Exploring the role of web accessibility in inclusive education: a case study

Marian Pădure
Babes-Bolyai University
Str. Sindicatelor 7, Cluj-Napoca, Romania
marian.padure@ubbcluj.ro

Costin Pribeanu
Academy of Romanian Scientists
Ilfov Street 3, Bucharest, Romania
costin.pribeanu@aosr.ro

ABSTRACT
Equal access to education is an important objective of the Digital Agenda for Europe. To ensure accessibility of the public web, systematic evaluation and monitoring measures are needed. This paper reports on a case study that targeted the accessibility evaluation of a Romanian university website. The approach to evaluation is user-centered. An evaluation instrument that consists of two sets of questions has been administered to students with various kinds of disabilities. The results show that web accessibility issues affect not only visually impaired students but also students with hearing and motor disabilities.

Keywords
accessibility evaluation, university websites, WCAG2.

ACM Classification
D.2.2: Design tools and techniques. H5.2 User Interface.

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INTRODUCTION

More than 80 million people in the European Union (EU), which means around one in five people, have some form of disability [13]. Since the population is continuously aging, the number of people with disabilities will increase in the future [13]. Web accessibility enables people with disabilities to perceive, understand, navigate, and interact with web applications.

Web accessibility is a precondition for ensuring equal access to digital services and content for all citizens. Web accessibility is a goal of the European Commission which launched several documents to strengthen the accessibility measures: Disability Strategy [11], Web Accessibility Directive [12, 28], and the European Accessibility Act [13]. The last one is planned to enter into force in 2025.

Poor web accessibility has negative effects as regards the access of all citizens to online services. Accessibility of university websites should remove the barriers to education for young people with some degree of disability.
In the last decade, universal access to the information society has been a key research concern and there are more and more studies that approach various aspects related to the evaluation of universities' websites and highlight the need to strengthen the accessibility policies [2, 5, 6, 9].

This work takes a user-centered approach to the accessibility of a Romanian university website. The focus is on the accessibility of information needed by university students to fulfill their learning tasks, get informed about what happens in the university, and successfully prepare for exams.
The next sections present the web accessibility model, some national regulations regarding accessibility, and related work in accessibility evaluation. Then, the method and accessibility evaluation results are presented. The paper ends with the discussion, conclusion, and intention of future work.

WEB ACCESSIBILITY

Web accessibility guidelines

To better support web accessibility, the World Wide Web Consortium launched the second version of web content accessibility guidelines (WCAG2) which defines three levels of conformance: A - lowest, AA -average, and AAA - highest [29].

WCAG2 model is based on four key principles: perceivable, operable, understandable, and robust [29]. For each principle, several guidelines have been defined that could be checked for conformance with several success criteria. In turn, for each success criterion, various techniques have been defined that guide developers on how to meet this criterion.

National regulations

In 2008, the Ministry of Communications and Information Society published the first guide for central and local government websites, which includes a chapter on web accessibility. Later on, the Ministry of Public Consultations and Social Dialogue published a Guide for the accessibility of public institutions' web pages [22]. The reference used in this guide is WCAG 2.0.

In 2022, the Authority for Digitalization in Romania published a monitoring norm that reinforces the application of European accessibility regulations. According to this, administrators of public websites should post on the website an accessibility statement.

Article 7(1) of the Order of the Ministry of Education 4481/2024 stipulates that higher education institutions shall configure their web pages to facilitate the provision of information also to persons with disabilities/special educational needs. Thus, the webpage of higher education institutions will have to include information on measures and policies for the inclusion of students with disabilities/special educational needs made available by the institution to these persons. So, this information should be accessed in an accessible and easy-to-find form.

RELATED WORK

Ahmi & Mohamad [3] reported on the web accessibility evaluation of 20 Malaysian public university websites. They approached a tool-based evaluation by using AChecker and WAVE and found that the accessibility is low, most errors being related to navigation, lack of a text alternative for non-text content, and lack of keyboard-based access to functionality.

Ismail & Kuppusamy [17] evaluated the accessibility of 302 university homepages in India. They took a checking tool-based approach by using Achecker and WAVE. Their results showed a large number of errors. Most accessibility issues were related to a lack of alternative text, lack of headers, unstructured forms, and color contrast.

