ACCESSIBILITY OF DIGITAL INFORMATION RESOURCES FOR DIVYANG STUDENTS IN NON-AGRICULTURE UNIVERSITIES OF MAHARASHTRA: A STUDY

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Abstract :

In Indian universities, huge investments in digital library ecosystems and infrastructures are yet to yield any real ease of use from the perspective of students with disabilities, who are termed Divyang in policy statements. Thus, impairment consequent to disability impacts and poses a series of accessibility roadblocks while searching for and utilizing information resources in digital formats. Within this paper, a mixed-methods late-stage assessment of accessibility readiness, implementations, and lived experiences is proposed and carried out in non-agricultural universities of Maharashtra. The paper draws from the social model of disability, UDL, and WCAG 2.2 as theoretical frameworks as well as for analytical tools and analyzes accessibility in 4 layers: (1) institutional policy and governance, (2) digital platforms (university and library websites, discovery systems, LMS, IRs, and e-resource portals), (3) digital content (e-books, PDFs, videos, AV, datasets), and (4) end-user supports (ATs, training, remote and in-person services). The data used for this research include an accessibility audit of core digital properties, a survey of Divyang students and library/IT staff (n ≈ to be filled after data collection), semi-structured interviews, and a document analysis of policies and procurement clauses. Keywords: Assistive Technology; Students with Disabilities; Digital Libraries; WCAG 2.2; Universal Design for Learning; Higher Education; Inclusive ICT; Maharashtra; E-resources; Divvying

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Introduction :

In India, the State of Maharashtra is endowed with one of the widest and most complex ecosystems for non-agriculture universities, including state universities, central universities, deemed universities, and private universities. All these schools together impart education to a huge number of students in programs like arts, social sciences, commerce, law, engineering, and management. In Maharashtra, for the past 10+ years, higher education has been focusing on digitization and digitized tools such as Learning Management Systems (LMS), Institutional Repositories (IRs), discovery services, e-journal and e-book platforms, video conferencing systems, and remote access authentication systems have already seen initial implementation. These set of initiatives address a framework set forth in policies such as the National Education Policy (2020), which clearly creates an impression of a digitally empowered learning ecosystem. Somehow, the aspect of accessibility in the decremental digital transition has received comparatively less emphasis. Thus, digital accessibility means an extent to which

online platforms, electronic resources, and ICT services are perceived, operated, understood, and robust (POUR) for various types of learners including the ones who may be disabled.

For Divyang students-who may have visual, hearing, motor, cognitive, or multiple impairments-the concept of digital accessibility represents the only way of allowing meaningful participation in academic life. Practically speaking, this also means that they must be compatible with assistive technology like screen readers, screen magnifiers, refreshable braille displays, voice recognition software, synchronized captions, transcripts for images, alt-text, navigable headings, EPUB3/DAISY formats, and keyboard navigation. Access and inaccessibility unite with discriminatory factors at systemic levels, thus becoming systemic exclusion.

Hence, without adequate semantic markup, a journal database might appear to be fully functional to a sighted user. But for a student with a visual impairment, it becomes a "no-access" scenario-a screen reader simply does not allow it to be accessed. Similarly, lecture recordings not provided with captions exclude those with hearing disabilities, and so poorly designed PDFs exclude those with cognitive/language disabilities. These issues are recognized in the Indian framework from legal and policy viewpoints. According to the Rights of Persons with Disabilities Act (2016), reasonable accommodation is to be provided to persons with disabilities by educational institutions concerning ICT, learning materials, and digital resources being accessible to them. The University Grants Commission and Ministry of Education have also emphasized inclusive higher education standards. On the international level, the Web Content Accessibility Guidelines 2.2 (WCAG 2.2) establish measurable criteria for website and mobile application accessibility under the auspices of the World Wide Web Consortium (W3C). The Marrakesh Treaty (2013) further increases access by removing copyright limitations that prohibit works from being converted into accessible formats. Since libraries lie at the convergence of pedagogy, technology, and information services, they can further help in operationalization of accessibility standards. In addition to repositories of knowledge, libraries also act as mediators of digital equity so that Divyang students reap the benefits of all institutional investments in digital learning, which may include accessible procurement policies (holding vendors accountable for WCAG/EPUB3 violations), staff awareness training in accessibility, retrofitting of legacy resources, and implementation of universal design in the delivery of digital services.Conceptual Framing:

