

*International Journal of Learning, Teaching and Educational Research*  
Vol. 25, No. 2, pp. 243-263, February 2026  
<https://doi.org/10.26803/ijlter.25.2.12>  
Received Jul 12, 2025; Revised Oct 24, 2025; Accepted Jan 13, 2026

# Integrating Multimedia for Pedagogical Transformation in ODeL: Cognitive, Pedagogical, and Equity Perspectives

Khanyisile Twabu\*<sup>ID</sup>, Geesje van den Berg<sup>ID</sup>  
and Patience Kelebogile Mudau<sup>ID</sup>  
University of South Africa  
Pretoria, South Africa

**Abstract.** The study explores how multimedia integration supports pedagogical transformation in open distance e-learning (ODeL), with a focus on cognitive engagement, instructional design, and equitable access. Grounded in Mayer's Cognitive Theory of Multimedia Learning and Sweller's Cognitive Load Theory, the research investigates how lecturers use multimedia to enhance learning and how institutional practices influence these practices. Within an interpretive paradigm, a qualitative, single case study design was used at a large South African ODeL university. Data were collected through open-ended questionnaires and semi-structured interviews with twenty participants. Thematic analysis, combining inductive and deductive coding, was used to identify recurring patterns and theoretical connections. Findings reveal that multimedia tools such as video lectures, discussion forums and synchronous platforms enhance cognitive engagement and comprehension when aligned with sound pedagogical principles. However, poorly designed or excessive multimedia often led to cognitive overload. The study also found growing shifts toward learner-centred approaches, although uneven digital competencies and limited institutional support constrained innovation. Persistent inequities in connectivity, device access, and student digital literacy further limited inclusive participation. The study concludes that effective multimedia integration in ODeL requires the intersection of cognitive theory, pedagogical design, and institutional strategies that ensure equitable access, thereby enabling sustainable and transformative learning experiences.

**Keywords:** multimedia integration; cognitive engagement; pedagogical strategies; equitable access; open distance e-learning

---

\*Corresponding author: Geesje van den Berg; [vdberg@unisa.ac.za](mailto:vdberg@unisa.ac.za)

## 1. Introduction

The integration of multimedia in Open Distance eLearning (ODeL) environments has transformed teaching and learning practices, requiring lecturers to adopt innovative pedagogical strategies that enhance student engagement and success. In the contemporary landscape of education, ODeL is a fundamental aspect of accessible and flexible learning, providing individuals the opportunity to pursue knowledge at their own pace and convenience (Mapolisa, 2022). Within ODeL, learning complexities are heightened due to the persistent digital divide, varied student preparedness, and the reliance on technology-mediated instruction (Laurillard, 2012). Teaching in this context goes beyond content transmission; it is iterative, evidence-informed practice shaped by cognitive, social, and technological factors that must respond to the diverse needs of learners (Hutchings et al., 2011). This paper critically examines how multimedia integration can foster pedagogical adaptation in ODeL, addressing both challenges and opportunities for effective, inclusive, and sustainable learning.

Multimedia integration has emerged as a transformative approach within digital learning environments, offering visual, auditory, and interactive modalities to enhance cognitive engagement and facilitate deep learning (Mayer, 2013). However, its effective implementation requires educators to carefully navigate potential issues, including cognitive overload, digital equity, and the need for deliberate pedagogical adaptation (Garrison & Vaughan, 2008). In recent years, particularly during and after the COVID-19 pandemic, higher education institutions have increasingly adopted diverse technologies to enhance teaching and learning, permanently reshaping educational practices (Lalani & Li, 2020).

Among these technologies, multimedia tools such as video lectures, simulations, podcasts, and interactive platforms have become central to supporting flexible and student-centred learning. Yet, despite their pedagogical potential, many lecturers unintentionally overlook pedagogical considerations when integrating multimedia. This is due to their lack of sufficient pedagogical content knowledge and limited experience with effective online teaching strategies (Huber & Helm, 2020). Within ODeL environments, lecturers should understand how the intersection of technology, pedagogy, and content can provide meaningful learning experiences for students (Sailin & Mahmor, 2018).

