

Accessibility of Electronic Resources for Students with Disabilities

Bonimir Penchev - Latinka Todoranova*

Received: July 10, 2024; received in revised form: November 19, 2024;
accepted: November 20, 2024

Abstract:

Introduction: The rapid development of technologies provides more opportunities and ways to adapt the learning environment to the individual needs of students with disabilities.

Methods: The current paper aims to explore the types of educational electronic resources published on the e-learning platform of UE - Varna and to highlight the importance of adapting them to ensure accessibility for students with disabilities.

Results: Recommendations are provided regarding the type and structure of electronic resources, so that they can be fully utilized by students with disabilities.

Discussion: The provided recommendations are concerning periodically updates, reflecting changes in standards, choosing, and applying tools to evaluate and provide the accessibility of resources.

Limitations: The scope of the paper are only students with impaired vision or hearing. The researched resources are only for specific disciplines.

Conclusions: Using the PDF format for electronic resources is a good approach, but educational institutions need to develop guidelines that lecturers should follow when preparing educational resources.

Key words: accessibility, disabilities, education, electronic resources.

Introduction

Ensuring accessibility of the educational environment, as well as educational resources, is not a new initiative. This is a problem that has been taken very

* Bonimir Penchev, University of Economics - Varna, Varna, Bulgaria, b.penchev@ue-varna.bg;
<https://orcid.org/0000-0002-7316-997X>
Latinka Todoranova, University of Economics - Varna, Varna, Bulgaria, todranova@ue-varna.bg;
<https://orcid.org/0009-0000-9591-8057>

seriously by several authors over the past three years. Online learning and the transition to an electronic educational environment have catalyzed these studies. The intensification of research is also due to the global sustainable development goals of the United Nations, and specifically goal 4: Quality Education. Subgoal 4.5 concerns people with disabilities: “By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for vulnerable groups, including people with disabilities, indigenous people, and children in vulnerable situations.”¹ In order to provide greater clarity on the research in this paper, the definitions of disabilities and impairments given in the International Classification of Functioning, Disability and Health (ICFDH) of the World Health Organization (WHO) are used. According to this classification, disabilities represent problems in a given function or structure of the organism, such as a significant deviation or loss, while impairments usually refer to any condition that reduces or limits one or more functions of the organism. In most of the cases, people with disabilities/impairments face a number of difficulties in their attempts to obtain quality education. This is when the so-called special educational needs (SEN) or special needs arise.

1 Current regulatory framework

Analyzing the current regulatory framework in Bulgaria, Regulation No. 1 of January 23, 2009 concerns the education of children and pupils with special educational needs and/or chronic illnesses. The regulation does not provide a definition of the term SEN, but it states that “these are educational needs that may arise from:

1. various types of impairments - sensory, physical, intellectual (mental retardation), multiple impairments;
2. communicative disorders;
3. specific disorders of learning ability (dyslexia, dysgraphia, dyscalculia);
4. disorders from the autistic spectrum;
5. emotional and behavioral disorders.”

According to Article 3, paragraph 1 of the same regulation, children and pupils with special educational needs are educated and raised in an integrated manner in kindergartens and in schools. This is also included in the Law on Public Education (LPE): Article 18 and Article 26, paragraph 1, item 1-10 or item 12.

The Law on Preschool and School Education also provides definitions for the terms “special educational needs” and “inclusive education.” According to this law, “special educational needs of a child and a pupil are the educational needs

¹ The 2030 Agenda for Sustainable Development, https://commission.europa.eu/strategy-and-policy/sustainable-development-goals/eu-and-united-nations-common-goals-sustainable-future_en

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that may arise from sensory impairments, physical impairments, multiple impairments, intellectual difficulties, language and speech disorders, specific disorders of learning ability, disorders from the autistic spectrum, emotional and behavioral disorders.”

According to the same law, “inclusive education is a process of awareness, acceptance, and support for the individuality of each child or pupil and the diversity of needs of all children and pupils by activating and involving resources aimed at removing obstacles to learning and creating opportunities for development and participation of children and pupils in all aspects of community life.”