A more recent accessibility study on Indian universities has been reported by Gupta & Singh [16]. They analyzed the websites of 27 university websites by using the WAWE tool and found similar errors. Overall, the accessibility was low since only 7% of websites had less than 100 errors and about 33% had more than 500 errors.

The comparative study of Ismailova & Inal [18] targeted the accessibility of top university websites in four countries (Azerbaijan, Kazakhstan, Kyrgyzstan, and Turkey). They used AChecker as an accessibility evaluation tool and found that most websites didn't pass the WCAG2 A accessibility level. Most frequent were the lack of text alternatives for non-text content and the navigation issues.

Another comparative study published by Macakoglu et al. [20] targeted 330 universities from Europe, Oceania, and North America. Prospective student web pages have been evaluated for accessibility, usability, and security. For accessibility evaluation against WCAG 2.0 guidelines, the TAW tool has been used. The results showed that the most frequent violations were related to the lack of text alternatives (85% of websites), then parsing, info and relationships, and link purpose.

Alahmadi and Drew [5] evaluated the website accessibility of 20 top-ranking universities by using the AChecker tool. For each website three pages have been analyzed: home page, admission page, and course description page. The results showed that the number of errors per type of page is not significantly different. A comparison with previous studies didn't show a notable improvement in web accessibility in the last 10 years (2005-2015).

Alim [7] used three accessibility assessment tools (WAVE, TAW, and EIII) to analyze the accessibility of the home pages of 66 universities in the UK. Most frequent A-level errors were related to three success criteria: non-text content (1.1.1), information and relationships (1.3.1), and link purpose in context (2.4.4). As regards the level AA- level errors the study mentioned frequent contrast issues.

Laamanen et al. [19] tested 38 homepages of higher education institutes in Finland by using a combination of two accessibility checking tools: WAVE and Siteimprove. Overall, the accessibility was low, with an average of more than 100 errors per institution. Most frequent accessibility violations were related to a lack of text alternatives, color contrast, and link purpose.

The study of Akram & Ali [4] analyzed the compliance with WCAG of 33 university websites by using AChecker and TAW accessibility checking tools. The most frequent violations of the accessibility guidelines were the lack of text alternatives, lack of text description for links, unstructured content, and resizing text without the use of assistive technology. They recommended the involvement of disabled users in the evaluation.

Recently, the literature review of Bong & Chen [8] highlighted the need for accessible learning materials and digital tools. Their study focused on the competence of faculty members to provide an accessible learning environment. Based on the analyzed research they proposed a set of 10 recommendations for training and practice. As regards training, they mentioned accessibility standards and regulations, universal design for learning environments, using evaluation instruments (questionnaires) to assess outcomes, involving students with disabilities in the training programs, and providing device knowledge.

Another literature review having the goal of summarizing the results of the accessibility evaluation of university websites has been published by Campoverde et al. [9]. Based on 42 selected papers, their main findings were: almost 90% of studies evaluated only the home page, 90% of university websites were analyzed with accessibility checking tools, most preferred checking tools were AChecker and TAW, and most violated guidelines were text alternatives, keyboard accessibility, distinguishable, adaptive, and navigable.

The accessibility of Romanian university websites has been rarely analyzed. Only three studies have been reported, [10, 24, 26], all of them finding several errors, especially as regards the lack of alternative text for images, lack of labels for controls, and lack of text describing the link purpose.

EVALUATION RESULTS

Method and tool

This work targets the subjective perceptions of disabled students about access to education and aims to answer two main research questions: (1) how difficult is it to access the information on the website? and (2) how disabled students perceive the severity of the main web accessibility issues.

The evaluation was carried on in May-June 2024. The target of the evaluation was the website of "Babeș-Bolyai" University of Cluj-Napoca. The approach is user-centered.

An evaluation instrument has been administered to students having various disabilities. A number of 17 students (7 male / 10 female students) answered the questionnaire. The average age is 26.2 years old (SD=9.35). Students are enrolled in social sciences (7), theology (4), political sciences (2), and other faculties (4).

As regards disability, there are students with auditory disabilities (3), motor disabilities (7), and visual disabilities (7).

