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ASSESSMENT OF WEB ACCESSIBILITY OF UNIVERSITY WEBSITES IN BULGARIA: A PATH TOWARDS INCLUSIVE HIGHER EDUCATION

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Abstract. Digital inclusion has become a central element of contemporary educational and social policy within the European Union. One of its core dimensions is web accessibility – the functionality of websites that allows them to be usable by all users, including people with disabilities.

This study aims to evaluate the web accessibility of the homepages of official university websites in Bulgaria. Web accessibility is considered a key component of the right to education and equal access to digital environments, particularly for students with functional limitations. The analysis covers 51 functioning websites of higher education institutions and is based on two widely recognised automated tools – WAVE and TAW – applying the standards of WCAG 2.1.

The results indicate that 98% of the websites contain at least one accessibility error. The most common issues are related to insufficient colour contrast, missing alternative text, and inaccessible navigation elements.

The findings confirm the presence of systemic shortcomings in the implementation of accessibility standards and underscore the need for institutional measures to improve digital inclusion in higher education.

Keywords: web accessibility; higher education; WCAG 2.1; digital exclusion; people with disabilities; university websites

Introduction

Over the past decade, digital transformation has established itself as a leading paradigm in the development of modern societies and economies. In this context, the European Union (EU) has formulated ambitious policies and strategies to build an inclusive information society, in which digital technologies not only enhance the efficiency of public services but also ensure equal access to knowledge, education, and participation in public life. The European Commission regards digital inclusion as a social right, enshrined in

initiatives such as the Digital Compass 2030 (European Commission 2021) and the Digital Decade (Decision (EU) 2022/2481).

At the core of these visions lies the concept of e-inclusion – the aspiration that every individual, regardless of age, disability, or social status, should be able to benefit from the opportunities offered by the digital age. As Hristova (2025a) notes, e-inclusion refers to "the effective participation of individuals and communities in all dimensions of a knowledge-based society and economy, through access to and use of ICT".

The reverse side of this process – digital exclusion – comprises a set of barriers that hinder equal access to digital resources and services, often deepening social and economic inequalities. Stoilova (2025) emphasises that digital inequalities often reproduce and reinforce existing social, economic, and regional disparities. This is particularly evident in education, where the lack of access or digital skills leads to secondary digital exclusion. One of the most important – yet often underestimated – aspects of digital exclusion is inaccessible web design, which fails to account for the needs of persons with disabilities.

In this context, web accessibility is emerging as a fundamental principle of digital justice and a prerequisite for equal participation in society, education, and the labour market. Analysing 50 definitions of web accessibility from various scholarly sources between 1996 and 2014, Petrie et al. (2015) arrive at a synthesised definition: "all people, particularly disabled and older people, can use websites in a range of contexts of use, including mainstream and assistive technologies; to achieve this, websites need to be designed and developed to support usability across these contexts". So web accessibility is understood as the ability of all users, including those with disabilities, to use websites via various devices and technologies. Web accessibility ensures that websites and digital services are usable and accessible for people with a range of impairments – visual, auditory, motor, or cognitive.

The importance of web accessibility is recognised internationally through the standards developed by the World Wide Web Consortium (W3C), which, under the Web Accessibility Initiative (WAI), creates guidelines and support materials that help ensure equal access to the web for people with disabilities (Ferri, Favalli, 2018). The first version of the Web Content Accessibility Guidelines (WCAG 1.0) was published in 1999, followed by WCAG 2.0, which was approved as an ISO standard in 2012. In 2018, the European Union formally adopted WCAG 2.1 as the mandatory standard for websites, electronic documents, and mobile applications (Abou-Zahra, 2018). The most recent version, WCAG 2.2, was published in 2024 and builds upon its predecessors by placing greater emphasis on the needs of three key user groups: people with cognitive or learning disabilities, users with low vision, and users with disabilities who rely on mobile devices (W3C 2024).

