

Cognitive Load Theory and Multimedia Learning: Implication for Instructional Design in Nigerian University Classrooms

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Abstract: *As Nigerian universities navigate a rapid digital transition, the integration of Information and Communication Technology (ICT) and multimedia tools has become essential for pedagogical resilience. This study explores the application of Cognitive Load Theory (CLT) and Mayer's Cognitive Theory of Multimedia Learning (CTML) to optimise instructional design within the unique Nigerian socio-technical context. Despite the transformative potential of tools such as Augmented Reality (AR) and virtual labs, their efficacy is often hindered by significant challenges, including unreliable power supply, high internet costs, varying digital literacy, and the cognitive demands placed on second-language English learners. Employing a qualitative secondary research design and thematic analysis of peer-reviewed literature and National Universities Commission (NUC) publications, the study evaluates how evidence-based design principles such as segmenting and coherence can mitigate extraneous cognitive load. Findings indicate that while multimedia tools enhance student engagement and achievement across diverse disciplines, successful implementation is frequently stymied by a gap between technology procurement and pedagogical expertise. The paper concludes that CLT serves as a vital bridge between technological adoption and effective learning, transforming complex information into manageable knowledge. To ensure sustainable digital transformation, the study recommends that the NUC mandate CLT-based pedagogical training for academic staff, establish a national framework for indigenous multimedia content, and prioritise resilient infrastructure. By aligning instructional design with human cognitive architecture and local realities, Nigerian higher education can foster deeper cognitive engagement and better prepare graduates for 21st-century professional demands.*

Keywords: Cognitive Load Theory, Multimedia Learning, Nigerian Higher Education, Instructional Design, Socio-technical Constraints.

1. Introduction

The integration of Information and Communication Technology (ICT) and multimedia tools, such as PowerPoint, instructional videos, and virtual labs, is reshaping the pedagogical landscape of Nigerian universities. Central to this transition is the Cognitive Theory of Multimedia Learning (CTML), which provides a framework for optimizing cognitive load (CL) and minimizing extraneous load (EL) across various digital media. Emerging technologies like Augmented Reality (AR) extend these capabilities by superimposing digital information—such as 3D models and holograms—onto the physical environment in real time (Azuma, 1997; Carmigniani et al., 2011; Mann et al., 2023). Whether delivered via handheld devices, head-mounted displays like the HoloLens 2, or spatial projectors, AR can utilize marker-based tracking or sophisticated computer vision for marker-less registration (Zhou et al., 2008).

The efficacy of these multimedia interventions often depends on the level of realism and interactivity they provide. In high-stakes instructional settings, this may range from simple visualizations to digital twins, which are highly faithful digital models that replicate the actual functioning of their real-world counterparts (Batty, 2018; Grieves, 2019). Because of these unique affordances, educational researchers are increasingly exploring AR's potential to enhance learning outcomes (Candido et al., 2023; Yu, 2023). For Nigerian universities adopting these tools, the goal is to determine if the principles of CTML maintain their effectiveness in managing mental effort when transitioning from traditional video-based instruction to more immersive, interactive environments.

However, the impact of advanced multimedia on a student's cognitive capacity remains a subject of intense debate. While some research suggests that immersive tools can reduce the mental effort required to process complex information (Bressler & Bodzin, 2013; Santos et al., 2014), other studies warn that the complexity of the interface can lead to cognitive overload (Cheng & Tsai, 2013; Dunleavy et al., 2009). This inconsistency underscores the necessity of further investigation into how interface characteristics and instructional design influence cognitive load (Akçayır & Akçayır, 2017).

In Nigeria, understanding the dynamics of e-learning through the use of multimedia is crucial to ensure ICT facilitates deep learning. Global trends like widening access to university education, preparing graduates for 21st-century tech demands, and building resilient education systems have made e-learning inevitable. The country has access to ICT-enabled tools like Open Educational Resources (OER), Massive Open Online Courses (MOOCs), Learning Management Systems (LMS), and Virtual Learning Environments (VLE), which can improve teaching, learning, and research. However, these resources are often used more for administrative tasks

than for enhancing pedagogy (National Universities Commission, 2023). To address this, the NUC has developed guidelines for integrating e-learning into university programs, focusing on standards, creativity, and innovation, as laid out in the Core Curriculum Minimum Academic Standards (CCMAS)

