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Building the Inclusive Digital Classroom: A Framework for Quality and Equity in Open Distance Electronic Learning

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Abstract: The rapid digitalisation of higher education, accelerated by the COVID-19 pandemic and the Fourth Industrial Revolution, has created unprecedented opportunities for expanding access to learning while simultaneously exposing deep-seated inequalities that marginalise students with disabilities. This paper examined the imperative of building inclusive digital classrooms within Open Distance and Electronic Learning (ODeL) environments, with particular attention to the experiences of learners with diverse disabilities including visual impairments, hearing impairments, intellectual disabilities, and physical disabilities. Drawing on a synthesis of recent empirical research from African and international contexts, the paper proposed a comprehensive framework for quality and equity anchored in four interconnected pillars: equitable infrastructure access, Universal Design for Learning (UDL) implementation, institutional capacity building, and participatory governance. Empirical findings from a Zimbabwean university study reveal that only 14% of audited courses achieved full WCAG 2.1 Level AA compliance, with absent video captions (88%), missing image alt-text (86%), and inaccessible PDFs (80%) among the most prevalent barriers for students with visual and hearing impairments respectively (Zongozzi & Ngubane, 2025; Chomunorwa et al., 2024). The paper argued that true inclusivity in ODeL requires moving beyond a narrow focus on technological access to address systemic barriers related to disability, socio-economic status, digital literacy, and cultural relevance. The study recommended a multi-level, multi-stakeholder approach that integrates social justice principles, redistribution, recognition, and participation, into the design and delivery of digital education, positioning inclusive ODeL not as an optional accommodation but as a fundamental rights-based obligation and a cornerstone of equitable education in the digital age (Tabe, 2025; Fraser, 2008).

Keywords: Inclusive Digital Classroom, Open Distance Electronic Learning (ODeL), Equity, Universal Design for Learning (UDL), Digital Divide, Students with Disabilities, Visual Impairment, Hearing Impairment, Intellectual Disability, Physical Disability, Social Justice, Quality Assurance, Artificial Intelligence, Assistive Technology, Neurodiversity

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1. INTRODUCTION AND BACKGROUND

The landscape of higher education has undergone a profound transformation, driven by the dual forces of technological innovation and the global shift towards open and distance learning. The emergence of the COVID-19 pandemic served as a critical catalyst, necessitating a rapid reconfiguration of educational structures and accelerating the adoption of digital learning platforms across the globe (Pietersen, 2025; Zongozzi &

Ngubane, 2025). Open Distance and Electronic Learning (ODeL) holds immense potential to reach students who might otherwise be excluded from higher education due to geographical location, socio-economic constraints, or physical disabilities (Tabe, 2025). However, this potential is only realised when digital learning environments are designed and implemented with quality and equity as foundational principles (Rice et al., 2025).

The concept of the "inclusive digital classroom" has gained increasing attention as educators and policymakers grapple with the challenge of ensuring that no learner is left behind in the digital transition. Tabe (2025) defines an inclusive digital classroom as an educational ecosystem defined by several key attributes: the fusion of technologies to create a seamless and accessible learning experience; a multiplicity of sites where learning occurs across physical, virtual, and hybrid spaces; the provision of non-discriminatory educational opportunities; the promotion of lifelong learning; and a student-centred approach to teaching and learning that empowers students to take an active role in their education. Rice et al. (2025) similarly emphasise that a research-based conceptual framework for inclusive online, distance, and digital education (IODDE) must focus on learners' biopsychosocial needs alongside policy supports and direct learner supports.

In the African context, these challenges are particularly acute. A study conducted at a state university in Harare, Zimbabwe, provides stark evidence of the barriers facing students with disabilities in ODeL environments. Chomunorwa et al. (2024) found that only 14% of audited courses achieved full WCAG 2.1 Level AA compliance, with absent video captions (88%), missing image alt-text (86%), and inaccessible PDFs (80%) among the most prevalent failures, barriers that disproportionately affect students with hearing and visual impairments respectively. Furthermore, 81.5% of students with disabilities lacked appropriate assistive technologies, while 76.8% of all students rated high data costs as a "major" or "severe" barrier (Chomunorwa et al., 2024). These findings are consistent with Zongozzi and Ngubane (2025), who found significant gaps in knowledge, policies, practices, and resources that impede the full engagement of students with disabilities in digital learning in South African higher education.

The intersectional nature of exclusion compounds these challenges. Crenshaw (1989) first articulated the concept of intersectionality to describe how multiple forms of marginalisation interact to create unique experiences of disadvantage. In the context of ODeL, students who experience both disability and rural origin face an exclusion risk nearly six times the baseline (Chomunorwa et al., 2024). This intersectional compounding reflects the reality that marginalisation in digital education is not a simple matter of a single barrier but a complex interaction of disability, socio-economic status, geography, and gender (Tabe, 2025; Chomunorwa et al., 2024).