The standards are structured around four fundamental principles: perceivability, which requires that information and user interface components must be presented

in ways that can be perceived by different senses; operability, which demands that user interface components and navigation must function and be manageable by users; understandability, which ensures that both the information and the operation of the user interface must be easy to comprehend; and robustness, which guarantees that content can be reliably interpreted by a wide range of users, including those using assistive technologies (W3C 2024). Each guideline includes specific measurable success criteria, categorised into three levels: A, AA and AAA. Level A represents the basic standard of accessibility, while level AAA represents the highest. As requirements increase, WCAG 2.1 introduces 17 new success criteria to the previous version, and WCAG 2.2 adds 9 more, bringing the total to 87. Despite their significance, not all AAA-level success criteria are applicable to all types of content; therefore, universal compliance at this level is not generally recommended. Nevertheless, WCAG standards constitute the leading framework for achieving an accessible digital environment and serve as a foundation for regulatory documents and legislative practices in many countries, including Bulgaria.

The importance of web accessibility is also recognised at the political level through European legislation. With the adoption of Directive (EU) 2016/2102 on the accessibility of websites and mobile applications of public sector bodies, the EU formalised the legal obligation for public institutions, including universities, to provide accessible digital services, specifically aimed at addressing the needs of people with disabilities. The Directive requires Member States to implement the necessary legislative, regulatory and administrative provisions by 23 September 2018, to ensure its effective application.

In Bulgaria, Directive 2016/2102 was transposed into national law in 2019 through amendments to the Electronic Governance Act, with accessibility defined in a subordinate regulatory framework. According to the Ordinance on the General Requirements for Information Systems, Registers and Electronic Administrative Services (adopted by Council of Ministers Decree No. 3 of 9 January 2017, Supplementary Provisions, §1, item 5), "accessibility" means "the quality of an information system that ensures all citizens, regardless of age or physical abilities, can view, understand, manage, and interact through the user interface".

In the context of the Directive, web accessibility includes not only principles but also specific techniques to be followed in the design, development, maintenance, and updating of websites and mobile applications of public sector organisations. The aim is for people with disabilities to perceive, understand, navigate, and interact effectively with the digital environment (Directive (EU) 2016/2102). The relevant accessibility standard is defined in the harmonised European standard EN 301 549 v3.2.1 (2021-03), which is based on the WCAG 2.1 guidelines, level AA. In this regard, web accessibility is no longer a desirable "best practice", but a legal requirement and an integral part of the broader European vision for an ethical, sustainable and inclusive digital society.

However, the realisation of this vision depends on its practical implementation at both national and institutional levels. While the political framework is clearly defined, numerous studies indicate that the websites of educational institutions, including universities, often do not comply with accessibility requirements, placing students with disabilities at a disadvantage. This phenomenon represents a specific form of secondary digital exclusion, in which users have access to the internet and devices but are unable to fully benefit from content due to design-related barriers.

Given the central role of higher education in promoting social mobility and inclusion, assessing the accessibility of university websites becomes a key indicator of progress towards a digitally just society. University websites should not merely be viewed as communication platforms but rather as public infrastructures that can either facilitate or obstruct access to education – particularly for students with functional limitations. In Bulgaria, research on the web accessibility of university websites is limited; this paper addresses this gap by empirically evaluating their accessibility levels. It assesses the degree of compliance of their homepages with internationally recognised criteria (WCAG 2.1) using two automated web accessibility evaluation tools. The findings aim to shed light on current practices and deficiencies at the national level and identify opportunities for improvement through policy measures, staff training, and technological solutions. The results of this study are directly relevant to the priorities of the Ministry of Education and Science in relation to digital transformation and accessibility within the higher education system.

Previous research

There is no doubt that, in the information society, universities must ensure their websites are accessible to all students and maintain this commitment over time (Thompson et al., 2010). Numerous studies have empirically documented a lack of compliance with web accessibility requirements across university websites in various countries. Campoverde-Molina et al. (2020) conducted a systematic literature review of 25 studies from different regions (Europe, Latin America, Asia), published between 2009 and 2019. They concluded that educational websites do not meet WCAG standards or their levels of compliance, suggesting that substantial efforts are required to improve web accessibility and to create more inclusive websites.

There are several approaches to evaluating web page accessibility, including expert assessment, end-user testing, consultancy evaluations, automated testing tools, and combinations of these methods. The scope of the tested web pages also varies. Synthesising findings from higher education accessibility research, Nir and Rimmerman (2018) summarise that most studies focus on assessing specific pages, primarily the main institutional websites and library homepages. According to the authors, the results of these studies are generally inconclusive and highlight the need for clearer standards and improved accessibility. Their overall conclusion is that there remains significant room for improvement.