1.1 Problem Statement

Cognitive Load Theory (CLT) provides valuable insights for optimizing multimedia learning in Nigerian university classrooms by highlighting the importance of understanding cognitive processing limitations (Longo, 2016). To manage cognitive load effectively, instructors and learners can employ strategies like the Multimedia Principle (incorporating visual aids with text), Split-Attention Effect (integrating text and visuals), Redundancy Effect (eliminating non-essential info), Signaling Principle (highlighting key info), and Segmenting Principle (breaking content into manageable bits) (Castro-Alonso et al., 2021). Adapting content to local contexts and leveraging tech like mobile tools for real-time assessment can also enhance learning (Longo, 2016). However, diverse learning environments and tech access in Nigerian universities may impact these strategies' effectiveness.

1.2 Research Objective/Justification

The objective of this paper is to explore how CLT principles can optimize multimedia instructional design specifically for the Nigerian socio-technical context. In Nigerian higher education, rapid deployment of multimedia tools often overlooks students' neurological limitations. The country's socio-technical environment - fluctuating infrastructure, varying digital literacy, and second-language learning - creates unique cognitive demands. Applying Cognitive Load Theory (CLT) can help create a sustainable, evidence-based pedagogical framework, structuring information to align with human memory and addressing local challenges.

2. Conceptualisation of Multimedia Learning

Multimedia learning involves using multiple media forms like text, images, and sounds to boost understanding and retention (Rajabalee, 2023). It's based on the idea that learners grasp concepts better when info is presented through words and visuals, rather than words alone. The process involves multimedia comprehension (temporary working memory changes) and multimedia learning (permanent long-term memory changes). Effective design can mitigate cognitive overload and enhance outcomes (Rajabalee, 2023; Mayer, 2001). Multimedia serves as instructional tools, tutorials, and educational resources (Nursafitri, 2018), focusing on engagement and cognitive activity (Mayer, 2019). However, poorly designed multimedia can hinder learning, emphasizing the need for thoughtful design

The institutionalisation of multimedia within university curricula is essential yet frequently challenged by practical and evaluative hurdles. Educators often encounter resistance due to technical complexities, role ambiguity, and the steep learning curve associated with mastering virtual environments (Fedulov, 2005). Despite these barriers, multimedia tools empower lecturers to synthesise text, animation, and visual data into cohesive programmes that offer the depth necessary to combat student disengagement. Addressing disengagement is vital, as a lack of interest negatively impacts cognitive processing and academic achievement, often serving as a precursor to student attrition. Consequently, fostering active participation is a prerequisite for achieving deeper learning, which necessitates a significant investment of effort from the learner to ensure academic success (Olusola-Fadumiye, Harun & Zakaria, 2023)

Distinguishing between types of involvement is crucial, as traditional behavioral engagement—characterised by mere presence and participation—does not always translate to the high-level cognitive processes required for complex tasks (Olusola-Fadumiye et al., 2023). While well-organised students may appear involved, those who are behaviorally disengaged often suffer from a lack of meaningful teacher-student interaction, which jeopardises their overall motivation (Nguyen et al., 2016). To mitigate this, generative instructional methods are recommended to stimulate both cognitive and behavioural interest, ensuring that learners are supported in developing real-world skills without the interference of boredom or digital distractions (Xie, 2021). By providing an authentic learning context, multimedia can transform conventional instruction from a focus on discrete, isolated facts into a dynamic strategy centred on problem-solving and practical application (Herrington & Oliver, 2000).

In the Nigerian higher education landscape, while the adoption of technological teaching methods is growing, there remains a significant research gap regarding the specific impact of multimedia on cognitive and behavioural involvement. Many instructional programmes still suffer from inadequate guidance, which hinders the effectiveness of digital tools in the classroom. This study seeks to address these deficiencies by evaluating how authentic-based multimedia environments influence student test performance and engagement levels (Olusola-Fadumiye et al., 2023). It posits that by integrating authentic learning factors, institutions can create more lucrative and effective educational experiences that align with the rigorous demands of the modern professional world.

3. Theoretical Framework

The theoretical framework of this paper is predicated on Cognitive Load Theory (CLT) and Mayer's Cognitive Theory of Multimedia Learning (CTML).