Even though multimedia technologies may be marketed as powerful tools for teaching and learning, research suggests that their use does not automatically guarantee improved learning outcomes. In many cases, multimedia applications, while engaging and stimulating, fail to promote deep content understanding and critical thinking when not purposefully aligned with sound pedagogical principles (Darling-Hammond et al., 2020). It is therefore of utmost importance for curricula to integrate multimedia thoughtfully, guided by evidence-based design principles and an awareness of cognitive processes, to enhance student engagement and optimise learning experiences (Sharif et al., 2025). The COVID-19 pandemic further exposed significant gaps in multimedia integration. While lecturers improvised by adopting a wide range of digital tools to sustain teaching continuity, many online lessons lacked pedagogical strength and strategic design

(Kumi-Yeboah et al., 2020). Research confirms ongoing challenges in ODeL contexts, including lecturer's limited digital literacy, inadequate training in multimedia use, and insufficient institutional support (Waang, 2023; Kiat et al., 2023). Within the South African context, which is the focus of this study, these challenges are particularly pronounced. Studies indicate that many lecturers hold unfavourable views towards the integration of multimedia, mainly due to inadequate professional development, which results in the underutilisation in their teaching practices (Ohei et al., 2023).

Against this background, this study addresses a critical gap by exploring multimedia integration in ODeL. It focuses on how multimedia can be used to enhance pedagogy while developing active and equitable learning experiences. Specifically, the study addresses the following research questions:

- How do multimedia tools mediate cognitive engagement and knowledge retention?
- Which pedagogical strategies do lecturers adopt to facilitate active learning in digital environments?
- What are the implications of multimedia integration for equitable access and student success in ODeL?

By addressing these questions, the study generates evidence-based insights that inform more purposeful approaches to multimedia integration in ODeL.

## **2. Literature Review**

### **2.1 Multimedia-Enhanced Teaching and Learning in ODeL**

Multimedia integration has become an indispensable element of teaching and learning in ODeL, transforming traditional approaches to offering curricula that offer multimodal pathways to knowledge. Through visual, auditory, and interactive modalities, multimedia tools such as instructional videos, simulations, podcasts, and interactive quizzes support deeper engagement and meaningful learning experiences (Clark & Mayer, 2023). By stimulating multiple senses and presenting information in multiple modes, multimedia supports diverse learning preferences, facilitates knowledge retention, and helps students grasp complex or abstract concepts through visualisation and real-life examples (Tordet et al. 2024).

However, the effective integration of multimedia is not guaranteed by technology alone. For instance, understanding cognitive load management and superficial engagement and distraction are crucial, as inappropriate multimedia use can disrupt learning rather than facilitate it (Sweller et al., 2019; Sharif et al., 2025). Aligning multimedia resources with clear pedagogical objectives is also essential, as any disjunction can lead to shallow, ineffective learning experiences (Lai et al., 2018). In ODeL, where students study asynchronously and often independently, multimedia also plays a critical role in sustaining motivation and supporting self-regulated learning.

## 2.2 Cognitive Load and Multimedia Design

The relationship between multimedia and learning outcomes is best understood through the lens of Mayer's Cognitive Theory of Multimedia Learning (CTML) framework. It states that students process information more effectively when instructional materials are both visual and auditory verbal while avoiding overload at the same time (Mayer, 2008). Multimedia design must be aligned with cognitive learning principles to enhance retention rather than overwhelming learners (Sweller et al., 2019).

Several studies indicate that excessive multimedia elements, such as unnecessary animations, dense text, or unstructured narration, can lead to extraneous cognitive load, hindering comprehension (Clark & Mayer, 2023). The integration of multimedia must be intentional, ensuring that learners focus on essential content rather than being distracted by excessive visual or auditory stimuli (Ibrahim, 2012). In ODeL, where students are required to self-regulate their learning, poorly designed multimedia can create significant barriers, leading to disengagement and reduced learning efficiency and achievement (Taher & Bentri, 2024).