The main problems faced by students with hearing disabilities in accessing online continuations are primarily those related to the lack of accessibility of audio and video materials or messages [14]. Also, the inaccessibility of educational content for students who frequently use the distance learning platform [23]. No specific technologies are needed, but the content could be improved by adding simple captioning/caption captcha and interpretation in Romanian Sign Language (LSR).

Instead, students with limited mobility can use different types of assistive devices and applications to facilitate their navigation, from voice recognition and voice command applications to eye-tracking technologies, special keyboards, and adapted mice.

Most navigation problems are related to the activation of page elements [25], the dynamics of web page components and animations [27], the lack of shortcuts to simplify navigation [15], and the lack of solutions to combine shortcuts with voice commands [21].

By using a screen reader, navigating through web pages becomes difficult for visually impaired users due to issues related to lack of labels, lack of content descriptions (especially images), undefined links, overlapping elements by adjusting sizes, ineffective text/background contrast, hard to control pop-ups [1].

The questionnaire asks students to evaluate on a 5-point Likert scale two sets of questions. The first set refers to the difficulties encountered while trying to access information on the website (very easy, easy, moderate, difficult, and very difficult). The tasks and the mean values are presented in Table 1.

Table 1. Difficulty of performing tasks (N=17)

	Task	M	SD
T1	Accessing the university webpage	1.76	1.09
T3	Accessing the academic calendar	1.82	1.07
T2	Accessing the university library	2.35	0.79
T5	Accessing announcements	1.94	0.90
T11	Finding the search function	1.94	1.03
T4	Accessing the department webpage	1.59	0.71
T6	Finding the course schedule	1.94	0.90
T7	Reading the course schedule	2.00	1.06
T8	Finding learning documents	1.88	1.11
T9	Accessing learning documents	1.88	1.05
T10	Uploading homework	2.18	1.29

Overall, most students perceived the tasks as being easy to moderate. The most difficult was to access the university library, to upload the homework, and to read the course schedule.

The second part of the evaluation instrument refers to the severity of accessibility issues (very low, low, moderate, high, and very high). The accessibility issues and mean values are presented in Table 2.

Overall, most students perceived the severity of accessibility issues as being low to moderate. The most severe issues were related to the complexity of tables, the number of links, the lack of labels, and unstructured content.

Table 2. Severity accessibility issues (N=17)

	Accessibility issue	M	SD
A1	Lack of text alternative	1.88	0.93
A2	Lack of link purpose description	2.06	0.90
A4	Lack of control labels	2.24	1.15
A11	Poor contrast	1.94	1.30
A3	Lack of headings	1.82	1.24
A5	Improper heading ordering	2.12	1.32
A6	Complex forms	1.88	1.22
A7	Complex tables	2.94	1.56
A8	Too many links on a webpage	2.59	1.37
A9	Unstructured content	2.24	1.25
A10	Difficult navigation	2.06	1.43

There were also five general questions as regards the page loading time, awareness of accessibility functions of the browser, frequency of using the university website, navigation path, and the device used.

Frequency of use and equipment

There is a large diversity as regards the frequency of use (M=3.33, SD=1.45), from weekly use (6) to monthly (5), and occasional (2) or yearly use(2). Most students found the loading time acceptable (M=3.53, SD=1.46). Most students (13) are aware of the accessibility functions provided by the browser.

As regards the equipment used, four students are using a computer, four a mobile phone, two are using a tablet and seven are using two devices. Except for three students with motor disability and one with auditory disability, all students are using assistive devices. Most students (11) use to start navigation from the department web page. Six students mentioned the use of search engines.

Difficulty in performing tasks

The tasks have been grouped into two categories: tasks to access general information (accessing the university webpage, academic calendar, university library, announcements, and the search function) and tasks related to the learning process (accessing the faculty webpage, schedule, documents, and uploading the homework).

The results are presented in Figure 1 and are analyzed by disability type. The analysis of mean values shows that the most affected are students with visual disabilities (M=2.11, SD=0.28), then students with auditory disabilities (M=1.60, SD=0.27). Students with motor disabilities are less affected by the difficulties in accessing and using the university website (M=2.11, SD = 0.33).