3.1 Cognitive Load Theory (CLT)

Cognitive Load Theory (CLT) asserts that educational success is fundamentally governed by the finite architectural limits of human working memory, which can only retain a small volume of information for a brief duration (Sweller, 1988, 2022; Cowan, 2001; Miller, 1956; Peterson & Peterson, 1959). When instructional demands exceed these neurological constraints—typically processing only three to four items simultaneously—cognitive overload occurs, leading to a breakdown in information integration and a collapse in academic performance (Baddeley, 2012; Sweller et al., 2019). To address this, scholars categorize mental effort into three streams: intrinsic load, which arises from the inherent complexity of the subject matter relative to a student's prior knowledge; extraneous load, which results from poorly designed materials that force students to waste energy on irrelevant processing; and germane load, which represents the productive effort used to construct mental schemas (Kalyuga, 2005; Sweller, 2011; Orru & Longo, 2018; Syagif, 2024).

The interaction between these loads is highly dynamic, as extraneous load becomes particularly damaging when the intrinsic complexity of a task is already high, leaving learners with no residual mental capacity to overcome poor instructional design (Paas et al., 2003; Emory, 2019). Effective pedagogy, therefore, focuses on reducing distracting extraneous elements and utilizing visualization or contextualized practice to redirect mental resources toward germane load, thereby facilitating deep learning and long-term retention (Paas et al., 2010; Miwa et al., 2017; Syagif, 2024). However, because learners with high prior knowledge can often compensate for weak design, researchers emphasize that evaluating the threshold where productive challenge becomes overwhelming requires a nuanced understanding of how these loads overlap across different student demographics and task types (Cowan, 2010; Krieglstein et al., 2022; Orru & Longo, 2018).

3.2 Mayer's Cognitive Theory of Multimedia Learning (CTML)

Mayer's Cognitive Theory of Multimedia Learning (CTML) is centered on the dual-channel processing model, which asserts that the human mind utilizes distinct pathways for handling visual-pictorial and auditory-verbal data (Mayer, 2014; Mayer, n.d.). This framework operates under three fundamental assumptions: that these channels have a restricted processing capacity, that learners must actively engage in selecting and organizing information to learn effectively, and that these two streams of data can be engaged simultaneously (Mayer, 2009). By aligning instructional materials with these cognitive constraints, educators can minimize extraneous load while fostering essential and generative processing. This is particularly vital in multimedia design, as the multimedia principle suggests that the integration of both words and imagery leads to a significantly deeper conceptual understanding than text-based instruction alone (Mayer, 2014, 2024).

To facilitate this deep learning, CTML identifies five critical cognitive actions: the selection of pertinent words and images, the structural organization of this information into coherent mental representations, and the final integration of these new models with a learner's existing prior knowledge (Mayer, 2005). While this theory offers a rigorous scientific foundation for instructional design, contemporary critics argue that the success of dual-channel processing may be influenced by individual variations in learner characteristics and digital preferences. Consequently, ongoing research is necessary to investigate how diverse student backgrounds—such as those found in Nigerian university classrooms—interact with these multimedia principles to determine if the benefits of dual-channel integration remain consistent across different demographic and socio-technical environments (Mayer, 2009; Mayer, 2014).

4. Methodology

This study employs a qualitative secondary research design, utilising a systematic search strategy to identify relevant literature across several prominent academic databases, including Google Scholar, ResearchGate, JSTOR, and official publications from the National Universities Commission (NUC). The inclusion criteria are strictly defined to capture peer-reviewed articles, ensuring the analysis reflects contemporary advancements in Cognitive Load Theory (CLT), multimedia learning, and the specific pedagogical landscape of African and Nigerian higher education. To synthesise the gathered data, the study applies thematic analysis, a process that involves identifying, analysing, and reporting recurring patterns or themes within the literature. This methodical approach allows for a comprehensive integration of existing findings to evaluate how instructional design can be optimised for the unique socio-technical constraints of Nigerian university classrooms.

5. Review of Empirical Literature Review

The implications of multimedia learning for instructional design in Nigerian university classrooms are significant, as they can enhance student engagement, performance, and overall learning experiences. By integrating multimedia elements into instructional strategies, educators can create more interactive and effective learning environments. This response will explore key aspects of multimedia learning, including its principles, benefits, and challenges in the context of Nigerian higher education.