International frameworks position inclusive digital education as a rights-based obligation. The UN Convention on the Rights of Persons with Disabilities (CRPD) and Sustainable Development Goal 4 (SDG 4) mandate equitable access to education for all learners (UNESCO, 2023; Akanni et al., 2026). Universal Design for Learning (UDL) has emerged as a guiding framework for embedding accessibility and flexibility into ODeL systems from inception (Meyer et al., 2014; Rose & Meyer, 2002). UDL is defined as "a process in which a curriculum (goals, methods, materials and assessments) are intentionally designed to offer flexible and inclusive approaches that can be customised and adjusted for individual needs" (CAST, 2018, as cited in Nikolenko et al., 2026, p. 382). The key components of UDL are to ensure flexibility and accessibility in the ways information is presented (multiple means of representation), the way students respond or demonstrate knowledge and skills (multiple means of action and expression), and the

way they are engaged in the learning process (multiple means of engagement) (Meyer et al., 2014).

This paper addresses the critical question: "How can we build inclusive digital classrooms that ensure quality and equity in Open Distance Electronic Learning?" It argued that building such classrooms requires a holistic framework that goes beyond simply providing access to technology. It necessitates a fundamental shift in pedagogical practice, institutional policy, and resource allocation, guided by principles of social justice and inclusive design (Tabe, 2025; Fraser, 2008).

1.2 Research Questions

1. What are the systemic barriers to inclusive digital learning for students with disabilities in ODeL environments?
2. How do specific disability types, visual, hearing, physical, intellectual, and neurodevelopmentalexperience unique barriers in digital learning spaces?
3. What role does Universal Design for Learning (UDL) play in addressing these barriers?
4. What strategies can institutions implement to address the identified barriers and build more inclusive digital classrooms

2. LITERATURE REVIEW

2.1 Defining the Inclusive Digital Classroom

An inclusive digital classroom in ODeL is more than a virtual space where content is delivered online. It is a carefully designed educational ecosystem that ensures all students, regardless of their background or abilities, can participate fully and achieve equitable outcomes. Rice et al. (2025) developed a research-based conceptual framework for inclusive online, distance, and digital education (IODDE) that focuses on learners' biopsychosocial needs alongside two major types of supports: policy supports and direct learner supports. The framework also identifies two crucial forms of access: digital access and instructional access.

The digital divide has evolved beyond a simple binary of access/no access to encompass three distinct dimensions (Tabe, 2025; Oregon Department of Education, 2023). The first is the "digital access divide", which concerns infrastructure and connectivity whether students have access to reliable internet, appropriate devices, and electricity. The second is the "digital use divide", which concerns how technology is employed in learning, distinguishing between using technology as a simple substitute for traditional methods and using it to augment and redefine learning in transformative ways. The third is the "digital design divide", which concerns how the design of digital tools and materials either promotes or limits learning for students (Oregon Department of Education, 2023).

Fraser's (2008) social justice framework provides a theoretical foundation for understanding the dimensions of inclusion. Fraser (2008) argues for three interconnected principles: "redistribution" (equitable allocation of resources), "recognition" (valuing diverse identities and experiences), and "participation" (ensuring all students have a voice in decision-making). Tabe (2025) applies this framework to ODeL, arguing that inclusive digital classrooms must address all three dimensions simultaneously.

2.2 Students with Disabilities in ODeL: Specific Barriers and Needs

Students with disabilities (SwDs) face particularly acute challenges in ODeL environments. The challenges extend across multiple dimensions, with specific disability types presenting distinct barriers that require targeted solutions (Zongozzi & Ngubane, 2025; Manase, 2023; Nikolenko et al., 2026).

2.2.1 Students with Visual Impairments

For students with visual impairments, the most significant barriers include the absence of alternative text for images, inaccessible PDF documents that cannot be read by screen readers, and non-compliant learning management systems that do not interface effectively with assistive technologies such as JAWS or NVDA screen readers (Chomunorwa et al., 2024). Chomunorwa et al. (2024) found that 86% of audited courses had missing image alt-text, while 80% had inaccessible PDFsboth critical barriers for blind or partially sighted students. Additionally, platforms such as SUNLearn, MS Teams and Zoom present difficulties when using accessible technologies such as screen readers and Braille displays, requiring further instruction for students to participate effectively in discussions, access educational resources, and complete assessments (Zongozzi &Ngubane, 2025; Pitsoane&Matjila, 2021).

Manase (2023) emphasises that making student devices accessiblesuch as user-friendly computers with enlarged words and symbols specifically designed for visually impaired studentsis essential for meaningful participation. The lack of accessible hardware compounds the challenges of inaccessible software, creating a double barrier for students with visual impairments (Ngubane-Mokiwa & Zongozzi, 2021).

2.2.2 Students with Hearing Impairments

For students with hearing impairments, the primary barriers are the absence of closed captions and transcripts for video content (Chomunorwa et al., 2024). The same study found that 88% of video content lacked captions, effectively excluding students who are deaf or hard of hearing from a substantial portion of instructional content. Students who are deaf or hard of hearing also face challenges with synchronous online sessions where real-time captioning or sign language interpretation is not provided (Zongozzi & Ngubane, 2025).

Pitsoane and Matjila (2021) note that students with hearing impairments also lack the incidental learning that occurs through overhearing conversations and environmental sounds, making deliberate and comprehensive captioning and transcription essential for equitable access. The absence of these supports contributes to what Nikolenko et al. (2026) describes as a "digital divide" that not only limits access but also reinforces existing patterns of inequality and exclusion (Nikolenko et al., 2026, p. 378).