We position accessibility as an ecosystem phenomenon rather than a single platform feature. The study integrates three different lenses:

Social Model of Disability :

This model shifts the focus from the person's impairment to the barriers created by society and environment. According to this view, disability does not just arise because a person is blind, deaf or has limited mobility; rather, disability is perceived when digital systems, infrastructure or pedagogical practices are not inclusive. For example, an academic article without alt-text, or one that cannot be navigated by a keyboard, are disabling to the learner beyond the impairment itself. Hence, the onus is on the designer for designing the

environment to suit different learners.

Universal Design for Learning (UDL) :

The UDL is a proactive framework that talks about accessibility from the beginning rather than later. It highlights: Multiple means of engagement (motiving learners in different ways, Newage Constructions), Multiple means of representation (displaying content via different ways, say, text, audio, video, captions, or tactile graphics), and Multiple means of action and expression (perhaps through doing, students may demonstrate different ways of learning). If A digital library/LMS platform is set up following UDL principles, it simultaneously engages a student in equity-based access, interaction, and sharing of knowledge, including Divyang learners.

Technology-acceptance & use :

According to the models like Technology Acceptance Model or TAM, the adoption of digital platforms basically depends on two factors: perceived usefulness (to what extent the student feels the system will help him/her to achieve academic goals) and perceived ease of use (how little effort has to be put into using it). For the Divyang students, the accessibility is the key medium: if a platform is inaccessible, they simply bring down its usefulness and usability, thus contributing to exclusion; an accessible design gives one confidence, independence, and therefore, thereby, into greater adoption rates.

Problem Statement :

The higher education setup in India follows a digital divide wherein national policies and global standards call for digitally inclusive environments. Some of the challenges they run into are inaccessible e-resources; irregular compliance with WCAG and EPUB standards for accessibility; or lack of staff training in the relevant design. Some of the present works cite these issues at a general level; however, it seems there exists no systematic state-level evidence on how the various non-agriculture universities in Maharashtra go about meeting the digital accessibility needs of the Divyang students. Filling this gap involves the present research that explores the contemporary practices, challenges, and potential areas of improvement.

Significance of the Study :

The study in question is important because it does not simply list problems but also tries to offer workable standards-based solutions for the universities in Maharashtra. In particular, it will: Benchmark accessibility performance - Ascertaining quantifiable evidence surrounding how much digital platforms, library systems, and learning resources conform to recognized and approved accessibility standards such as WCAG and EPUB. Universities will be able to judge their present standing and follow enhancement. High-impact fixes and capacity-building needs: Determine specific barriers for high-impact fixes in inaccessible PDF, lack of captioning, bad navigation, etc., and prioritize remediation along with training needs or policy amendments. Institutionalization of accessible procurement and content development- Assist interested universities to promote accessibility requirements in vendor contracts,

resource selection, and digital content development to ensure end compliance and sustainability. Enhance equity of opportunity and academic achievement – Finally, by eliminating digital barriers, this study wants to ensure that Divyang learners have equal access to knowledge and fully participate in academic life to meet educational achievement goals.

Objective :

- To assess the accessibility of essential digital properties (websites, OPAC/discovery, IRs, LMS, e-resource portals) online vis-à-vis WCAG 2.2 Level AA.
- To have a map for the availability and accessibility of digital information resources (e-books, e-journals, databases, video/AV, courseware) mainly concerning EPUB3, DAISY, tagged PDFs, captions, transcripts, and alt-text.
- To study the experiences, needs, and coping strategies of Divyang students in the use of digital resources and services.
- To evaluate organizational readiness with regard to policies, budgets, procurement clauses as well as staffing, training, and assistive technology infrastructure.
- To develop a context-driven Maharashtra University Digital Accessibility Index (MUDAI) and an implementable roadmap for digital library services with inclusivity.