## 2.3 Pedagogical Adaptation and Lecturer Preparedness

While cognitive considerations support the use of multimedia, successful integration also depends on pedagogical adaptation. Moving beyond a transmission model of teaching, lecturers must design learning experiences that are interactive, student-centred and aligned with the benefits of digital technologies (Laurillard, 2012). However, many lecturers lack formal training in digital pedagogies and face significant barriers in achieving this. Studies highlight gaps in digital literacy, limited experience in online pedagogies, and insufficient institutional support and training (Mafuhure et al. 2025).

In South African ODeL institutions, multimedia training and instructional design support are often limited, resulting in varied levels of competency among lecturers in using multimedia tools (Núñez-Canal et al., 2022). Studies highlight that while some lecturers leverage multimedia-enhanced assessments and interactive tools to engage students, others continue to rely on text-based instruction due to a lack of familiarity with multimedia technology (Golden et al., 2023). Recent literature suggests the importance of professional development in equipping educators with the necessary skills to create multimedia materials that align with learning science principles (Hodroj et al., 2021; Zepp et al. 2024).

## 2.4 Equity, Access, and the Digital Divide in ODeL

The transformative potential of multimedia in ODeL is often constrained by inequities in access to digital infrastructure, devices, and connectivity. Students in rural and low-income contexts face bandwidth limitations, unstable internet connections, and inadequate access to devices. Such barriers significantly affect these students' ability to engage in multimedia content (Cullinan et al., 2021; Zongozzi & Ngubane, 2025). Research indicates that without targeted interventions, the increased reliance on digital learning tools may exacerbate educational inequalities rather than bridge them (Imran, 2023). In this regard, ODeL institutions should implement low-bandwidth multimedia solutions,

ensuring that all students, regardless of location or economic status, can access digital learning materials (Viljoen et al., 2024). Additionally, adaptive multimedia content can be delivered in multiple formats, including downloadable videos, audio recordings, and mobile-friendly content (Waang, 2023). The role of ODeL institutions in addressing these disparities is crucial, as policies must support equitable access to multimedia learning resources while fostering student engagement across diverse educational contexts. Relevant approaches, together with investments in infrastructure and targeted skills development, can ensure that multimedia integration contributes to equitable access and student success in ODeL.

### 3. Theoretical Framework

This study is grounded in two complementary cognitive theories that explain how students process information and how instructional design can optimise learning: the Cognitive Theory of Multimedia Learning (CTML) and the Cognitive Load Theory (CTL). Together, these frameworks provide a powerful lens for understanding how multimedia tools can enhance cognitive engagement and knowledge retention, while also highlighting the pedagogical considerations required for effective integration in ODeL.

#### 3.1 Cognitive Theory of Multimedia Learning

Mayer's Cognitive Theory of Multimedia Learning (CTML) is based on three core assumptions (Mayer, 2013):

- **Dual-channel processing**, which refers to the fact that humans process information through two separate cognitive channels: the auditory-verbal channel (used for processing spoken words and sounds) and the visual-pictorial channel (used for processing images, animations, and text). Effective multimedia design leverages both channels in a complementary manner, ensuring that learners can maximise cognitive processing without overloading either channel. In ODeL, where students engage with multimedia asynchronously, dual-channel learning plays a crucial role in maintaining engagement and facilitating comprehension.
- **Limited capacity**, which states that each cognitive channel (auditory and visual) has a finite processing capacity, meaning that students can only absorb a certain amount of information at a given time. For multimedia to be effective in ODeL, instructional design must reduce extraneous load while promoting germane cognitive processing. This is particularly important because students often study independently and may struggle to filter relevant information.
- **Active processing**, which asserts that learning is an active, constructive process, requiring learners to select, organise, and integrate information meaningfully. The extent to which active processing occurs in ODeL settings depends on the quality of multimedia design and students' level of digital literacy. Some students may struggle to navigate interactive content effectively, particularly if they lack prior experience with online

learning environments. Additionally, in resource-constrained settings, bandwidth limitations may restrict access to multimedia tools, reducing opportunities for interactive engagement.