Over the past two decades, various studies in Bulgaria have explored the digitalisation of the public sector; however, web accessibility and compliance with international standards remain under-researched. Existing studies reveal systemic difficulties in ensuring equal access to electronic information and services for people with disabilities. One of the earliest empirical studies on this topic was conducted by a team at the Technical University of Varna (Stavreva-Kostadinova & Koicheva, 2013), involving the assessment of 18 public-facing websites by volunteers with different types of functional limitations. The results showed that 80% of the assessed websites posed difficulties for this user group.

A more extensive study was conducted in 2016 by the Horizons Foundation, assessing 100 websites of central and local government institutions, public broadcasters, agencies, commissions, and other socially significant authorities. The evaluation was carried out by volunteers with visual impairments and IT competencies. According to the findings, only half of the websites could be considered largely accessible (Fondatsia Horizonti, 2016).

Sabev et al. (2020) applied both manual and automated analysis (using the tools WAVE and aXe) to 100 public administration websites and identified similar issues – such as the absence of appropriate alternative text, missing or incorrect use of headings, the lack of skip-to-content links, and insufficient colour contrast.

The most comprehensive study to date is that of Hristova (2025b), which analysed all 264 municipal websites in the country using the automated WAVE tool. The results showed that only 7% of the websites were error-free, with the most common issue being insufficient colour contrast (76%). Other frequent violations included the absence of alternative text, empty links, and missing form labels. This study underscores a systemic issue with web accessibility in the public sector and highlights the need for stricter enforcement of accessibility standards.

Within the framework of institutional oversight of digital accessibility, the National Audit Office of Bulgaria established as early as 2018 that the lack of a unified approach to the structure and design of websites of central government bodies hinders access for people with disabilities. Following the entry into force of Directive (EU) 2016/2102, Bulgaria began systematic monitoring of websites and mobile applications of public sector organisations, based on the methodology of the European Commission and the EN 301 549 standard. Between 2020 and 2024, over 760 websites were assessed, including 147 in the field of education – such as universities, schools, and regional structures. The data indicate that a significant proportion of these sites do not fully meet accessibility criteria, resulting in limited digital access for vulnerable groups.

Despite the presence of a regulatory framework and monitoring mechanisms, there remains a lack of sufficient empirical data on the actual compliance of public web platforms with accessibility requirements. The higher education sector in Bulgaria is under-researched in this regard; therefore, the present study seeks to fill

this gap by evaluating the web accessibility of university websites using automated tools (WAVE and TAW) based on the WCAG 2.1 standard.

In summary, both international and national studies point to a widespread failure to comply with accessibility standards across websites in the education and public sectors. These findings provide the foundation and rationale for the current research, which aims to assess the state of accessibility of Bulgarian university websites in light of international guidelines. As public-sector institutions, universities are expected to ensure that their websites and mobile applications (where applicable) are accessible, thereby enhancing the experience for students from diverse social backgrounds and varying levels of digital proficiency.

Research Questions

The central research question of this study is to what extent do the official websites of accredited higher education institutions in Bulgaria comply with the criteria for web accessibility (WCAG 2.1), and what are the social consequences of the identified barriers for digital inclusion in the educational environment?

The specific research objectives are: to determine the degree of compliance of university websites with the core principles of web accessibility; to identify the most common types of accessibility errors and their social implications; to interpret inaccessibility as an indicator of digital exclusion and institutional shortcomings; to compare the findings with existing European and international literature.

Methodology

The present study aims to assess the degree of compliance with the principles of web accessibility of the websites of all higher education institutions in Bulgaria that were officially recognised and accredited by the National Evaluation and Accreditation Agency (NEAA) as of June 2025.

The object of the present study is web accessibility in the higher education system in Bulgaria, considered as a key factor for ensuring equal access to educational resources and services in a digital environment. The subject of the study is the specific level of compliance of the homepages of Bulgarian universities' websites with internationally recognised web accessibility standards – the Web Content Accessibility Guidelines (WCAG) 2.1.

Scope of the Study

The scope of the study includes the official websites of 52 higher education institutions in Bulgaria, including public and private universities, colleges, and academies. Of these, 51 websites were accessible and functioning at the time of assessment and were therefore included in the analysis. One website (that of the European Higher School of Economics and Management – Plovdiv) could not be evaluated due to prolonged technical inaccessibility.