Higher education is not explicitly mentioned in the Law on Preschool and School Education, but the definitions given apply to it in a full degree. It is probably not mentioned because compulsory education in Bulgaria is up to the age of 16. However, regardless of the educational level at which people with disabilities are being educated, inclusive education must be provided for them. Higher education institutions must provide a supportive environment, special adaptations, necessary educational resources, and additional teaching assistance to support the learning and evaluation process of people with disabilities. In addition, specialists, who take part in this process, must be prepared to work with people with disabilities.

These are not new guidelines for work and change in Bulgarian education, but despite the multitude of projects and strategies, they have not yet found adequate reflection in our educational system. Many of the guidelines remain only on paper and are only recommendations. However, significant resources and efforts have been invested in ensuring accessibility of the physical environment in most state institutions in Bulgaria, particularly in educational ones, which allows learners to be present in classrooms. This means that this issue is largely resolved.

But currently, the educational environment is not the physical environment of educational institutions. It is actually any environment in which learning takes place. This applies to both primary and secondary education, higher education, and vocational training. The new environment provides personal freedom for each learner, who will be able to study at a convenient time and place, using the most appropriate personal learning style for them. In this context, the role of the lecturer is to influence the use of this freedom by offering different ways of transferring knowledge and learning styles. Lecturers must now be specialists in several areas: not only in the one they teach, but also in pedagogy, and in computer technology. Then the problem arises with the absence of pedagogical theories and learning models for the application of technologies in the learning process. This statement of course is not a new one. The publication of Pearson and Koppi (2006) addresses this issue. The authors state that many accessibility

advocates would argue that accessibility should be the primary consideration for the development of online resources, but in the academic setting it is usually teaching staff who are largely responsible to produce their own electronic resources. However, the academics may lack the time, expertise, and the motivation to undertake inclusive practices. The poor provision of the learning process in an electronic environment has led to several problems (Nacheva, 2022). This is even more true for the educating of people with disabilities. But since this issue is quite extensive, it is not the subject of the current paper.

The current research focuses especially on the possibilities for providing educational resources that are accessible to students with SEN. It is important to note that some of the impairments of students can be overcome thanks to the high level of technological development. With the help of modern technological solutions, people with disabilities can compensate for some of their health problems - for example, if they have difficulty with hearing, there are devices that can amplify the sound. Another approach is to add subtitles, which can be created using Automatic Speech Recognition (ASR). This in turn is a much faster and cheaper solution than using a professional human transcriber, and at the same time proves to be quite effective (Liyanagunawardena, 2020). This way, those who do not have difficulty in learning the educational material will be able to participate fully and equally in the learning process along with other learners.

The role of information and communication technologies in education is becoming increasingly serious, with the following main advantages they provide: fast feedback in the learning process; ensuring individualization of the learning process; increasing clarity in the learning process; easy access to information from various sources; modeling of the studied processes and phenomena; easy organization of collective and group work. They also provide accessibility to the learning process by creating conditions for overcoming mental and physical difficulties by considering the real possibilities of the learners. Each learner is unique, with an individual set of knowledge, motives, interests, and attitudes, and it is necessary to consider these individual characteristics when organizing educational activities. Individualization of learning means, above all, accepting differences and taking them into account when providing educational resources, setting tasks, and their implementation. Effective teaching strategies include simplifying or complicating the requirements for a specific task depending on the individual needs, abilities, and skills of individual learners and using different systems for organizing practical activities. All of this becomes easier and possible thanks to the e-learning platforms, despite the fact that the need for specific software to perform certain online activities has been highlighted as a considerable financial burden (Musikavanhu, 2024).

In Bulgaria, state higher education institutions have had an e-learning platform since 2015. Despite the pandemic caused by COVID-19 in 2020 being a challenge for the organization of the educational process in higher education and exacerbating inequalities between universities, whose funding, digital sustainability, and emergency training are weaker than their national and international competitors (Nacheva, 2022), it led to the transition to online learning, to the active use of such platforms, and to the need for the development of a large set of educational resources.