Literature Review :

Global Standards and Frameworks Global policy and technical standards constitute a firm foundation in ensuring the rights-based access to digital information for persons with disabilities. The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD, 2006), however, recognizes accessibility as an inherent human right and demands educational, informative, and communicative systems to be inclusive from states that are in accession to it. Article 9 mentions accessible ICTs, while Article 24 mentions inclusive education, thereby making governments and institutions responsible for ensuring equitable participation. The World Wide Web Consortium (W3C) created the World Wide Web Consortium General Web Accessibility Guidelines 2.2 to give a technical benchmark for ensuring those rights. The guidelines transform the concept into meaning by accessibility into four broad principles: perceivable, operable, understandable, and robust (abbreviated as POUR). The world has agreed on WCAG 2.2 Level AA as a reference standard to assess websites, learning centers, and digital repositories. The Magnus Treaty (2013) is further administered by the World Intellectual Property Organization (WIPO), removing copyright barriers to making and sharing books across borders in accessible formats like braille, audio, and DAISY. It has, in fact, underpinned the rise in the availability of education in accessible formats across various jurisdictions. Sector-specific organizations have also been in the mix. The International Federation of Library Associations and Institutions (IFLA) lays down frameworks on inclusive library services; it suggested policies, workflows, and training to assist library staff in providing access to the library in digital and physical realms. The DAISY Consortium, on the other hand, has prepared technical standards (e.g., DAISY, EPUB3) that

Accessibility in Higher Education :

Research literature suggests that barriers faced by institutions of higher education in achieving full accessibility of digital systems still linger. Such barriers include non-WCAG-compliant webpages, inaccessible PDFs, multimedia without captions or transcripts, and e-resources with hard, nonsemantic formats that are simply unusable by an assistive technology. Here, however, we see another set of fallibilities aware of oneself: the cases where institutions go astray, with little or no clear accessibility policy, responsibilities poorly demarcated between libraries and the IT department, and so forth. Sometimes these staff are themselves not in a position to implement such tasks, or simply lack the time to engage in accessibility work. In short, Divyang students get left almost entirely to fend for themselves through personal coping mechanisms, rather than receiving systemic support. Whereas, research shows that embedding Universal Design for Learning (UDL) or accessibility "upstream" into course design, repository submission workflows, content licensing agreements, and procurement processes greatly mitigates barriers. This proactive approach improves learning outcomes for Divyang students while simultaneously improving usability and flexibility for all students.

While researchers seem to be of the opinion that universities probably had their hard time implementing full accessibility across digital systems, some barriers still exist. Pages are not necessarily WCAG-compliant, PDFs are inaccessible, multimedia lacks captions or transcripts, and e-resources are turned into rigid formats which do not support any assistive technologies. Generally, these inadequacies are attributed to institutional disconnects such as lack of clear accessibility policies and weak delineation of demarcation of responsibilities between libraries and IT departments. Again, there will be situations where staff are inadequately trained or just simply don't have time for accessibility work. Thus, the students with disabilities are left more or less on their own to come up with their own coping mechanisms rather than benefiting from organized support. In such a setting, embedding Universal Design for Learning (UDL) and accessibility practices in course design will go a long way in breaking down barriers in repository submission workflows, content licensing agreements, and procurement processes. This proactive measure, therefore, leads to enhanced teaching and learning for Divyang students while improving the usability and flexibility of the system for students in general.

Identified Gaps :

Though accessibility in higher education has been looked into the international literature and to some extent in India, certain gaps remain:

- Absence of indices to benchmark accessibility at the state level- While WCAG and DAISY exist as international standards, no such state-specific indices have been made in Maharashtra to ascertain the level of accessibility of digital platforms and resources under the direct purview of non-agricultural university governance. The absence of such an index means that there is no organized tool through which an entity may benchmark its accessibility performance vis-a-vis another or even track its own progress over time.

