence and paragraph length according to the PDF/UA compliance report. The built-in audio and video components have control elements.

Part of the Digital Accessibility Testing phase is also testing the accessibility of the web content. In this article, we use the WAVE Web Accessibility Evaluation Tool as a plug-in for the Mozilla Firefox browser (version 128.0.2, 64-bit), which displays the number of critical errors, contrast issues, and alerts according to the WCAG compliance test. It also facilitates human evaluation of web content (Institute for Disability Research, Policy & Practice, 2024).

Table 4 shows the test results of the Moodle course pages we created on localhost. The Moodle Boost Union theme is installed and activated, but no improvements have been made by the authors. Since the structure of the three courses is identically organized, the results are comparable.

Table 4

Number of Detected Issues in Moodle Course Pages

WCAG Indicator	OS Course	UXD Course	WT Course
Errors	6	6	6
Alerts	3	8	13
Contrast Issues	26	23	20

Source: Own Elaboration

The errors that WAVE reports are specifically related to missing alt texts on standard theme icons, as well as problems with the contrast between text and background - light shades of blue (code #23E4FA) are used, which can cause problems for people with visual impairments problems.

The alerts are for redundant links - adjacent links go to the same URL, as well as for redundant title text - title attribute text is the same as text or alternative text.

Overall, the subject matter and course settings we described above meet the requirements for accessibility of the learning content. The reported errors and alerts are minor and can be easily fixed by the CSS code of the Moodle theme.

In the third phase of the research procedure - *Expert Evaluation*, we can form some basic recommendations for improving the digital learning content. They are the following:

- Create descriptive titles and labels to reflect the content structure for form fields and interactive elements.
- Include alt text for images, graphs, and charts, ensuring it conveys the same information as the image.
- Add visual focus indicators for navigation elements to use keyboard shortcuts to quickly access frequently used document elements.
- Provide captions and transcripts for audio and video content, as well as stop-and-play controls.
- Apply semantic HTML in web page layout, as semantic tags are often used by assistive technologies to quickly access content via keyboard shortcuts.
- Ensure sufficient color contrast, using where necessary alternative accessible color schemes optimized for people with visual impairments.
- Compliance with WCAG and PDF/UA standards recommendations and principles for accessible digital content.
- Create clear and consistent navigation throughout the content.
- Inclusion of accessibility plugins that allow users to adjust text size, spacing and contrast settings, and alternative color schemes.
- When adding interactive learning content such as forms, tests, games, and others that are outside the e-learning platform, it is necessary to check that they are accessible. If they are not, alternatives should be provided so that students with special needs receive the same content in an appropriate form.

The specified list of recommendations can be taken as ensuring a basis for the general accessibility of digital learning content. As Todoranova (2024) points out, research should be done on the specific needs of the audience, as well as recording data describing the type of disability of the student. Next, the analysis of the disability data and specifying the accessibility requirements of the learning materials need to be done to meet the specific requirements of the audience.

CONCLUSION

Accessibility of digital learning content is one aspect of inclusive education to ensure equal access to educational resources for all students, regardless of their disability. Thus, students with special needs are allowed to fully participate in a learning environment, promoting better achievements and inclusion in higher education. Accessible content enhances the educational experience. Educational resources must comply with the basic recommendations and principles of accessibility standards, which is essential for the commitment of educational institutions to the fulfillment of the UN goals for sustainable development and, above all, to equal access to quality education. As technology advances, the need for accessible digital learning content will grow, and accessibility recommendations and standards are set to evolve more and more dynamically. By adopting best practices, using innovative tools, and seeking feedback from users with disabilities, educators can create inclusive digital learning environments, enriching the educational experience of this special group of students.

ACKNOWLEDGMENTS

This research was funded by the NPI-65/2023 project "Artificial Intelligence to Help People with Disabilities in Ensuring Digital Accessibility in the Higher Education Learning Process".

REFERENCES

1. Acosta-Vargas, P. et al. (2020). The portable document format: An analysis of PDF accessibility. in Advances in intelligent systems and computing, pp. 206–214. https://doi.org/10.1007/978-3-030-51369-6_28.
2. Campbell, A., et. al. (2023). Web Content Accessibility Guidelines (WCAG) 2.2. [online] Available at: https://www.w3.org/TR/WCAG22/ [Accessed 13 May 2024].
3. Darvishy, A. et al. (2023). The state of scientific PDF accessibility in repositories: A survey in Switzerland. Learned Publishing, 36(4), pp. 577–584. https://doi.org/10.1002/leap.1581.
4. Diggs, J., Nurthen, J., Cooper, M., MacLeod, C. (2023). Accessible Rich Internet Applications (WAI-ARIA) 1.2. [online] Available at: https://www.w3.org/TR/wai-aria-1.2/ [Accessed 13 May 2024].
5. General Services Administration. (2023). Government-wide Section 508 Assessment Criteria. [online] Available at: https://www.section508.gov/manage/section-508-assessment/ [Accessed 23 May 2024].