In their study Parusheva, Aleksandrova, and Hadzhikolev (2018) point out that all the 24 surveyed higher education institutions in Bulgaria use platforms for electronic and online learning, with Moodle being the dominant platform. This platform is also used at the University of Economics - Varna. It is developed and maintained by specialists from the Center for E-Learning and Distance Learning. When the pandemic was announced and educational institutions were closed, the center's specialists created the necessary electronic courses for each discipline and the lecturers of the respective disciplines developed the electronic learning resources. The universities in Bulgaria operate in a very dynamic environment. The Ministry of Education and Science (MES) changes annually the requirements that their systems must meet (Kuyumdzhiev, 2020). In addition, educational institutions also seek to meet the demands of business by changing the curriculum and teaching methods, i.e. gradually progressing towards the concept of Education 4.0. On the other hand, the pressure exerted by the globalization process on universities inevitably leads to the internationalization of education (Nacheva & Sulova, 2020). However, for this to happen, it must be borne in mind that the participation of students with disabilities in higher education requires individual and institutional capacity building, including pre-service and in-service training of lecturers in inclusive education and the pooling of human, material, financial, time, and technological resources to meet the individual needs of these students (Majoko & Dunn, 2018).

For people with disabilities, it is important to ensure accessibility and adequacy of the educational program, content, and form of the educational resources. Several authors are seeking an answer to this question. More than 10 years ago, Christensen, Keegan, and Stevns (2012) proposed an approach in which the RoboBraille Service was turned into a self-service solution for students at Stanford University, called the Stanford Converter into Braille and E-Text - or SCRIBE. In an extensive study, Hunt, Cromwell, and Creel (2024) evaluate the existing literature in library and information science journals on academic libraries and students with disabilities between 2009 and 2023. In addition to the conclusions they draw in their study regarding the possibility of access for students with disabilities to university libraries, they find that students also regularly express concerns with the accessibility of online resources.

Moreover, there are accessibility issues also connected to the software that is used to work with the provided educational resources. Nacheva (2023) argues that many companies often do not apply any methods or means of testing or evaluating the accessibility of the software products they develop. Reliance is placed solely on the subjective judgment of developers, designers, and managers who are usually not familiar with the details of software accessibility issues, especially mobile applications. To overcome this problem, many authors examine another topic - the one connected with web accessibility. Different standards have been developed and are applied for this issue. According to Bankov (2023), with the proliferation of smart devices with different screen sizes, it has become more important than ever to create websites that are optimized for all screen sizes. In addition, accessibility is increasingly becoming a crucial factor in website design, both for legal compliance and for improving the user experience.

The influence of the rapid development of technology on the learning habits of the new Z generation should also be considered. This generation is visually oriented, replaces words with images, communicates through different channels and is often described as digitally dependent. Its representatives find it easier to ask Google or ChatGPT questions than ask their own parents, relatives, or teachers. They love all gadgets and technological “toys”, do not like to read and follow instructions. People with disabilities are no exception and it is important alongside with the accessibility to also consider the type of educational recourses that will be provided to this type of learners.

2 Adaptation of the electronic educational resources for students with disabilities

For the purposes of education and in response to the modern trends of change in the interaction between lecturers and students in higher education, it is possible to construct methods for effective and accessible learning for most of the studied disciplines, considering the characteristics of the students and the educational requirements for the respective educational degree.

The study “Inclusion of Doctoral Students with Disabilities within Higher Education” (Kasprzak, 2021) emphasizes that opening up higher education to people with disabilities is an important step towards their social inclusion. Although the report points out shortcomings in existing educational approaches and solutions, these problems do not diminish the importance of efforts to adapt learning resources to the needs of learners with disabilities.

During the learning process, each student with SEN must be motivated and have a desire to learn. The education should be organized in a pleasant way so as not to be perceived as a difficult task. Learning should stimulate thinking, emotions, and imagination. Creating a safe social environment is one of the mandatory

conditions for the full course of the educational process. The education should orient the student towards learning through actions. He should participate in the process and all his perceptions and abilities should be activated. Thanks to this, the knowledge becomes more accessible to the individual consciousness of each student. As Ajani (2024) argues “through continued collaboration and innovation, educational institutions can create a supportive ecosystem for digital integration that prepares students for success in the digital age and fosters lifelong learning and growth.” To make all this possible in the education of people with disabilities, it is important to ensure accessibility of the technologies and educational resources that are used.