For visually impaired students, the most difficult tasks were to read the course schedule, access the university library, and find the search function. In very many cases timetables are published in visual formats (PDFs or pages that are not optimized for screen readers). Sometimes small text size is a problem for visually impaired students, and many sites do not respect accessibility principles. Library cataloging systems are sometimes cluttered and not very user-friendly with the title of the catalogs.

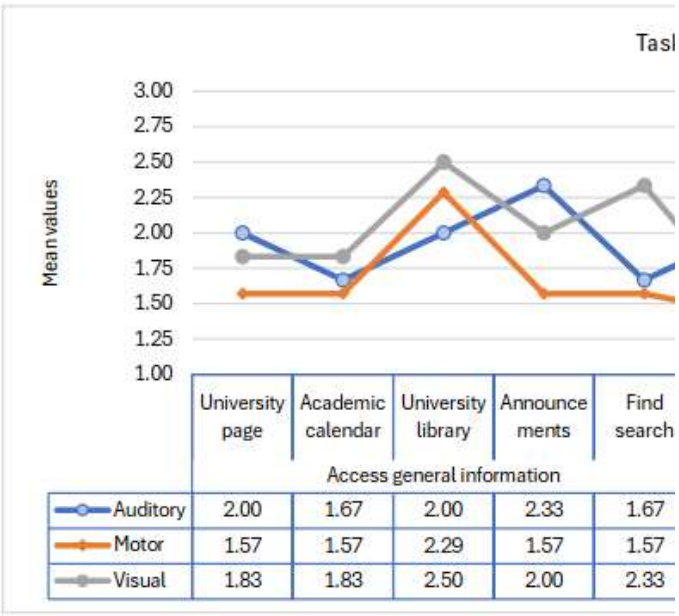

Figure 1. Difficulty of performing tasks (N=17)

For students with hearing disabilities, the most difficult was to find and access the announcements, and the course schedule and to upload the homework. Relying heavily on gestural communication, written messages are often complicated for them to understand. Online learning platforms may have video instructions without subtitles, which can create difficulties in understanding the homework upload process.

For students with motor disabilities, the most difficult was to access the university library and upload the homework. The lack of digital libraries is a real problem since physical access to libraries is difficult for a wheelchair user, as well as getting around and accessing services which is time-consuming. Online platforms may not be optimized for users using assistive devices such as special keyboards or voice recognition technologies. The process of uploading files may require several actions that are difficult for people with motor limitations.

The severity of accessibility issues

The accessibility issues have been grouped into three categories: text alternatives & relationships, info & relationships, and navigation.

The results are presented in Figure 2 and are analyzed by disability type.