2.2.3 Students with Physical Disabilities

For students with physical disabilities, barriers include the incompatibility of learning platforms with adaptive input devices such as mouth sticks, eye-gaze technology, or switch controls (Zongozzi & Ngubane, 2025). Students with limited mobility may require alternative input methods for navigation and text entry that are not supported by standard ODeL platforms. Additionally, examination accommodation remains limited, with students often being offered reduced options such as smaller, quieter examination rooms rather than technology-enabled solutions like voice-to-text dictation or specialised examination software (Manase, 2021).

Chimhanda (2023) argues that institutions often fail to consider the physical accessibility of learning spaces, both physical and digitalwhen designing ODeL programmes. This oversight perpetuates the exclusion of students with physical disabilities who require accessible physical environments to complement digital access.

2.2.4 Students with Intellectual Disabilities

For students with intellectual disabilities, challenges include the cognitive overload of poorly structured digital content, the lack of simplified language options, and insufficient

time to complete tasks (Zongozzi & Ngubane, 2025). Research from the South African context found that a participant with an intellectual disability expressed the view that "relying just on assistive technologies is insufficient, as he also requires the assistance of a caregiver to help with his daily tasks," and that his "intellectual disability necessitates a longer period of time for studying" (Zongozzi & Ngubane, 2025, p. 8).

These students benefit from Easy-to-Read language, clear visual structuring of content, and flexible timeframes for completion of assessments (UNESCO, 2023). Nikolenko et al. (2026) argue that using gamification and specific software applications can promote engagement and participation for students with intellectual disabilities by making the learning process more visible and more appealing (Nikolenko et al., 2026, p. 388).

2.2.5 Neurodiverse Learners

For neurodiverse learners, including those with autism and ADHD, challenges relate to sensory overload, the need for predictability and structure, and difficulties with social communication in online environments (Akanni et al., 2026). Akanni et al. (2026) argue that inclusive ODeL frameworks must be specifically designed to address the needs of neurodiverse learners, who are often overlooked in mainstream approaches to digital inclusion.

Studies indicate that implementing UDL principles effectively can help address these challenges by providing multiple means of engagement, representation, and action/expression (Meyer et al., 2014). However, research also shows that despite training, teachers often struggle to implement learner-driven UDL guidelines, particularly with deafdisabled students, highlighting the need for ongoing professional development (Nikolenko et al., 2026).

2.3 The Intersection of Disability and Other Forms of Exclusion

The intersectional nature of exclusion compounds these challenges, with students experiencing multiple marginalisations facing disproportionately higher barriers (Crenshaw, 1989; Tabe, 2025). Research in the Zimbabwean context found that the disability–rurality interaction (OR = 5.61) produced exclusion risk nearly six times the baseline (Chomunorwa et al., 2024). The same study identified rural origin (OR = 3.87), disability status (OR = 2.94), low income (OR = 2.15), and female gender (OR = 1.68) as significant predictors of digital exclusion (Chomunorwa et al., 2024). This suggests that the "digital divide" is not a simple binary but a complex web of intersecting inequalities.

Chidarikire (2023) similarly found that inclusion in Zimbabwean rural schools faces compounded challenges due to the interaction of geographical isolation, resource scarcity, and limited teacher capacity. These findings underscore the need for intersectional approaches that recognise and address the multiple, overlapping barriers facing marginalised learners (Tabe, 2025).

2.4 Universal Design for Learning as a Guiding Framework

Universal Design for Learning (UDL) offers a comprehensive approach to addressing these diverse needs (Meyer et al., 2014; Rose & Meyer, 2002). UDL is an instructional design framework that promotes expert learning by promoting accessibility and reducing barriers to learning (CAST, 2018, as cited in Nikolenko et al., 2026). It is based on three core principles: (1) multiple means of engagement (the "why" of learning), (2) multiple means of representation (the "what" of learning), and (3) multiple means of action and expression (the "how" of learning) (Meyer et al., 2014).

Research demonstrates that designing UDL in eLearning (UDeL) can significantly improve accessibility and inclusivity (Nikolenko et al., 2026). However, studies also indicate that engaging in additional teacher education and research is key to ensuring educators develop the knowledge and skill to understand and apply UDL (Nikolenko et al., 2026; Pete & Soko, 2020). Manase (2021) proposes the necessity of expanding the range of instructional materials, teaching methods and assessment modalities to minimise the disadvantages faced by SwDs, suggesting the incorporation of Universal Design for Learning into educational institutions to accommodate all forms of diversity.

2.5 The Pedagogy of Care in Digital Learning Environments

Recent scholarship advocates for a fundamental reimagining of ODeL as a space for radical transformation, centring student agency, dialogue, and co-creation (Pietersen, 2025; Tabe, 2025). This approach, rooted in critical pedagogy, care ethics, and social justice, challenges the traditional, transactional nature of online instruction. Pietersen (2025) argues that a "pedagogy of care" in ODeL moves beyond a one-size-fits-all model, recognising the diverse socio-economic and emotional needs of learners.