The research was conducted between 20 and 25 June 2025. The evaluation is limited to the homepages of the university websites, which is an established methodological approach in studies on web accessibility (Ismailova & Inal 2017; Nir & Rimmerman 2018; Inal et al. 2023). The homepage is considered particularly significant, as it typically contains the main navigation elements and key information, and accessibility issues identified there tend to be replicated across the entire site (Olalere & Lazar 2011; Acosta-Vargas et al. 2016). This is largely due to the use of standardised content management systems (CMS), meaning that design, structural, and interface errors found on the homepage are often indicative of the overall accessibility status of the website.

Evaluation Tools

The evaluation was carried out using two widely recognised automated tools for web accessibility testing (WAVE and TAW), which allow for the objective and systematic identification of key barriers to access for users with disabilities.

– TAW (Test de Accesibilidad Web) – a specialised tool for automated evaluation based on WCAG 2.1, which provides a typology of errors according to principles and criteria. It was used to conduct a detailed analysis of the frequency and type of issues, classified by severity. In this study, the websites were evaluated with TAW using enabled options for HTML, CSS, and JS, and at priority level 3 (AAA).

– WAVE (Web Accessibility Evaluation Tool) – a browser extension that visually overlays accessibility data directly onto the webpage, allowing for real-time identification of barriers. It served as a control tool to validate the results produced by TAW.

Limitations

The analysis covers only errors that can be automatically detected; it is likely that additional barriers exist which require manual testing or the involvement of users with disabilities.

The websites were assessed during a specific time period (20 – 25 June 2025), and any subsequent updates are not reflected in the findings.

The study does not include internal systems (e.g. electronic platforms, closed portals), focusing exclusively on publicly accessible sections – specifically, the homepages.

Results

The TAW tool identified a total of 3,184 errors, while WAVE detected 1,762 errors. TAW recorded an average of 64 errors per website (minimum 0, median 54, maximum 354, SD = 56.83). WAVE reported an average of 34 errors per website (minimum 0, median 22, maximum 160, SD = 32.80).

Most of the errors reported by WAVE correspond to the lowest level of compliance (Level A), while those identified by TAW are predominantly associated with the highest level of compliance (Level AAA).

Accessibility Errors Identified by TAW

The results provided by TAW indicate the presence of barriers to information access for older individuals and/or persons with disabilities on the evaluated websites, as shown in Table 1. The TAW automated evaluation tool revealed that each of the university websites assessed contained at least one error.

The lowest number of errors was found on the websites of the "G. S. Rakovski" Military Academy – Sofia (7 errors) and the "Vasil Levski" National Military University – Veliko Tarnovo (7 errors). The highest number of errors was observed on the websites of the Medical University – Pleven (354), the University of Architecture, Civil Engineering and Geodesy – Sofia (164), the University of Food Technologies – Plovdiv (132), and the "D. A. Tsenov" Academy of Economics – Svishtov (127).

An analysis of the errors by accessibility principles revealed that non-compliance was most prevalent under the principles of Operable (72%) and Perceivable (22%) (Table 1).

Table 1. Web Accessibility Errors Categorized by Principle and Type with TAW

Errors by Principle and Type	Number of Errors (% of errors)	Number of Affected Websites
Perceivable	712 (22,5%)	46
1.1.1. Non-text content (A level)	412 (12,9%)	42
1.3.1. Info and relationships (A level)	300 (9,4%)	42
Operable	2294 (72,0%)	49
2.1.3. Keyboard (no Exception) (A level)	18 (0,6%)	6
2.4.4. Link purpose (in context) (A level)	647 (20,3%)	43
2.4.9. Link purpose (link only) (AAA level)	1442 (45,3%)	43
2.4.10. Section Headings (AAA Level)	187 (5,8%)	44
Understandable	102 (3,2%)	38
3.1.1. Language of page (A level)	4 (0,1%)	1
3.2.2. On input (A level)	27 (0,8%)	21
3.3.2. Labels or instruction (A level)	71 (2,3%)	28
Robust	76 (2,4%)	26
4.1.2. Name, Role, Value (A level)	76 (2,4%)	26
Total	1538	49

Source: Compiled by the author

Following classification by priority level, the majority of errors were Priority AAA issues. Although not mandatory, these indicate a strong commitment to digital inclusiveness. The remaining errors fell under Priority A – the most basic level of compliance that all developers should observe.