- Limited mixed-methods studies- Widely available reports either depend on technical audits (like website accessibility checks) or on self-reported surveys. Few studies incorporate the mixed-methods approach in the form of audits, surveys, interviews, and policy and document analysis. This triangulation technique is necessary to build a broader picture of accessibility from the angle of technical compliance and the lived student experiences thereof.
- Few research studies record the lived experiences of such students and the strategies employed in coping. Given the focus on compliance metrics (how many sites comply with WCAG criteria, etc.), there is less attention given to the real-life experiences of Divyang students- how they perceive and operate with systems based on accessibility or the workarounds they apply when barriers hinder them academically. These perspectives are vital for the development of pragmatic, student-focused solutions.

Methodological Aspects :

Research Design :

A mixed-method approach integrates quantitative audits of the digital platform/resource with qualitative insights from students and staff. Justification: it ensures that we have not only the technically compliant engineering data but also the data that concerns lived experiences. Thus, it provides a holistic view. The population here, nature-wise, comprises all the non-agricultural universities located in Maharashtra, including state universities, central universities, deemed universities, and the private universities into consideration for the study. Together, these agencies form a heterogeneous ecosystem of higher education and cater to a vast population of students, comprising students with disabilities who have varied academic requirements. The whole population might not be covered; therefore, a sample has been chosen to represent all types of institutions and the geographical context of the state. Purposive sampling was adopted among the universities, with around 10 to 12 institutions being selected for representation in terms of governance structures (i.e., state, central, deemed, and private) and representation in terms of location (for example, Vidarbha, Marathwada, Western

Maharashtra, Konkan, and North Maharashtra). In this manner, the results would embrace regional or institutional variations in access practices. Divyang students would constitute the student sample from these universities and might span across different faculties and disciplines, placed through the offices for persons with disabilities, cells for equal opportunity, or student support offices in the university. Presence of students across disciplines would add to garnering varied experiences in accessing information in digital formats.

Toying with some staff nomenclature will have a lot of implications, ranging from being the e-resources library professionals managing, ICT to managing the digital platform such as LMS and repositories, including administration for policy and procurements. From a coding and managerial view, their perspectives are critical to this study. Such an approach will ensure that data from students using digital resources and stakeholders designing, managing,

and providing support to those resources are gathered, thus having a 360-degree view on accessibility pertaining to non-agriculture universities in Maharashtra.

Data for the study will be collected using a multi-method approach so that all aspects of accessibility are taken care of. In the first place, accessibility audits with WAVE, axe, NVDA screen reader checks, and Adobe Acrobat accessibility checker will be conducted. The audit shall cover university websites, OPAC/discovery services,

Regarding benchmarking against WCAG 2.2 Level AA and EPUB3/DAISY standards, it will be done on institutional repositories, LMS, and e-resource portals. Second, resource analysis will be conducted on a sample of e-books, e-journals, databases, audio-visual materials, and courseware to find tagged PDFs, alt texts, captions, transcripts, and navigable structures. Third, surveys having structured questionnaires will be administered to Divyang students to glean information regarding their usage, accessibility problems faced, ways to cope, and overall satisfaction. Fourth, they have semi-structured interviews and focus group discussions with Divyang students, and librarians and IT staff to obtain qualitative insights into lived experiences, institutional barriers, and potential solutions. And finally, a policy and document review will explore institutional accessibility policies, procurement clauses, staff training records, and budget allocations. These approaches put together will help form quantitative benchmarks as well as qualitative perspectives on accessibility within non-agricultural universities of Maharashtra.

Data Analysis Process :

The table below summarizes the data analysis process adopted in the study, highlighting methods, data sources, analytical techniques, and expected outputs.