6. Shah, H. (2023). Advancing Web Accessibility - A Guide to Transitioning Design Systems from WCAG 2.0 to WCAG 2.1. 15th International Conference on Web services & Semantic Technology (WeST 2023). [online] Available at: https://ssrn.com/abstract=4646676 [Accessed 13 May 2024].
7. Institute for Disability Research, Policy & Practice. (2024). WAVE Web Accessibility Evaluation Tools. [online] Available at: https://wave.webaim.org/ [Accessed 13 May 2024].
8. International Organization for Standardization (2014). ISO 14289-1:2014(en) Document management applications — Electronic document file format enhancement for accessibility — Part 1: Use of ISO 32000-1 (PDF/UA-1). [online] Available at: https://www.iso.org/obp/ui/en/#iso:std:iso:14289:-1:ed-2:v1:en [Accessed 23 May 2024].
9. ISO. (2008). ISO 32000-1:2008(en) Document management — Portable document format — Part 1: PDF 1.7. [online] Available at: https://www.iso.org/obp/ui/en/#iso:std:iso:32000:-1:ed-1:v1:en [Accessed 13 May 2024].
10. Mileva, L., Petrov, P., Yankov, P., Vasilev, J., Petrova, S. (2021). Prototype model for big data predictive analysis in logistics area with Apache Kudu. Electronic Journal "Economics and Computer Science", 1, pp. 20-41.
11. Nielsen, M. (2021). Web Accessibility For People With Disabilities In Georgia: State Of Affairs And Global Best Practice Report. United Nations University. [online] Available at: https://www.undp.org/sites/g/files/zskgke326/files/migration/ge/undp_ge_dg_web-accessibility_pwds_current-situation-2021_eng.pdf [Accessed 13 May 2024].
12. Nkang, C. (2023). Accessibility & Assistive Technologies 2023CASE STUDY REPORT. [Preprint]. [online] Available at: http://dx.doi.org/10.13140/RG.2.2.24028.97923 [Accessed 13 May 2024].
13. PDF/UA Foundation. (2024). PAC 2021 - The Free PDF Accessibility Checker. [online] Available at: https://pdfua.foundation/en/pdf-accessibility-checker-pac/ [Accessed 23 May 2024].
14. Pierrès, O., Schmitt-Koopmann, F., and Darvishy, A. (2024). PDF accessibility in international academic publishers,' in *Lecture notes in computer science*, pp. 38–46. https://doi.org/10.1007/978-3-031-62846-7_5.
15. Rajkumar, A.J. et al. (2020). PDF Accessibility of Research Papers: What Tools are Needed for Assessment and Remediation?. Proceedings of the 53rd Hawaii International Conference on System Sciences, pp. 4185-4194.
16. Richards, J., Spellman, J., and Treviranus, J. (2015). Authoring Tool Accessibility Guidelines (ATAG) 2.0. [online] Available at: https://www.w3.org/TR/ATAG20/ [Accessed 13 May 2024].

17. Todoranova, L. (2024). An Approach for Development of Digitally Accessible Educational Resources. Conference Proceedings of Conference VIII National Scientific Conference with International Participation TechCo, Lovech: Technical College Lovech, pp. 139 -143.
18. Todoranova, L., Penchev, B. (2023) Higher Education – Accessible for People with Disabilities. Journal "Човешки ресурси & Технологии = HR & Technologies", Creative Space Association, 2, pp. 45-56.
19. UN. (2024). Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. [online] Available at: https://sdgs.un.org/goals/goal4#targets_and_indicators [Accessed 13 May 2024].
20. Vasilev, J., and Milkova, T. (2022). Optimisation Models for Inventory Management with Limited Number of Stock Items. Logistics, 6, ID: 54. https://doi.org/10.3390/logistics6030054.
21. WHO. (2021). WHO policy on disability. World Health Organization. [online] Available at: https://iris.who.int/bitstream/handle/10665/341079/9789240020627-eng.pdf [Accessed 13 May 2024].
22. WHO. (2023). Disability Key facts. [online] Available at: https://www.who.int/news-room/fact-sheets/detail/disability-and-health [Accessed 13 May 2024].