Most university websites were found to have more than one type of error, with an average of six errors per site (minimum 1, median 7, maximum 8, SD = 1.72). This suggests that accessibility is not embedded by default in the design process but is entirely absent from the institutional approach to digital environments. The result is multi-layered digital exclusion: inability to access specific functions (navigation, content); inability to participate in academic processes (e.g. registration, learning); loss of trust, self-exclusion, and eventual disengagement.

Overall Prevalence of Errors Identified by WAVE

Table 2 shows that only 4% of university websites (2 out of 51) were found to have no errors, while the remaining 98% had at least one accessibility issue. Roughly half of the university websites contain a relatively small number of errors, but nearly the other half fall within the range of moderate to critical deficiencies, with at least one site exhibiting an exceptionally high number of problems (see Table 2).

According to the results provided by the WAVE tool, only two university websites (those of the Academy of Music, Dance and Fine Arts – Plovdiv and Paisii Hilendarski University of Plovdiv) were found to be free of accessibility errors. The highest number of errors was detected on the websites of the Georgi Benkovski Air Force Academy – Dolna Mitropoliya (160 errors), the National Academy of Arts – Sofia (89), and the Medical University "Prof. Dr Paraskev Stoyanov" – Varna (85).

Table 2. Number and Share of Web Accessibility Errors by WAVE

Number of Errors	Number of All Websites	% of All Websites
0 (no errors)	2	4
1 – 29 (few errors)	25	49
30-59 (moderate errors)	14	27
60 – 89 (more errors)	9	18
90 and more errors (many errors)	1	2
Total	51	100.0

Source: Compiled by the author

Over half (52%) of the websites contained four or more distinct types of errors (mean – 4, minimum 0, median 4, maximum 8, SD = 1.86). The accumulation of multiple categories of barriers reflects not only a lack of technical oversight, but also a fundamental absence of accessibility as an organisational and cultural priority. This raises an important question: is accessibility treated as a matter of social responsibility at all, or is it simply left as a "technical concern" managed solely by IT departments, with no strategic oversight?

Analysis of the Frequency and Significance of Errors Detected by WAVE

The study reveals that the most frequently encountered errors on university websites are neither random nor technically trivial – they constitute systematically reproduced digital barriers that can be interpreted as symptoms of structural digital exclusion (table 4).

Table 3. Type of Error, Success Criteria, Conformance Level and Number of Errors by WAVE

Type of Error	Success Criteria	WCAG 2.1 Conformance Level	Number of Errors
Contrast error	1.4.3. Contrast (minimum)	Level AA	1107
Linked image missing alternative text	1.1.1. Non-text content 2.4.4 Link purpose (in context)	Level A	249
Empty links	2.4.4. Link purpose (in context)	Level A	161
Missing alternative text	1.1.1. Non-text content	Level A	109
Missing form labels	1.1.1. Non-text content 1.3.1. Info and relationships 2.4.6. Headings and labels 3.3.2. Labels or instructions	Level A/AA	46
Empty button	1.1.1. Non-text content 2.4.4. Link purpose (in context)	Level A	27
Broken ARIA reference	1.3.1. Info and relationships 4.1.2. Name, role, value	Level A	23
Empty heading	1.3.1. Info and relationships 2.4.1. Bypass blocks 2.4.6. Headings and labels	Level A/AA	20
Spacer image missing alternative text	1.1.1. Non-text content	Level A	7
Multiple forms labels	1.1.1. Non-text content 1.3.1. Info and relationships 2.4.6. Headings and labels 3.3.2. Labels or instructions	Level A/AA	5
Language missing or invalid	3.1.1. Language of page	Level A	3
Empty table header	1.3.1. Info and relationships	Level A	2
Broken skip link	2.1.1 Keyboard 2.4.1 Bypass Blocks	level A	1
Empty form label	1.1.1. Non-text content 1.3.1. Info and relationships 2.4.6. Headings and labels 3.3.2. Labels or instructions	Level A/AA	1

Type of Error	Success Criteria	WCAG 2.1 Conformance Level	Number of Errors
Image map area missing alternative text	1.1.1. Non-text content	Level A	1

Source: Compiled by the author

The most common error identified on university websites relates to insufficient contrast between text and background (1,107 instances). This presents a significant barrier for users with visual impairments, including individuals with low vision, dyslexia, colour blindness, as well as older users. Seventy per cent of university websites contain up to 30 contrast-related errors, while the remainder range between 31 and 121. The highest number of such errors was recorded on the website of the "Georgi Benkovski" Air Force Academy in Dolna Mitropolia (121). The prevalence of these issues suggests that, on some university websites, visual design is prioritised over functional accessibility, highlighting a lack of inclusive culture in web development.