Multimedia learning has a positive impact on instructional effectiveness when grounded in frameworks like CTML (Mayer, 2024; Abdulrahman et al., 2020; Noetel et al., 2021). In Nigeria, studies show improved student engagement and achievement with thoughtful multimedia integration (Ekwevugbe, 2025; Olusola-Fadumiye et al., 2023; Fadumiye & Aderemi, 2024; Olufunke et al., 2022). However, implementation quality varies due to infrastructural deficits and inconsistent policy support (Anyim, 2018; Aregbesola & Van Der Walt, 2023). While design principles like coherence and signaling are beneficial, some studies caution against overgeneralization, suggesting minimal multimedia may suffice when content and pedagogy are strong (instructional equivalence hypothesis) (Schmidt et al., 2025). There's also a gap between research and practice, with teachers lacking training in evidence-based design guidelines, limiting technology investment effectiveness (Désiron et al., 2024). Context-sensitive application and sustained professional development are needed.

Recent empirical evidence from the Nigerian higher education sector underscores the transformative potential of well-structured multimedia interventions in elevating pedagogical standards and student outcomes. Across a diverse array of academic fields ranging from the technical intricacies of accounting and business education (Abubakar et al., 2025; Olufunke et al., 2022) to the foundational requirements of English grammar and library user education (Kanya & Afolabi, 2023; Anyim, 2018) the integration of digital tools has consistently outperformed traditional, talk-and-chalk methods. Furthermore, in practical sciences such as agriculture and environmental studies, multimedia platforms have proven essential in bridging the gap between theoretical concepts and field applications (Ugwuoke et al., 2023; Ambe et al., 2023). These studies suggest that when Nigerian lecturers move beyond static instructional delivery, they can significantly increase the germane cognitive effort students apply to their coursework.

Beyond mere academic achievement, the adoption of authentic-based multimedia environments has been shown to foster deeper psychological ties to the learning process through heightened cognitive and behavioural engagement. By simulating real-world scenarios and professional challenges, these environments compel students to employ higher-order thinking and problem-solving skills rather than relying on rote memorisation (Olusola-Fadumiye et al., 2023; Fadumiye & Aderemi, 2024). This immersive approach is particularly crucial in the Nigerian context, where the alignment of university instruction with industry demands is a priority for graduate employability. Consequently, when multimedia is designed with authenticity at its core, it acts as a catalyst for meaningful learning, ensuring that students are not merely passive recipients of information but active participants in their own intellectual development (Olufunke et al., 2022).

5.1. Implementation Challenges

5.1.1 Infrastructural and Financial Constraints

While the potential for multimedia-driven pedagogy is vast, the Nigerian university system faces a multifaceted array of structural and systemic obstacles that stymie the seamless adoption of these technologies. Primary among these are the chronic deficits in basic infrastructure, most notably the prevalence of an unreliable national power grid and the prohibitive costs of maintaining high-speed internet connectivity (Aregbesola & Van Der Walt, 2023; Anyim, 2018). The financial burden of procuring state-of-the-art hardware and software often exceeds the budgetary allocations of many institutions, leading to a reliance on obsolete equipment that cannot support modern instructional demands (Ekwevugbe, 2025). Consequently, the socio-technical gap in Nigeria is often defined by these physical limitations, which create significant extraneous cognitive load for students who must navigate technical failures alongside their academic content.

5.1.2 Digital Competence and Pedagogical Resistance

Beyond physical infrastructure, the human element presents a significant hurdle through a widespread lack of digital competence and a general resistance to pedagogical change among both faculty and students. Many academic staff members have not received formal training in instructional design or the effective integration of Information and Communication Technology (ICT) into their curricula, leading to a superficial use of tools like PowerPoint rather than deep multimedia engagement (Egielewa et al., 2021). This digital literacy gap often results in a reluctance to abandon traditional, lecture-based methods in favour of more interactive, learner-centred digital environments. Furthermore, even when training is provided, the high costs of data and personal devices often prevent students from fully participating in virtual or blended learning initiatives, thereby widening the digital divide within the classroom.

5.1.3 Institutional Disparity and Sustainability Issues

These disparities are particularly evident when comparing the operational realities of public and private higher education institutions across the federation. Public universities, which cater to the vast majority of the student population, often suffer most acutely from underfunding and administrative bottlenecks, making large-scale technological overhauls difficult to sustain (Eze et al., 2018). In contrast, private institutions frequently boast more robust resources and modern facilities; however, they are not immune to systemic issues, as many have struggled with the long-term sustainability of digital infrastructures in the post-pandemic era (Ojajorotu et al., 2025). This lack of continuity across the sector highlights the need for a national strategic framework that addresses both the financial requirements of ICT and the psychological shift needed to embrace 21st-century instructional design.