Tabe (2025) emphasises student voice and engaged pedagogy, dialogue and care, and a balancing act between maintaining academic rigour while also prioritising student well-being. This aligns with a social justice framework, which argues for the need for redistribution (equitable resources), recognition (valuing diverse identities), and participation (ensuring all students have a voice) (Fraser, 2008). Chimbunde (2023) similarly argues that funding online teaching and learning in developing countries must be approached with a care ethic that prioritises the needs of the most marginalised learners.

3. RESEARCH METHODOLOGY

3.1 Research Approach

This study employed a qualitative document analysis approach, synthesising recent empirical research on inclusive ODeL from African and international contexts. The research design draws on the literature review methodology outlined by Tabe (2025) and Rice et al. (2025), with thematic analysis used to identify patterns in challenges and strategies for inclusive digital education.

3.2 Data Sources

The study draws data from multiple sources:

- Empirical studies on digital inclusion and accessibility in Zimbabwean higher education (Chomunorwa et al., 2024; Chimbunde, 2023)
- Research on equitable access for students with disabilities in South African higher education (Zongozzi & Ngubane, 2025; Ngubane-Mokiwa & Zongozzi, 2021)
- UNESCO guidelines on open and distance learning for persons with disabilities (UNESCO, 2023)
- Research on inclusive ODeL frameworks for neurodiverse learners (Akanni et al., 2026)
- Studies on UDL implementation with deaf and deafdisabled learners (Nikolenko et al., 2026)
- Research on the pedagogy of care in ODeL (Pietersen, 2025; Tabe, 2025)

3.3 Thematic Analysis

Data were analysed through thematic analysis, following the procedures outlined by Tabe (2025) and Rice et al. (2025). The analysis followed a multi-step process: identifying themes from each source, synthesising patterns across sources, and categorising findings according to the four pillars of the proposed framework. Themes were identified through

iterative reading and coding of the source materials, with patterns and contradictions noted and resolved through discussion.

4. FINDINGS

4.1 Infrastructure and Technology Access Barriers

Findings: The findings reveal significant infrastructure and technology barriers that impede inclusive ODeL. In the Zimbabwean study by Chomunorwa et al. (2024), 76.8% of all students rated high data costs as a "major" or "severe" barrier, with this figure rising to 85.2% for students with disabilities. Load-shedding disrupted online access for 87.8% of rural respondents. Only 14% of audited courses achieved full WCAG 2.1 Level AA compliance. The most prevalent failures were absent video captions (88%), missing image alt-text (86%), and inaccessible PDFs (80%) (Chomunorwa et al., 2024).

Why These Findings Emerged:

1. Socio-economic constraints: High data costs disproportionately affect students from low-income households, who often cannot afford the data bundles required for sustained participation in ODeL. Chomunorwa et al. (2024) found that the cost of data was the most frequently cited barrier across all student categories, with students with disabilities reporting even higher levels of difficulty.

2. Infrastructure failures: Load-shedding and unreliable electricity supply, particularly in rural areas, prevent students from accessing online materials and participating in synchronous sessions. Chidarikire (2023) notes that rural schools and students face particular challenges in accessing consistent electricity, which undermines the effectiveness of ODeL programmes.

3.Lack of accessible design standards: Institutions have not adopted or enforced accessibility standards for their digital content and platforms, resulting in widespread inaccessibility. Chomunorwa et al. (2024) found that the inaccessibility was primarily organisational rather than technological—Moodle provides sufficient accessibility tools, but what is absent is governance, training, and accountability.

Supporting Studies: The UNESCO (2023) guidelines argue that solutions provided thus far have included tailored materials and courses, and Open Educational Resources (OER) aimed at enhancing equal access using mobile phones and Aptus devices for rural regions. However, Zongozzi and Ngubane (2025) confirm that platforms such as SUNLearn, MS Teams and Zoom continue to present difficulties when using accessible technology such as screen readers and Braille displays. Ngubane-Mokiwa and Zongozzi (2021) confirmed that limited resources exacerbate the issue of accessibility for SwDs, with inclusive digital learning for SwDs worsened by the socioeconomic disadvantage of most SwDs, the hindrance posed by their disabilities, and the high costs of internet access.

4.2 Institutional Capacity and Staff Training Deficits

Findings: The findings indicate significant gaps in institutional capacity and staff training. Only 16.1% of staff had received training in accessible design, yet 87.1% expressed willingness to engage in professional development, signalling a missed institutional opportunity (Chomunorwa et al., 2024). There is little to no interaction between disability support units and academics (Zongozzi & Ngubane, 2025). Administrators leading disability units often lack information about curriculum requirements to organise advocacy campaigns and advocate for resources (Ntombela, 2020, as cited in Zongozzi & Ngubane, 2025).

Why These Findings Emerged:
1. Lack of policy frameworks: Institutions lack clear policies requiring accessible design training for all staff. Chomunorwa et al. (2024) found that despite the willingness of staff to engage in professional development, institutional policies had not been established to mandate or incentivise such training.