The concepts of people with disabilities and people with SEN are very broad. Therefore, in this paper, we limit the scope by examining only students with sensory impairments - impaired vision or hearing. Thanks to the rapid technological development and easier access to modern technologies, students with sensory impairments in most cases do not need special assistance. This is the case if they have the necessary technical means that help overcome their impairments, or on the other hand, they have the opportunity to use electronic learning resources, which can be accessed via a computer, tablet, or phone and can become accessible to them with the help of additional (specialized) software. As it was already mentioned in the previous sections of this paper, the platform used to provide online resources to students in a large portion of higher education institutions in Bulgaria is Moodle. Its advantages are presented in a large number of scientific publications. According to Amin, Sibuea, and Mustaqim (2022) Moodle is an innovative and successful online platform for improving Engineering Education students' research approach responses. Students rated Moodle positively in terms of utility, ease of use, and accessibility. The performance of research methods was improved due to a variety of circumstances. For instance, consider the method of implementation Moodle's intervention, as well as the length of time it took to implement it (one semester), ensured good outcomes, an effective set of Moodle features, and students' positive reactions to Moodle in terms of its usefulness, ease of use, and accessibility.

At the University of Economics - Varna, Moodle is also used not only during the pandemic to conduct online learning but also to provide learning resources to students in the regular learning process. Table 1 presents the main types of files published on the e-learning platform of University of Economics - Varna for the academic year 2022/2023.

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Table 1

Educational electronic resources published on the e-learning platform of the University of Economics - Varna (2022/2023) grouped by file type

<u>File type</u>	<u>Count</u>
Text Document	35.816
Image	15.725
Spreadsheet	3.425
Presentation	3.066
Archive	750
Video	61

For the purpose of a more detailed analysis of the availability of resources, in Table 2 they are presented by considering their file extension.

Table 2

Educational electronic resources published on the e-learning platform of the University of Economics - Varna (2022/2023) grouped by file extension

<u>File extension</u>	<u>Count</u>
pdf	25.298
png	13.679
doc/docx (Google Document)	8.595
xls/xlsx (Google Spreadsheet)	3.027
ppt/pptx (Google Presentation)	2.415
jpeg	2.046
doc/docx	1.923
zip/rar	750
ppt/pptx	651
xls/xlsx	398
mp4	61

The analysis of the documents published on the e-learning platform of University of Economics - Varna shows a very high share of text documents in PDF (portable document format) format. This format protects against content manipulation by users and has become the recommended format for developing electronic learning units. However, in order to ensure accessibility of these types of files, the following standards must be followed:

1. ISO/IEC 40500:2012 is known as Web Content Accessibility Guidelines (WCAG) 2.0. This is not a standard specifically aimed at the accessibility of PDF documents, but is a basic standard for accessibility on the internet. The current version of the standard is WCAG 2.2. It defines how to make Web content more accessible to people with disabilities. Accessibility

involves a wide range of disabilities, including visual, auditory, physical, speech, cognitive, language, learning, and neurological disabilities.

2. ISO 14289-1:2014 is an international standard for PDF files - PDF for Universal Access - PDF/UA, approved by the International Organization for Standardization (ISO). This standard is aimed at electronic document file format enhancement for accessibility. Specifies the use of ISO 32000-1:2008 to produce accessible electronic documents. The ISO 32000 standard specifies a digital form for representing documents called the Portable Document Format or usually referred to as PDF, and one of its requirements is to ensure accessibility of content to those with disabilities.

On the other hand, the organization that actively works to ensure accessibility of electronic and information technologies, including PDF files, is the U.S. Access Board (an independent federal agency that promotes equality for people with disabilities through leadership in accessible design and the development of accessibility guidelines and standards). It also develops and publishes Guidance for creating Accessible Electronic Documents, which are freely accessible.