5.2 Strategies for Effective Integration

To achieve a meaningful transformation in the Nigerian higher education sector, the adoption of multimedia must move beyond the mere presence of hardware toward a more holistic, evidence-based integration. Successful implementation requires a multi-pronged approach that addresses both technical infrastructure and human agency.

5.2.1. Continuous Professional Development for Instructors

The transition to digital pedagogy necessitates that educators move beyond basic computer literacy toward a sophisticated understanding of how technology interacts with cognitive architecture. Continuous professional development should focus on training lecturers in the principles of Cognitive Load Theory and instructional design, ensuring they can create multimedia content that reduces extraneous load and fosters deep learning (Ekwevugbe, 2025). Without such ongoing support, there is a risk that high-tech tools will be used to reinforce low-impact, traditional teaching methods.

5.2.2 Strategic Investment in Socio-Technical Infrastructure

Infrastructure remains the backbone of multimedia learning, yet it requires a strategic rather than a haphazard investment. Universities must prioritise the development of reliable power solutions—such as solar-powered computer labs—and campus-wide high-speed internet to mitigate the external stressors that disrupt the learning process (Orji et al., 2022). Investing in digital twins and virtual laboratories can also provide a cost-effective alternative to expensive physical equipment, provided the underlying digital infrastructure is resilient and accessible to all students regardless of their socio-economic status.

5.2.3 Policy Consistency and Regulatory Alignment

For multimedia integration to be sustainable there must be a unified policy direction from regulatory bodies like the National Universities Commission (NUC). Policy consistency ensures that technological adoption is not dependent on the whims of changing university administrations but is instead embedded into the national accreditation standards (Falode & Mohammed, 2023). These policies should incentivise the development of indigenous multimedia content that reflects the local curriculum while maintaining international standards of quality and accessibility.

5.2.4 Alignment with Pedagogical Objectives and Learner Diversity

Technology should always serve pedagogy, not the other way around. Instructional design must be strictly aligned with specific learning objectives, ensuring that multimedia elements like videos or simulations are used only when they enhance the understanding of complex concepts (Abubakar et al., 2025). Furthermore, design must account for learner diversity, including different levels of digital literacy and the cognitive demands placed on students who are second-language English speakers. Customising multimedia interfaces to be intuitive and culturally relevant can significantly improve student engagement and retention.

5.2.5 Leveraging Blended and Hybrid Learning Approaches

A blended approach—combining the strengths of traditional face-to-face instruction with the flexibility of digital tools—is often the most effective strategy for the Nigerian context. This hybrid model allows for the preservation of essential teacher-student interactions while using multimedia to provide supplemental, self-paced learning opportunities (Ekwevugbe, 2025). By staggering the use of high-bandwidth digital tools with offline resources, institutions can navigate connectivity challenges while still providing a modern, immersive educational experience.

5.2.6 Inclusive Stakeholder Engagement and Planning

Finally, the sustainability of technology-driven environments depends on the active involvement of all stakeholders, including administrators, faculty, and students, in the planning and implementation phases. When students and teachers are involved in the selection and design of multimedia tools, they are more likely to take ownership of the technology and less likely to resist change (Orji et al., 2022). Collaborative planning ensures that the tools implemented actually solve the day-to-day problems faced in Nigerian classrooms, leading to a more lucrative and enduring digital transformation.

6. Implications for Instructional Design

6.1 Segmenting Principle

The segmenting principle is a vital instructional strategy that advocates for partitioning intricate subjects, such as engineering or medical phenomena, into concise and manageable multimedia units to prevent cognitive exhaustion. By allowing learners to navigate information at a self-determined speed, this method facilitates deeper comprehension and is particularly effective in Nigerian university settings where challenging courses like thermodynamics or fluid mechanics can be delivered through focused video modules (Schüler et al., 2024; Castro-Alonso et al., 2021). This approach not only enhances overall retention by enabling concentrated attention on isolated concepts but also empowers students with varying degrees of prior knowledge to exercise pacing control. Furthermore, the strategic integration of text, imagery, and audio within these segments accommodates diverse learning styles, ultimately rendering dense and complex academic material more accessible and less overwhelming for the student.