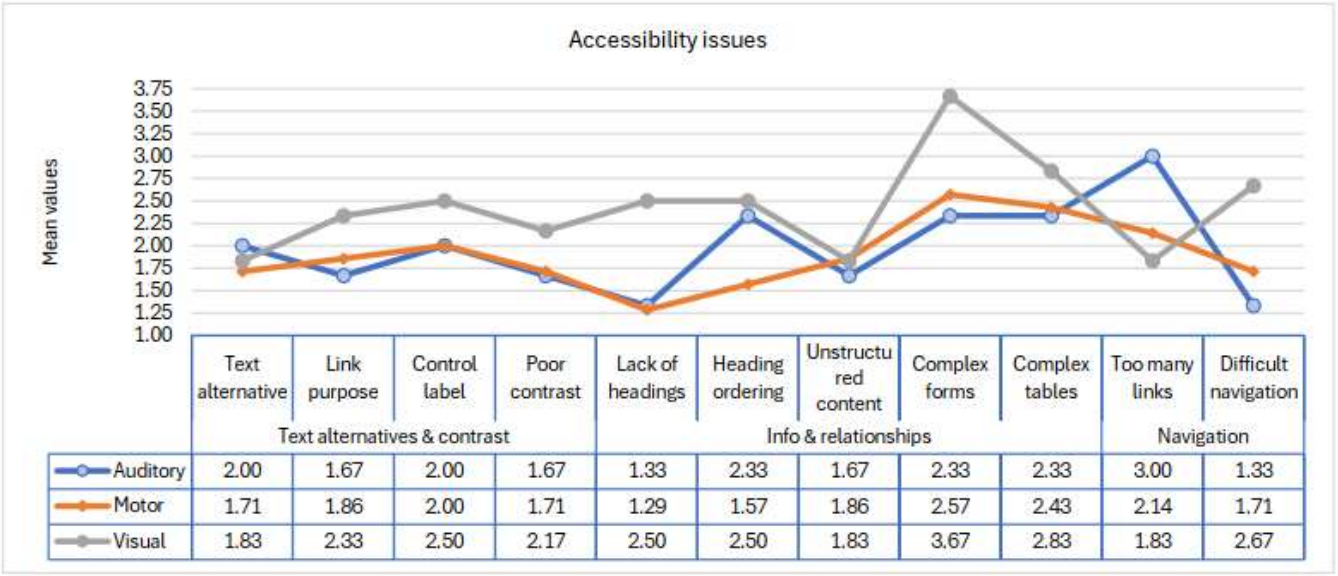

Figure 2. Severity of accessibility issues (N=17)

The analysis of mean values shows that the most affected by the severity of accessibility issues are students with visual disabilities (M=2.42, SD=0.54), then students with auditory disabilities (M=1.97, SD=0.50). Students with motor disabilities are less affected by the severity of accessibility issues (M=1.90, SD = 037).

For the visually impaired students, the most severe accessibility issues were related to the complexity of forms, the complexity of tables, and the navigation. Only three of the accessibility issues have a mean value below 2 (low): lack of text alternatives, unstructured content, and too many links on the webpage.

A logical and clear headings structure helps navigation and understanding of content, which is essential for those who rely on reading rather than hearing. Complex forms with numerous fields and steps can be difficult to complete and understand, especially if not accompanied by clear and accessible instructions.

Students with hearing disabilities evaluated as most severe the issues related to too many links on the webpage, improper heading ordering, the complexity of forms, and the complexity of tables.

Students with hearing disabilities often rely on visual navigation and written text to access information. A cluttered web page with too many links can be confusing and difficult to navigate effectively. Too many links without a clear structure can make it difficult to find the resources you need and access important information quickly. Titles and subtitles are essential to the logical structure of a web page. If they are not properly organized, students with hearing disabilities may have difficulty understanding the hierarchy of information and finding relevant sections.

The accessibility issues related to the number of links on a webpage, complexity of forms, and complexity of tables have been also perceived as severe by students with motor disability.

Discussion

The results show that web accessibility issues affect not only visually impaired students but also students with auditory and motor disabilities. Overall, the difficulty in performing education-related tasks is not high. As regards the severity of accessibility issues, the most important are the complexity of forms, the complexity of tables, and the navigation issues.

Visually impaired students reported significant difficulties in reading the course schedule, accessing the university library, and finding the search function. These challenges are primarily attributed to the following factors: students with hearing disabilities identified the most severe challenges in finding and accessing announcements, reading the course schedule, and uploading homework; students with motor disabilities found it particularly difficult to access the university library and upload homework.

The study identified several key accessibility issues that students with both auditory and motor disabilities perceived as severe. These included the presence of an excess of links on a webpage, the incorrect ordering of headings, and the complexity of forms and tables.

The results are not surprising since a recent study that analyzed the accessibility of Babes-Bolyai University, by using both automated and manual evaluation, found similar accessibility problems, most of them being related to the lack of text describing link purpose, improper heading ordering, and navigation issues [26].

The results of this study are in line with the findings from other studies and highlight the challenges to meeting the needs of students with disabilities: making information accessible on the university webpage, structuring the content, reducing the complexity of forms and tables, and training of teaching staff [4, 8, 15, 23].

This study is exploratory and has inherent limitations. The sample is small and there are few observations in each category. Future work will enlarge the sample and will extend the evaluation instrument to identify more barriers toward an inclusive education

CONCLUSION

This study highlights the significant challenges faced by students with various disabilities when accessing online educational resources. By focusing on a user-centered approach, the research emphasizes the subjective experiences and difficulties encountered by students at a Romanian university. The findings underscore the importance of adhering to web accessibility standards and implementing user-friendly designs to ensure inclusive education.

Website accessibility is not only relevant to people with severe disabilities but brings long-term benefits for all users, such as increased readership and improved user experience.

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