Method	Data Source	Analysis	Output
Quantitative Analysis	Accessibility audits are reviews conducted Along with student surveys	WCAG/EPUB compliance scoring, descriptive statistics (frequencies and percentages).	Accessibility levels: numerical indicators, trend of usage
Qualitative Analysis	Interviews, focus groups, and policy documents	Thematic coding, pattern identification, comparison of stakeholders.	Areas of insight pertaining to barriers, coping strategies, and institutional practices
Triangulation	Findings coming from audits, from surveys and from interviews	Cross-validating the results to ensure trusting reliability and robustness.	Synthesized evidence basis for MUDAI Index and recommendations

The Maharashtra University Digital Accessibility Index (MUDAI) is designed to be a composite score that will help benchmark the accessibility performance of non-agriculture universities. This index will assimilate four crucial dimensions: accessibility of platforms (websites, OPAC or discovery tool, LMS, and institutional repositories against WCAG 2.2 standards); accessibility of resources (accessible e-books, journals, multimedia, and courseware in accessible formats such as EPUB3, DAISY, tagged PDF, and video with captions);

The student experience (barriers, coping mechanisms, and satisfaction through survey feedback and interviews); organizational readiness (accessibility policies are in place, training for staff, infrastructure for assistive technology, and budgetary provisions). Each dimension will be given weighted scores and then aggregated into a value on a scale from 0 to 100. Higher and lower values will characterize universities into different performance bands viz., Excellent (80-100), Moderate (50-79), and Poor

Ethical Considerations Establishing the study within the broadest discourse of research ethics would be an assurance on the rights and dignity of all subjects, especially Divyang students who could become a vulnerable group under these circumstances. Prior to data collection, every subject will be asked for informed consent with clear details about the study's purpose, the procedures to be followed, and the participant's rights to end the process at any given time without facing any kind of repercussion.

When it comes to matters of privacy, utmost standards will be respected throughout the study. In all documents, transcripts, and any other forms such as a survey report or institutional report, facts that could lead to the identification of a subject will be stripped away. Private data will be stored in safe storage and used for academic purposes only. Negotiations will continue with relevant stakeholders to ensure research tools are accessible, including survey forms compatible with screen readers; interview guides in multiple accessible formats (e.g., digital text and large print); and audio-assisted responses, if so necessary. No inducement of a coercive kind would be offered to subjects; hence, even if occasionally they might be offered a token, entering into the study is strictly voluntary. Further, consideration will be given to seeking ethical approval from the Institutional Ethics Committee at the university where the lead researcher is appointed. Limitations

Just like any other empirical research, this study faces several limitations. Firstly, the samples considered (10-12 institutions) may not represent all non-agriculture universities of Maharashtra; in effect, limiting generalizability. Secondly, accessibility audits would be undertaken through a mixture of tools, some automated and some manual; while these might be moderately effective, some of those barriers experienced by real users might never make it to the report stage.

Resource analysis will be made for the limited sample of e-books, journals, and multimedia resources and might not cover the whole content licensed by each institute. Fourth, self-reporting via surveys may be prone to possible recall or social desirability bias or underreporting stemming from stigma. Fifthly, the study is for the most part on digital

resources and does not treat the states of physical infrastructures or instructing processes that might as well affect the learning experience for Divyang students. Finally, being cross-sectional, it pitches only a tentative snapshot without any view of the ongoing institution-based change or policy reformation.

Conclusion :

The Divyang account of students has still not been able to appropriately earn from the platforms and other educational e-resources due to disparate institutional practices, which do not make the resources fully accessible. This mixed-method comprehensive study, consisting of audits, surveys, interviews, and review of policies, sheds light on the technical shortcomings validated gloriously by the students themselves, like sites not being WCAG-compliant, unfriendly PDFs, and incomplete captioning, thus revealing some hard truths of their suffering. Attempting to respond to this issue, the study proposes MUDAI, the Maharashtra University Digital Accessibility Index: a scoring system to check and contrast universities' accessibility performances, thereby, scoring the universities based on respective accessibility parameters, helping them trace their weak links in the accessibility chain while improving on their shortcomings till the pests are root out. Finally, the study stresses that accessibility conceptualization should not be deemed a mere policy requirement or technical fix, and accessibility itself becomes a moral and educational imperative for the equity, inclusion, and empowerment of Divyang learners in higher education.