From the above assumptions, there emerge several evidence-based principles for designing multimedia instruction. For example, the modality principle suggests combining narration with visuals rather than on-screen text to distribute processing across channels (Mayer, 2024). The segmenting principle advises breaking complex material into smaller chunks, while the signalling principle highlights the value of cues that guide attention to key information (Valley & Joseph, 2024). Together, these principles ensure that multimedia content supports rather than overwhelms cognitive processing.

### 3.2 Cognitive Load Theory

Cognitive Load Theory (CLT) complements CTML by explaining how cognitive resources are used during learning and how instructional design can manage the mental workload. CLT distinguishes between three types of cognitive load (Sweller et al. 2019):

- **Intrinsic load**, which refers to the inherent complexity of the content, is determined by its nature and students' prior knowledge.
- **Extraneous load**, which refers to the unnecessary cognitive effort caused by poor instructional design, such as redundant text or irrelevant visuals.
- **Germane load**, which is relevant to the cognitive resources devoted to schema construction and deep learning.

Effective instructional design aims to minimise extraneous load, manage intrinsic load and maximise germane load. This balance is particularly crucial in ODeL, where students often engage with multimedia independently and must self-regulate their cognitive effort.

### 3.3 Linking the CTML and CLT for Effective Multimedia Integration

Although CTML and CLT originated from different strands of cognitive psychology, they are highly complementary and mutually reinforcing. Together, they explain not only why multimedia works, but also which conditions lead to deeper cognitive engagement and long-term knowledge retention. For example, the modality and coherence principles from CTML reduce extraneous load as described by CLT, while segmenting helps manage intrinsic load by pacing the introduction of complex information. Similarly, the generative processing encouraged by CTML aligns with germane load, promoting deeper understanding.

In practice, designing multimedia with CTML principles inherently addresses the cognitive load considerations outlined by CLT, leading to more effective and efficient learning experiences, supporting active engagement even in large, diverse and digitally uneven student cohorts.

## **4. Methodology**

### **4.1 Study context and design**

This study was conducted within the context of a large ODeL university in South Africa. The university serves a diverse student population, including adult learners, working professionals and students in remote and under-resourced regions. Its mission is to widen access to higher education through technology-mediated teaching and learning. However, this goal is challenged by persistent issues, such as digital inequities, varied levels of student digital literacy, and uneven pedagogical integration of multimedia tools. These complexities, therefore, make the institution an ideal context for exploring how multimedia can be used to enhance cognitive development, facilitate knowledge retention and promote equitable learning outcomes.

The study is located within an interpretivist paradigm, which assumes that reality is socially constructed and that knowledge is best understood through the meaning individuals assign to their experiences. This paradigm aligns with the study's aim to explore how lecturers conceptualise, implement, and experience multimedia integration in ODeL. The research, therefore, sought to understand the phenomenon and form perspectives of those directly involved in teaching and learning (Venkatesh et al., 2016). A qualitative approach was adopted because it allows for rich, contextual insights into complex educational processes. Multimedia integration in ODeL involves technological, pedagogical, cognitive and social dimensions, which are interrelated and too complex to be fully captured through quantitative measures alone. The qualitative approach, therefore, assisted in getting deep insights and comparisons, supporting the validation of conclusions and fostering a reflective understanding (Creswell & Creswell, 2017).

A single case study design was used, which is particularly suited for investigating contemporary phenomena within its real-life context (Yin, 2009). A case study was regarded as the most suitable design for the study as it enables a holistic examination of the processes and practices shaping multimedia integration within one institution. The choice of a single case study was further motivated by the institution's distinctive role as a large-scale ODeL provider in the Global South, where issues of equity, access, and pedagogical innovation are relevant.

### **4.2 Participants and data collection**

Participants in this study were purposively and conveniently chosen to provide rich and varied insights into the integration of multimedia in ODeL. Convenient and purposive sampling was chosen because they facilitate the selection of available information-rich participants who can offer in-depth insights into the phenomenon under investigation (Creswell & Poth, 2016). The sample comprised 20 participants, including 13 lecturers, four academic leaders, and three professional and support staff. This combination ensured that the study captured multiple perspectives on how multimedia is conceptualised, implemented, and supported across different institutional levels.