Adobe Acrobat Pro DC is one of the leading software tools for creating and editing PDF files. The latest versions of the software include features that are designed to create accessible PDF documents in accordance with the PDF/UA standard. Using the paid version of Adobe Acrobat allows you to create accessible documents and to correct already created ones.

Important to consider is the PAC 3 (PDF Accessibility Checker) software. It is a free tool provided by Access for All that can check PDF files for compliance with accessibility standards, including PDF/UA. This tool is useful for checking and improving existing PDF documents. Unlike Adobe Acrobat Pro DC, PAC 3 only provides information about accessible and inaccessible elements in the document, but does not offer the possibility to correct and convert them into accessible ones.

The analysis of the types of documents provided to students through the e-learning platform of the University of Economics - Varna shows also a significantly high share of text documents in doc/docx format, spreadsheets, and presentations, with a predominance of those created using Google products.

The factors that determine the large share of documents created using Google products can be summarized as follows: the ability to easily create, share, and collaborate on documents in Google Drive. In addition, the emails provided by the university to lecturers, staff, and students are based on Gmail. Moreover, they (email accounts) are used to access various electronic functionalities at the university.

On the other hand, the use of Microsoft products is explained by the contract between the company and the state educational institutions in Bulgaria. In this

way, lecturers, staff, and students have the opportunity to use the products included in Microsoft Office completely free of charge.

Based on the analysis conducted, it can be concluded that the accessibility of the presented types of files is mainly ensured in the following directions: Screen Reader Support, which includes Headings and Styles; Alt Text for Images; Use a braille display; Use Keyboard Shortcuts; Touch input; Use screen magnifier; Type with voice.

The positive thing in this case is that the large companies like Google and Microsoft are constantly working to improve the accessibility of their applications. They develop their software products while adhering to accessibility standards.

This, in turn, requires lecturers who create learning resources to be familiar with and able to use the verification and accessibility tools built into the software. However, this leads to the problem that educators are specialists in their subject areas and rarely have high computer skills. One possible approach is to train them to work with software products using the accessibility checking features. Another approach for the lecturers is to develop their resources without considering whether they are accessible or not. Of course, in this case it will be necessary for the specialists that are responsible for the e-learning platform to check them and make the necessary corrections.

To reduce the workload to this kind of specialists when applying the second approach, documents created using both Google and Microsoft tools can be saved as PDF files, which would provide a single format and perhaps a single tool for ensuring accessibility.

It should be also noted that a large proportion of the documents published on the e-learning platform of the University of Economics - Varna are in PNG format. Images themselves are not accessible to people with visual impairments. A good approach is to include them as part of web pages or other documents and add alternative text (description).

Thanks to the development of the information and communication technologies in modern conditions, there are various tools and software that can be used to create accessible files in accordance with the above-mentioned standards.

Conclusions

In today's world, it is increasingly important to focus on respecting, accepting, and understanding people with disabilities. However, they are often viewed as "second-hand" people, as if they do not exist. Both globally and in Bulgaria, in recent years, research on the possibility of people with disabilities to access quality education has been extremely active. Accessibility of the physical environment remains in the background, as electronic learning is increasing its adoption. In this context, studies on the accessibility of websites, software

applications, and online resources are very serious. The catalyst for this process is the United Nations General Assembly Agenda for Sustainable Development. As a result of this research, the findings of Sun, Manabat, Chan, Chong, and Vu (2017) are confirmed, according to which regardless of format, however, the content needs to be accessible. Although accessibility guidelines and accessibility evaluations tools are available to users, there is no comprehensive accessibility evaluation technique to help guide users in selecting the most accessible learning resources.

Using the PDF format for electronic resources is a good approach, but educational institutions need to develop guidelines that lecturers should follow when preparing educational resources. These guidelines should be periodically updated, reflecting changes in standards, choosing and applying a tool to evaluate the accessibility of resources, and correcting them if necessary.

Accordingly, the direction for future work can be determined, namely, to conduct an analysis of the level of accessibility of the PDF files published on the e-learning platform of the University of Economics - Varna. It could be researched to what extent they comply with current accessibility standards, what are the tools for testing this indicator, and how could they be analyzed and edited in a timely manner to become accessible.