2. Weak institutional coordination: Disability support units are not integrated with academic departments, creating a disconnect between policy and practice. Zongozzi and Ngubane (2025) found that disability units are often headed by administrators who "lack information about the requirements of the curriculum's mandate," making advocacy and resource allocation difficult.

3.Insufficient professional development: Institutions have not invested in continuous professional development for staff in accessible course design. Pete and Soko (2020) emphasise the need for capacity building for lecturers in online education but note that such programmes remain underfunded and underutilised in many institutions.

Supporting Studies: Nikolenko et al. (2026) emphasise that engaging in additional teacher education and research is key to ensuring educators develop the knowledge and skill to understand and apply UDL effectively. Zongozzi and Ngubane (2025) found that "most academics do not know how to support students with disabilities and most academics also do not consider students with disabilities when designing the content" (p. 5). Pitsoane and Matjila (2021) found that loss of academic time due to absence of resources in accessible formats contributed to students falling behind in their studies.

4.3 Specific Barriers for Students with Different Disability Types
Findings: The findings reveal distinct barriers for different disability types that require targeted solutions:

- Visual Impairment: Missing image alt-text (86%), inaccessible PDFs (80%), and platforms incompatible with screen readers (Chomunorwa et al., 2024). Students using screen readers require further instructions to navigate platforms such as MS Teams and Zoom (Zongozzi & Ngubane, 2025).

- Hearing Impairment: Absent video captions (88%), lack of real-time captioning for synchronous sessions, and absence of sign language interpretation (Chomunorwa et al., 2024; Zongozzi & Ngubane, 2025).

- Intellectual Disability: Need for extended time for studying and the requirement for caregiver assistance in daily tasks (Zongozzi & Ngubane, 2025). These students benefit from Easy-to-Read language and clear visual structuring (UNESCO, 2023).

- Physical Disability: Limited compatibility with adaptive input devices and alternative assessment formats (Zongozzi & Ngubane, 2025; Manase, 2021).

- Neurodiverse Learners: Challenges related to sensory overload, need for predictability and structure, and difficulties with social communication in online environments (Akanni et al., 2026).

Why These Findings Emerged:
1.Design failures: Content is created without considering the needs of students with different disabilities, reflecting a one-size-fits-all approach to content creation. Zongozzi

and Ngubane (2025) found that "most academics do not consider students with disabilities when designing the content," leading to widespread inaccessibility.

2.Lack of assistive technology provision: 81.5% of students with disabilities lacked appropriate assistive technologies (Chomunorwa et al., 2024). Manase (2023) notes that advanced assistive technology has been developed to help learners with learning disabilities, but these technologies are often not available to students who need them.

3.Insufficient assessment accommodations: Accommodations have been limited to examination modifications such as extra time and scribes rather than comprehensive support (Manase, 2021). Zongozzi and Ngubane (2025) found that accommodation remain "limited to modifications in exam settings and material formats," rather than addressing the full range of barriers.

Supporting Studies: Manase (2021) proposes the necessity of expanding the range of instructional materials, teaching methods and assessment modalities to minimise the disadvantages faced by SwDs. Nikolenko et al. (2026) argue that implementing UDL effectively can promote independence in students who are deaf disabled, but additional teacher education is key to ensuring educators develop the knowledge and skill to understand and apply UDL. Akanni et al. (2026) argue that inclusive ODeL frameworks must be specifically designed to address the needs of neurodiverse learners, who are often overlooked in mainstream approaches.

4.4 Governance, Policy, and Participation Gaps

Findings: The findings indicate a persistent policy-practice disconnect. Thematic analysis revealed four qualitative themes: inaccessibility as the norm, emotional toll, reliance on informal peer support, and a persistent policy-practice disconnect (Chomunorwa et al., 2024). Accessibility deficits are primarily organisational rather than technological—Moodle provides sufficient tools, but what is absent is governance, training, and accountability (Chomunorwa et al., 2024). Only 16.1% of staff had received training in accessible design, yet 87.1% expressed willingness to engage in professional development (Chomunorwa et al., 2024).

Why These Findings Emerged:

1. Weak governance: Institutions lack mechanisms to enforce existing accessibility policies. Chomunorwa et al. (2024) found that despite the existence of policies on inclusion, there were no mechanisms to ensure compliance, leading to a persistent policy-practice disconnect.

2. No accountability: Without clear accountability structures, accessibility remains a low priority. Zongozzi and Ngubane (2025) found that "there is little to no interaction between the disability section... and academics," and that this lack of integration undermines the effectiveness of support.

3. Exclusion from decision-making: Students with disabilities are not included in relevant committees (senate, examination boards, quality circles), and participation rights are not guaranteed. European Agency for Special Needs and Inclusive Education (2024) emphasises the importance of participation as co-determination in decision-making processes, not merely as consultation.

Supporting Studies: European Agency for Special Needs and Inclusive Education (2024) recommends that universities "guarantee students with disabilities permanent seats and voting rights in relevant committees (e.g., senate, examination boards, quality circles)."

UNESCO (2023) emphasises that the active involvement of students with disabilities is a prerequisite for needs-oriented measures, acceptance, and effectiveness. Chimbunde (2023) argues that funding online teaching and learning in developing countries must be accompanied by governance mechanisms that ensure accountability and inclusion.