The 13 lecturers represented a range of disciplines from four different Colleges within the university. All were available to participate in the research, had at least

five years of teaching experience in higher education, although some had more than a decade of experience in ODeL contexts. Their responsibilities included designing and facilitating online modules, developing multimedia materials, and assessing students' work. Despite their experience, they reported varying levels of confidence and competence in integrating multimedia into their teaching, highlighting broader institutional challenges around digital readiness and professional development.

The four academic leaders were deans from four different Colleges who were responsible for strategic decision-making related to teaching, learning, curriculum innovation, and digital transformation within the institution. They were responsible for overseeing curriculum development, ensuring quality assurance processes, and implementing educational technologies on a large scale. Their perspectives shed light on institutional priorities, policy directions, and systemic constraints that influence multimedia adoption and use.

The three professional and support staff members were responsible for professional development and information and communication technology (ICT) units. They were selected because of their critical role in enabling multimedia integration by providing support, training, and instructional design expertise. Their involvement offered additional insight into the infrastructural, logistical, and capacity-building aspects of multimedia implementation. Below is a table with the information about the participants. For the purpose of anonymity, the names of the Colleges are not included.

**Table 1: Research participants**

Participant role	Pseudonym	Interview participation
1. Dean, College 1	D1	Yes
2. Lecturer, College 1	L1C1	No
3. Lecturer, College 1	L2C1	Yes
4. Lecturer, College 1	L3C1	No
5. Lecturer, College 1	L4C1	No
6. Dean, College 2	D2	Yes
7. Lecturer, College 2	L1C2	Yes
8. Lecturer, College 2	L2C2	No
9. Lecturer, College 2	L3C2	No
10. Lecturer, College 2	L4C2	No
11. Dean, College 3	D3	Yes
12. Lecturer, College 3	L1C3	No
13. Lecturer, College 3	L2C3	No
14. Lecturer, College 3	L3C3	Yes
15. Lecturer, College 3	L4C3	No
16. Dean, College 4	D4	Yes
17. Lecturer, College 4	L1C4	Yes
18. Support: ICT	S1	Yes
19. Support: ICT	S2	Yes
20. Support: Continuous Professional Development	S3	Yes

Data were collected using two complementary methods to allow for triangulation and rich analysis. First, open-ended questionnaires were distributed to all participants to capture their initial views on multimedia use, challenges, and pedagogical practices. Second, individual semi-structured interviews were conducted with available participants, lasting between 45 and 75 minutes, to explore emerging themes in greater depth.

The open-ended questionnaires, which consisted of 19 questions, including a few biographical and primarily open-ended questions, were distributed to all participants. It aimed to generate data on their perceptions, experiences, and practices related to multimedia use in teaching and learning. The questions addressed participants' familiarity with multimedia tools, the type of tools they integrated, the pedagogical purposes, the perceived benefits and challenges, and the kind of institutional support available. By allowing participants to respond in their own words, the questionnaire provided rich, descriptive insights that informed the subsequent interview phase.

Semi-structured interviews provided further depth and clarity, conducted via MS Teams due to remote working arrangements, ensuring flexibility for participants (McMillan & Schumacher, 2010). Participants were asked in the questionnaires if they would be available for a follow-up interview. Of the 20, 11 were available. The interviews lasted between 45 and 75 minutes, and the 12 guiding questions formed the basis for the discussion. The questions were follow-up questions to the questionnaires and were organised around the main themes. The semi-structured approach ensured consistency across the interviews while allowing for probing and follow-up questions to deepen understanding of participants' experiences.

Both instruments underwent pilot testing with two academic staff members not included in the study sample. Feedback from the pilot led to minor refinements in question wording and sequencing to improve clarity.

### **4.3 Data analysis**

Data analysis in this study followed a qualitative thematic analysis approach, which is well-suited to explore complex phenomena and identify patterns of meaning within textual data (Braun & Clarke, 2019). Thematic analysis allowed us as researchers an inductive and deductive engagement with the data, enabling us to identify the themes grounded in participants' experiences and also connecting the themes with the theoretical framework. The analysis consisted of iterative overlapping stages. Throughout this process, we as researchers constantly verified each other's work to ensure accuracy.