Another major issue is the absence of alternative text for images (Linked image missing alternative text, Missing alternative text, Spacer image missing alternative text – 365 instances in total). This hinders the effectiveness of screen readers and prevents blind users from accessing essential content. The absence of alt text constitutes a direct barrier to information access and violates one of the core WCAG principles – perceivability. In the context of higher education, this may result in inaccessible diagrams, graphics, buttons, or logos conveying critical information (such as admission details, programme descriptions, or application instructions).

A third common violation involves empty links and buttons (188 in total), which disrupt keyboard navigation and create difficulties for users relying on assistive technologies. Such errors can cause a loss of context as to where a given element leads. These issues represent an unintentional but real form of digital exclusion.

Additionally, there are 52 instances of missing or duplicate form labels (Missing form labels, Multiple forms labels, Empty form label). Inaccessible forms for application, enrolment, contact, or feedback directly hinder participation in the academic process. This is an example of an institutional barrier – a technological feature that excludes without intending to. It constitutes a form of "technical inequality" with tangible social consequences, such as the inability to independently complete forms, enrol, or apply.

There are also 49 cases of ARIA and semantic errors, including empty headers and missing language attributes. These issues are not visible on the surface but are critical for users who rely on screen readers or assistive technologies. These so-called "invisible barriers" can render a website entirely unusable for certain groups.

A comparative analysis with international research indicates that the accessibility issues found on Bulgarian university websites align with broader European trends – namely, insufficient contrast, missing alternative text, and navigational difficulties. While the average number of errors in Bulgaria is lower than in countries such as Finland (Laamanen et al. 2022) and Spain (Máñez-Carvajal et al. 2019), in many cases Bulgarian websites display deeper structural shortcomings, such as missing labels and inaccessible forms. Despite some examples of good practice, the overall level of accessibility remains below minimum requirements, in line with findings from countries like Cyprus (İşeri et al. 2017) and the United Kingdom (Alim 2021). The data underline the need for sustained institutional efforts to improve digital accessibility in Bulgarian higher education as part of a broader strategy for social inclusion.

Conclusion

The assessment of web accessibility on university websites in Bulgaria reveals that, despite the existence of a regulatory framework and well-established international standards such as WCAG 2.1, a substantial proportion of higher education institutions' websites do not fully comply with accessibility requirements. The most common errors – related to contrast, alternative text, navigation, and forms – create real barriers to accessing information and digital services for students and staff with disabilities. These issues could be resolved with minimal effort and without significant financial investment, which makes their persistence particularly problematic.

These technical shortcomings are not merely a matter of poor practice – they carry serious social implications. As Stoilova (2025) highlights, digital exclusion is closely linked to social, economic, and cultural inequalities. The lack of an accessible digital environment in education contributes to the reproduction of inequalities based on disability, age, geographic location, and social status, limiting equal access to knowledge – a key resource in the modern world. In this sense, web accessibility is not simply a technical standard but a fundamental element of digital justice and active citizenship (Hristova, 2025b; Konstantinov, 2025).

In conclusion, insufficient web accessibility on university websites should not be viewed as a technical oversight, but rather as a structural deficit with profound social dimensions. Ensuring inclusive education and a fair digital transition requires not only legal obligations but also sustained institutional efforts. It is recommended that higher education institutions develop internal accessibility policies, incorporate training modules for IT teams and content editors, and establish mechanisms for consultation with users with disabilities. In the long term, web accessibility should be integrated into accreditation processes and internal evaluations of the quality of digital infrastructure. The Ministry of Education and Science could support this process by developing guidelines, promoting shared best practices, and creating

platforms for monitoring and self-assessment. Such measures would ensure not only compliance with regulations, but also bring about tangible change towards a more accessible, equitable, and inclusive university environment.

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