5. Discussion

5.1 Summary of Major Findings

The findings of this study reveal a comprehensive picture of the barriers facing students with disabilities in ODeL environments and the systemic gaps that perpetuate these barriers. The research demonstrates that:

1. Infrastructure barriers are widespread, with high data costs affecting 76.8% of students overall and 85.2% of students with disabilities, while load-shedding disrupts online access for 87.8% of rural respondents (Chomunorwa et al., 2024).

2. Content inaccessibility is pervasive, with only 14% of audited courses achieving full WCAG 2.1 Level AA compliance. Absent video captions (88%), missing image alt-text (86%), and inaccessible PDFs (80%) represent the most common barriers (Chomunorwa et al., 2024).

3. Specific disability types face distinct challenges: students with visual impairments are affected by missing alt-text and inaccessible PDFs; students with hearing impairments are affected by absent captions; students with intellectual disabilities require extended time and caregiver support; students with physical disabilities face compatibility issues with adaptive input devices; and neurodiverse learners face challenges related to sensory overload and social communication (Zongozzi & Ngubane, 2025; Akanni et al., 2026).

4. Institutional capacity deficitsare evident in the fact that only 16.1% of staff had received training in accessible design, despite 87.1% expressing willingness to engage in professional development (Chomunorwa et al., 2024).

5.Governance gaps are reflected in the persistent policy-practice disconnect, with accessibility deficits described as primarily organisational rather than technological (Chomunorwa et al., 2024).

6. Intersectional exclusion is pronounced, with the disability–rurality interaction producing exclusion risk nearly six times the baseline (Chomunorwa et al., 2024).

5.2 Discussion of Findings

The prevalence of infrastructure barriers reflects the broader socio-economic challenges faced by students in developing countries. The finding that 85.2% of students with disabilities rate data costs as a "major" or "severe" barrier highlights the compounded disadvantage experienced by students with disabilities, who often face higher living costs and reduced employment opportunities (Chomunorwa et al., 2024). This aligns with Ngubane-Mokiwa and Zongozzi's (2021) finding that inclusive digital learning for SwDs can be worsened by the socioeconomic disadvantage of most SwDs, the hindrance posed by their disabilities, the prevalence of unfair practices, the exclusion and inequalities that SwDs face, and the high costs of internet access.

The pervasive content inaccessibility demonstrates that the design of digital learning materials often reflects a "curriculum for the average student" approach that excludes students with diverse learning needs (Tabe, 2025). The finding that only 14% of courses achieved full WCAG compliance reflects what Zongozzi and Ngubane (2025) describe as

a "lack of integration of technology" to enable fair and equal access for individuals with disabilities. This suggests that institutions are not implementing available accessibility standards, despite the existence of clear guidelines such as WCAG 2.1.

The identification of distinct barriers for different disability types underscores the need for targeted, differentiated solutions. For students with visual impairments, the absence of alt-text and inaccessible PDFs prevents access to essential course materials. For students with hearing impairments, the absence of captions excludes them from the majority of video-based learning content. The finding that students with intellectual disabilities require both assistive technologies and caregiver support challenges the assumption that technology alone can solve accessibility challengesa point made by Zongozzi and Ngubane (2025), who found that participants with intellectual disabilities emphasised that "relying just on assistive technologies is insufficient" (p. 8). This finding highlights the importance of a holistic approach that combines technological solutions with human support.

The institutional capacity gap between staff willingness (87.1% expressed willingness to engage in professional development) and actual training (16.1% had received training) represents a significant missed opportunity (Chomunorwa et al., 2024). This gap is consistent with findings from South Africa, where Ntombela (2020, as cited in Zongozzi & Ngubane, 2025) found "little to no interaction between the disability section... and academics," and the unit is "headed by administrators who lack information about the requirements of the curriculum's mandate." This suggests that institutional leaders are not prioritising accessibility training, despite staff readiness to engage with it.

The governance and participation gaps reflect what the literature describes as the "policy-practice disconnect." While institutions may have policies on inclusion, these are not effectively implemented. The finding that students with disabilities are not included in relevant committees mirrors European Agency for Special Needs and Inclusive Education (2024) research, which recommends that universities "guarantee students with disabilities permanent seats and voting rights in relevant committees (e.g., senate, examination boards, quality circles)." Without such participation, policies are developed without the input of those most affected, leading to solutions that may not meet actual needs.

5.3 Strategies to Address Outstanding Issues

Strategy 1: Institutional Adoption and Enforcement of Universal Design for Learning

Institutions must adopt UDL as the guiding framework for all ODeL course design, moving beyond a reactive accommodation model to a proactive, anticipatory design approach (Meyer et al., 2014; Rose & Meyer, 2002). This requires establishing institutional policies that mandate UDL compliance, providing ongoing staff development in UDL implementation, and creating accountability mechanisms to ensure compliance (Nikolenko et al., 2026). Manase (2021) argues that incorporating UDL into educational institutions is essential to accommodate all forms of diversity. Research demonstrates that implementing UDL effectively can promote independence in students who are deaf disabled, although additional teacher education is key to ensuring educators develop the knowledge and skill to understand and apply UDL (Nikolenko et al., 2026).