Acknowledgements

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

- Ajani, O. (2024). Teachers' competencies in digital integration of learning contents in dynamic classroom practices: A review of teacher professional development needs. *Acta Educationis Generalis*, 14(3), 18-40. <https://doi.org/10.2478/atd-2024-0016>
- Amin, M., Sibuea, A., & Mustaqim, B. (2022). *The effectiveness of Moodle among engineering education college students in Indonesia. International Journal of Evaluation and Research in Education (IJERE)*, 12(1). <http://doi.org/10.11591/ijere.v12i1.23325>
- Bankov, B. (2023). *Software solutions for responsive and accessible web systems. In Scientific seminar Digitalization of the economy in a big data environment (pp. 39-43). Varna: Science and Economics.*
- Christensen, L. B., Keegan, S. J., & Stevens, T. (2012). SCRIBE: A model for implementing robobrace in a higher education institution. In K. Miesenberger, A. Karshmer, P. Penaz, W. Zagler (Eds.), *Computers Helping People with Special Needs. ICCHP 2012. Lecture Notes in Computer Science*, 7382. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-642-31522-0_12

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- Hunt, L., Cromwell, J., & Creel, S. (2024). Students with disabilities perceptions on the library and college: Systematic review and case study. *The Journal of Academic Librarianship*, 50(1). <https://doi.org/10.1016/j.acalib.2023.102827>
- Kasprzak, T. (2021). Inclusion of doctoral students with disabilities within higher education. *Polish Journal of Educational Studies*, 73(1), 112-123. <https://doi.org/10.2478/poljes-2021-0008>
- Kuyumdzhiiev, I. (2020). A model for timely delivery of IT solutions for Bulgarian universities. *20th International Multidisciplinary Scientific Geoconference SGEM 2020: Conference Proceedings* (pp. 3-10). 18 - 24 August, 2020, Albena, Bulgaria, Sofia: STEF92 Technology Ltd.
- Liyanagunawardena, T. (2020). Transcripts and accessibility: Student views from using webinars in built environment education. *European Journal of Open, Distance and E-Learning*, 23(2), 37-50. <https://doi.org/10.2478/eurodl-2020-0009>
- Majoko, T., & Dunn, M. (2018). Participation in higher education: Voices of students with disabilities. *Cogent Education*, 5(1). <https://doi.org/10.1080/2331186X.2018.1542761>
- Musikavanhu, T., & Scheepers, E. (2024). A systematic literature review of synchronous e-learning challenges in higher education institutions in developing nations during the COVID-19 Pandemic. *Acta Educationis Generalis*, 14(3), 121-137. <https://doi.org/10.2478/atd-2024-0023>
- Nacheva, R. (2023). Conceptual functional model of mobile application accessibility evaluation system prototype. *Journal HR & Technologies*, 1, 76-98.
- Nacheva, R. (2022). Emotions mining research framework: Higher education in the pandemic context. In *Advances in Econometrics, Operational Research, Data Science and Actuarial Studies: Techniques and Theories* (pp. 299-310). Cham: Springer. https://doi.org/10.1007/978-3-030-85254-2_18
- Nacheva, R., & Sulova, S. (2020). Internationalization in context of Education 4.0: AHP ranking of Bulgarian universities. *CompSysTech '20: Proceedings of the 21st International Conference on Computer Systems and Technologies '20, Association for Computing Machinery* (pp. 278-284). <https://doi.org/10.1145/3407982.3408006>
- Pearson, E., & Koppy, T. (2006). A pragmatic and strategic approach to supporting staff in inclusive practices for online learning. *ASCILITE 2006 - The Australasian Society for Computers in Learning in Tertiary Education*, 2, 639-646.
- Sun, Y. T., Manabat, A. K. M., Chan, M. L., Chong, I., & Vu, K. P. L. (2017). Accessibility evaluation: Manual development and tool selection for evaluating accessibility of e-textbooks. In K. Hale, & K. Stanney (Eds.), *Advances in Neuroergonomics and Cognitive Engineering. Advances in Intelligent Systems and Computing*, 488. Cham: Springer. https://doi.org/10.1007/978-3-319-41691-5_28