Recommendations :

Based on the findings of this study, several recommendations are suggested to improve the accessibility of digital information resources for Divyang students in non-agriculture universities of Maharashtra:

1. Adherence to Accessibility Standards :

All universities must require adherence to international accessibility standards like WCAG 2.2 Level AA, EPUB3, DAISY, etc., to ensure that websites, learning management systems, institutional repositories, and licensed e-resources are accessible. Accessibility clauses should be inserted into contracts with vendors to ensure they deliver inclusive resources rather than having to retrofit systems later-which would be more expensive for publishers and software providers.

2. Strengthening Policies and Governance :

Each university ought to establish a policy on digital accessibility with clear definition of roles and responsibilities for implementation. The disability support cell and equal opportunity cell should be duly empowered with adequate resources, human officials, and legal power to withhold and report on matters of accessibility compliance. Periodic institutional audits shall be carried out, and the findings should be made public so as to improve transparency and accountability.

3. Capacity building and training :

Accessibility cannot succeed without skilled personnel. Universities should impart capacity-building programs to accommodate librarians, ICT staff, and teaching faculty. Training should cover awareness of assistive technologies, creation of accessible documents, captioning, alt-text preparation, and Universal Design for Learning (UDL) principles. Such continuous professional development will help keep accessibility as an ongoing practice rather than a one-time intervention.

4. Accessible Resource Development :

The library should prioritize retrofitting legacy resources such as untagged PDFs, scanned documents, and uncapped videos. One of the activities toward that goal is working with any open-source tool or in-house tool(s) to convert files into tagged, navigable formats. All new acquisitions should also be subject to an accessibility check prior to purchase. Course instructors should also be encouraged to prepare born-accessible content based on UDL principles so that all students can interact with resources on an equitable basis.

5. Student-Centric Support Systems :

Divyang students require disability accommodations within assistive technology labs, helpdesks, and peer-support teams. Licensed software (screen readers, magnifiers, voice-recognition systems) and hardware (refreshable braille displays, adapted keyboards) should be made available to clients across campuses. Further, these needs should be reassessed periodically to consider demand-based services, including transcription, note-taking aid, and accessible exam presentation.

6. Monitoring and Accountability through MUDAI :

The proposed Maharashtra University Digital Accessibility Index should be institutionalized as an annual benchmarking tool. Universities would be rated by MUDAI on four levels: platform accessibility, resource accessibility, student experience, and organizational readiness. Establishing public ranks could foster healthy competition and motivate universities to give priority to accessibility.

7. Partnerships for Advocacy :

Accessibility barriers are systemic and cannot be remedied in isolation by one university. Institutions should come together in consortia to share best practices, pool funds for retrofitting, and wield their collective commercial clout to insist upon accessible licensing from vendors. Partnerships and alliances with NGOs, accessibility experts, and organizations such as the DAISY Consortium or IFLA will bring in worldwide expertise to local implementation. At the policy level, universities should lobby the University Grants Commission (UGC) and Ministry of Education to secure dedicated funding and make accessibility a criterion in accreditation.

8. Continuous Feedback and Student Involvement :

Divyang students should be involved as active stakeholders in the design and evaluation of digital systems. Regular feedback sessions, student advisory committees, and the inclusion of Divyang representatives in procurement can ensure that accessibility solutions evolve from actual lived experiences rather than from presumption.

The above guidelines have established that digital accessibility cannot be considered a one-time technical fix but rather a long-term institutional commitment. By combining policy, technical compliance, staff training, resource development, student support, and monitoring, non-agriculture universities in Maharashtra can create inclusive digital ecosystems. This will not only fulfill legal obligations under the RPwD Act (2016) but also align with the broader vision of equity and inclusion enshrined in the National Education Policy (2020).

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