Strategy 2: Strengthened Governance and Accountability Mechanisms

Institutions must establish clear governance structures for digital accessibility, including an Accessibility Officer or Unit with authority to enforce accessibility standards and accountability mechanisms such as regular compliance audits of all ODeL courses. European Agency for Special Needs and Inclusive Education (2024) recommends that quality objectives for accessibility, well-being, and academic success should be defined

jointly with students with disabilities and regularly evaluated through public Inclusion Reports. Chomunorwa et al. (2024) found that accessibility deficits are primarily organisational rather than technological, suggesting that strengthened governance, not just improved technology, is the key to progress.

Strategy 3: Comprehensive Staff Development and Capacity Building
Institutions must invest in continuous professional development for all staff in accessible design and UDL implementation, leveraging the demonstrated willingness of 87.1% of staff to engage in professional development (Chomunorwa et al., 2024). Zongozzi and Ngubane (2025) recommend awareness training on discrimination and accessibility for all members of the university (teaching staff, administration, students) to raise sensitivity for the psychosocial dimension of digital exclusion. Training should be practical and ongoing, utilising models such as the University of Jyvaskyla's TINEL Project's Universal Design for eLearning (UDeL) camps, which provide staff with structured opportunities to develop inclusive eLearning skills (Nikolenko et al., 2026).

Strategy 4: Investment in Accessible Infrastructure and Assistive Technology
Institutions must ensure that all ODeL platforms are fully accessible, provide appropriate assistive technologies for students with disabilities, and subsidise data and connectivity for students who cannot afford them. Manase (2023) recommends making student devices accessible, such as user-friendly computers with enlarged words and symbols specifically designed for visually impaired students, and supporting the use of advanced assistive technology developed to help with learning disabilities. Additionally, low-tech delivery options such as downloadable content can benefit students in resource-constrained settings (UNESCO, 2023).

Strategy 5: Participatory Co-Design with Students with Disabilities
Institutions must involve students with disabilities in all stages of ODeL design and review, moving from consultation to co-governance. European Agency for Special Needs and Inclusive Education (2024) recommends guaranteeing students with disabilities permanent seats and voting rights in relevant committees (senate, examination boards, quality circles) and recording this in official documents. UNESCO (2023) emphasises that accessible formats (sign language interpreting, Easy-to-Read language, hybrid participation, provision of appropriate background information) as well as compensation for expenses and allocated time budgets ensure the actual exercise of these rights.

Strategy 6: Leveraging Artificial Intelligence and Emerging Technologies
Emerging technologies, particularly Artificial Intelligence, offer promising tools for enhancing accessibility in ODeL. Alvarez-Icaza and Huerta (2024) argue that augmented intelligence for open education offers the potential to bridge the digital gap with inclusive design methods. AI-powered tools can automate captioning and transcription, generate alt-text for images, and provide personalised learning support for neurodiverse learners. However, these technologies must be designed and implemented with input from students with disabilities to ensure they are genuinely inclusive and do not create new barriers (Akanni et al., 2026).

6. A FRAMEWORK FOR BUILDING THE INCLUSIVE DIGITAL CLASSROOM

Based on the findings and discussion, this paper proposes a comprehensive framework for building inclusive digital classrooms in ODeL. The framework consists of four interconnected pillars: Equitable Infrastructure Access, Universal Design for Learning (UDL) Implementation, Institutional Capacity Building, and Participatory Governance.

6.1 Pillar 1: Equitable Infrastructure Access

This pillar addresses the foundational prerequisites for participation, bridging the "digital divide" in all its forms (Tabe, 2025). It includes addressing the affordability and availability of connectivity, ensuring appropriate devices for students with disabilities, and providing reliable access through offline and low-tech alternatives (UNESCO, 2023). As evidence demonstrates, 76.8% of students rate high data costs as a major barrier, and 87.8% of rural students experience load-shedding disruptions (Chomunorwa et al., 2024). This pillar requires institutional investment in data subsidies, device loan schemes, and partnerships with telecommunications providers to reduce costs.

6.2 Pillar 2: Universal Design for Learning (UDL) Implementation

This pillar focuses on embedding UDL principles—multiple means of engagement, representation, and action/expression—into all ODeL course materials and platforms (Meyer et al., 2014). UDL is defined as "a process in which a curriculum (goals, methods, materials and assessments) are intentionally designed to offer flexible and inclusive approaches that can be customized and adjusted for individual needs" (CAST, 2018, as cited in Nikolenko et al., 2026, p. 382). The pillar includes ensuring all video content has closed captions (addressing the 88% of courses that currently lack captions), all images have alt-text (addressing the 86% of courses that currently lack alt-text), and all PDFs are accessible (Chomunorwa et al., 2024). Manase (2021) argues that expanding the range of instructional materials, teaching methods and assessment modalities is essential to minimise the disadvantages faced by SwDs.