6.2 Coherence Principle

The coherence principle serves as a critical instructional guideline by advocating for the systematic exclusion of irrelevant or distracting information from educational presentations, a strategy that proves exceptionally advantageous for Nigerian students who navigate their coursework as second-language English learners. By stripping away non-essential fluff and focusing exclusively on core pedagogical content, educators can significantly reduce the extraneous cognitive load that often impedes the understanding of complex disciplines, such as medical sciences (Sakka, 2022; Mayer, 2019). This streamlined approach ensures a higher degree of informational clarity, allowing students to allocate their limited cognitive resources more effectively toward mastering essential concepts rather than deciphering unnecessary details. Ultimately, applying the coherence principle fosters a more inclusive and supportive environment in multicultural Nigerian classrooms, where minimizing linguistic and visual distractions is key to overcoming language barriers and achieving equitable learning outcomes.

6.3 Training for Educators

The integration of Cognitive Load Theory (CLT) into the National Universities Commission (NUC) pedagogical training framework is essential for modernising instructional effectiveness across Nigerian higher education. By providing educators with a foundational understanding of cognitive architecture, the NUC can empower instructors to design learning experiences that purposefully align with students' mental processing limits, thereby moving beyond traditional, intuition-based teaching. Formal training programmes should specifically target multimedia design principles, such as segmenting and coherence, to ensure that lecturers can create digital materials that are engaging without being overwhelming (Mayer, 2019; Castro-Alonso et al., 2021). This systematic approach to professional development enables the creation of evidence-based curricula that prioritise germane load, ultimately leading to improved student performance by ensuring that instructional delivery reduces cognitive saturation and facilitates long-term knowledge retention.

In contrast, some may argue that the implementation of CLT principles requires significant resources and time, which could be challenging for institutions with limited funding. However, the long-term benefits of improved student learning outcomes and engagement may outweigh these initial challenges, making a strong case for the integration of CLT into educational practices.

7. Conclusion

In conclusion, Cognitive Load Theory (CLT) serves as the indispensable bridge between advanced technological tools and successful pedagogical outcomes within the Nigerian university system. While the mere introduction of multimedia can inadvertently increase extraneous load due to infrastructural instabilities and linguistic barriers, CLT provides a scientific blueprint for filtering these distractions through principles such as coherence and segmenting (Sakka, 2022; Castro-Alonso et al., 2021). By grounding multimedia design in the known limits of human cognitive architecture, educators can ensure that technology does not become a hurdle, but rather a powerful conduit that transforms complex information into accessible, manageable knowledge. This alignment effectively harmonises the socio-technical realities of the Nigerian classroom with the universal requirements of meaningful learning.

At last, the transition toward a digitally resilient higher education sector in Nigeria depends on moving beyond hardware procurement toward the evidence-based application of cognitive principles. The empirical evidence underscores that when instructional design is optimised to reduce mental fatigue and promote germane load, it fosters deeper cognitive engagement and prepares students for real-world problem-solving (Olusola-Fadumiye et al., 2023; Abubakar et al., 2025). By adopting a strategic framework supported by the NUC—prioritising professional development and inclusive stakeholder planning—Nigerian universities can leverage multimedia to bridge the gap between theoretical instruction and professional excellence. In this light, CLT is not merely an educational theory but a strategic necessity for sustainable digital transformation in the 21st-century Nigerian classroom.

Recommendations

To enhance the quality of higher education in Nigeria through the lens of Cognitive Load Theory and multimedia design, the National Universities Commission (NUC) should mandate the integration of CLT principles into the mandatory pedagogical training for all university academic staff. This systemic shift would move instruction beyond basic digital literacy toward evidence-based design, ensuring that lecturers can effectively apply the segmenting and coherence principles to manage the unique extraneous loads present in the Nigerian socio-technical environment. Furthermore, university administrations must prioritise strategic, long-term investments in resilient infrastructure, such as solar-powered learning hubs and campus-wide intranets, to mitigate the cognitive disruptions caused by frequent power outages and unreliable internet connectivity.

In parallel, regulatory bodies should establish a national framework for the development of indigenous, authentic-based multimedia content that aligns with local curricula while addressing the needs of second-language English learners. This policy should incentivise the exclusion of non-essential content—as advocated by the coherence principle—to support diverse learners and reduce linguistic fatigue. Finally, a culture of inclusive stakeholder engagement must be fostered, where students, faculty, and administrators

collaboratively plan and sustain technology-driven environments. By adopting a blended learning model that balances traditional teacher-student interaction with self-paced digital modules, Nigerian institutions can create a more sustainable and equitable educational landscape that transforms students from passive recipients into active, cognitively engaged participants.

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