6.3 Pillar 3: Institutional Capacity Building

This pillar focuses on developing the capacity of all staff to implement inclusive ODeL, including UDL expertise and competence in using assistive technologies. Given that only 16.1% of staff had received training in accessible design, yet 87.1% expressed willingness to engage in professional development (Chomunorwa et al., 2024), this pillar represents a significant opportunity for institutional transformation. Nikolenko et al. (2026) emphasise that additional teacher education and research is key to ensuring educators develop the knowledge and skill to understand and apply UDL effectively. Pete and Soko (2020) argue that capacity building for lecturers in online education is essential for sustainable inclusion.

6.4 Pillar 4: Participatory Governance

This pillar focuses on establishing governance structures and accountability mechanisms for digital accessibility, including co-design with students with disabilities. European Agency for Special Needs and Inclusive Education (2024) recommends guaranteeing students with disabilities permanent seats and voting rights in relevant committees (senate, examination boards, quality circles), establishing quality objectives defined jointly with students with disabilities, and publishing regular public Inclusion Reports. Tabe (2025) argues that participation must be established as co-determination in decision-making processes, not merely as consultation. UNESCO (2023) emphasises that the active involvement of students with disabilities is a prerequisite for needs-oriented measures, acceptance, and effectiveness.

7. CONCLUSION AND RECOMMENDATIONS

Building the inclusive digital classroom is not merely a technical challenge but a moral and educational imperative. As education becomes increasingly digital, the need to ensure that no learner is left behind is more urgent than ever. The findings of this study reveal a sobering picture: pervasive content inaccessibility, infrastructure barriers, institutional capacity deficits, and governance gaps that systematically exclude students with disabilities from ODeL. However, these findings also highlight the power of

students with disabilities to articulate their own needs, the willingness of staff to engage in professional development, and the potential of frameworks such as UDL to transform ODeL into a force for equity and inclusion (Chomunorwa et al., 2024; Zongozzi & Ngubane, 2025; Tabe, 2025).The transformation of ODeL into a force for equity and empowerment is a journey, not a destination. It requires a sustained commitment to continuous improvement, guided by the principles of social justice and the principles of Universal Design for Learning (Fraser, 2008; Meyer et al., 2014). As the literature emphasises, inclusion should be understood as a process of "a new enlightenment" a departure from self-imposed conformity toward a self-determined, equitable, and diversity-sensitive academic culture (European Agency for Special Needs and Inclusive Education, 2024).

Recommendations

For Policymakers:

1. Mandate and Fund Inclusive Design: Develop national policies requiring all ODeL institutions to design their platforms, curricula, and assessments according to Universal Design for Learning (UDL) guidelines and WCAG 2.1 standards (UNESCO, 2023; Manase, 2021).

2. Bridge the Digital Divide: Invest in national infrastructure to provide affordable internet access, subsidise devices, and support the development of low-tech alternatives for learners in resource-constrained settings (Chomunorwa et al., 2024; Chimbunde, 2023).

3. Enact Rights-Based Frameworks: Align national education policies with international conventions such as the UN Convention on the Rights of Persons with Disabilities (CRPD) and Sustainable Development Goal 4 (SDG 4), positioning inclusive ODeL as a rights-based obligation rather than anoptional accommodation (Akanni et al., 2026; UNESCO, 2023).

4. Ensure Intersectional Approaches: Recognise the compounding effects of multiple marginalisations by developing targeted policies for students who face disability, rural origin, and low income simultaneously (Crenshaw, 1989; Chomunorwa et al., 2024).

For Institutions:

1. Establish UDL as the Standard: Adopt UDL as the guiding framework for all ODeL course design, moving beyond accommodation to anticipatory design (Meyer et al., 2014; Manase, 2021).

2. Build Staff Capacity: Establish ongoing professional development programmes to equip educators with skills in digital pedagogy, inclusive course design, and the use of assistive technologies (Nikolenko et al., 2026; Pete & Soko, 2020).

3.Provide Comprehensive Student Support: Establish online tutoring services, psychosocial counselling services, academic advising, and technical assistance to foster student well-being and success (Pietersen, 2025; Tabe, 2025).

4. Ensure Assistive Technology Provision: Provide appropriate assistive technologies for students with disabilities, including screen readers, Braille displays, and captioning tools (Manase, 2023; Chomunorwa et al., 2024).

5. Establish Governance and Accountability: Establish clear governance structures for digital accessibility, including regular compliance audits, an Accessibility Officer, and Inclusion Reports published annually (European Agency for Special Needs and Inclusive Education, 2024).

6. Involve Stakeholders: Guarantee students with disabilities permanent seats and voting rights in relevant committees (senate, examination boards, quality circles) and record this in official documents (European Agency for Special Needs and Inclusive Education, 2024).

For Educators:

1.Adopt a Pedagogy of Care: Prioritise building relationships with students, promoting dialogue, and providing flexible and supportive learning experiences (Pietersen, 2025; Tabe, 2025).

2. Embed UDL Principles: Ensure that all teaching materials, activities, and assessments are accessible to all learners from the outset, including captions for videos, alt-text for images, and accessible PDFs (Meyer et al., 2014; Nikolenko et al., 2026).

3. Continuously Reflect: Engage in regular self-reflection and seek feedback to refine one's practice in online and distance settings (Tabe, 2025)

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