First, we familiarised ourselves with questionnaire responses and the follow-up interview transcripts. Initial impressions and recurring ideas were identified. Next, open coding was conducted manually, with meaningful units of text labelled according to their relevance to the research questions. Next, the codes were examined for similarities and differences, and related codes were clustered into categories. Through the process of refinement and comparison, the categories were synthesised into overarching themes that captured key dimensions. The

coding was done inductively to allow for new insights to emerge from the data, and deductively, guided by the concepts of CTML and CLT. For example, codes related to the organisation and presentation of multimedia content were linked to CTML principles such as processing and segmenting, while those related to cognitive overload and instructional design were examined in relation to CLT's focus on intrinsic, extraneous and germane cognitive load. Finally, the themes were finalised and reflected three dimensions related to the research questions. These themes provided the structure for presentation and discussion of the findings in the next section.

To ensure trustworthiness and rigour, several strategies were followed, linked to the criteria by Lincoln and Guba (1985). Credibility was ensured through triangulation of data sources, which were open-ended questionnaires and semi-structured individual interviews, and prolonged engagement with the data. Dependability was supported by maintaining a detailed audit trail of coding decisions, note-taking and theme development. Confirmability was ensured through reflexive journaling and peer debriefing with colleagues experienced in qualitative research and ODeL pedagogy. Lastly, transferability was facilitated by providing rich descriptions of the study context, participants, and findings, enabling the reader to assess the applicability to other similar settings. Ethical clearance was obtained from the university where the study was conducted.

## 5. Findings and discussion

This section presents and interprets the findings of the study, drawing from the data from the open-ended questionnaires and semi-structured interviews and in relation to the theoretical framework that underpins the study. The following themes and sub-themes emerged from the data analysis and will be discussed in detail next:

**Table 2: Themes and sub-themes**

Themes	Sub-themes
Multimedia tools and cognitive engagement	<ul style="list-style-type: none"> <li>• Multimedia for engagement and comprehension</li> <li>• Cognitive load and multimedia design</li> <li>• Enhancing engagement through synchronous tools</li> </ul>
Pedagogical strategies for active learning	<ul style="list-style-type: none"> <li>• Designing for interaction and participation</li> <li>• Integrating multimedia into assessment and feedback</li> <li>• Capacity building and pedagogical adaption</li> </ul>
Equity, access, and student success	<ul style="list-style-type: none"> <li>• Connectivity, infrastructure, and digital access</li> <li>• Strategies for inclusion and equitable participation</li> <li>• Digital literacies and student readiness</li> </ul>

### 5.1 Theme 1: Multimedia tools and cognitive engagement

The first theme focused on how multimedia tools mediate cognitive engagement and knowledge retention in ODeL contexts. The responses in this theme are based on questions on how different multimedia tools were used to improve teaching and learning. The findings show that lecturers used a variety of multimedia tools, including video lectures, discussion forums, and synchronous tools. However, the

effectiveness of these tools depends on their alignment with cognitive principles and sound pedagogical design. The theme had various sub-themes.

#### 5.1.1 Multimedia for engagement and comprehension

Participants consistently referred to the institutional learning management system, Moodle. It provided integrated spaces for assessments, announcements, discussions, and video materials, all of which were crucial in enhancing cognitive engagement.

As an example, a lecturer shared:

*“Assessments, forums, announcements, lessons, additional sources, statistics, marking, online classes and videos are all done on Moodle almost daily.” (L1C1)*

Another lecturer explained how Moodle facilitated assessment and interaction in ways that allowed them to embed videos for conceptual scaffolding:

*“I use video links in my lessons to better explain concepts” (L3C3), while another said, “In my assignments, I give video links... and base my application questions on the videos.” (L1C4)*

The finding resonates with Mayer’s Cognitive Theory of Multimedia Learning, which argues that people learn more effectively from words and pictures together than from words alone. By adding videos to text-based content, lecturers created dual-channel inputs that enhance comprehension and retention (Mayer, 2013). Similarly, Clark and Mayer (2023) emphasise that well-designed multimedia promotes deeper engagement by activating both cognitive channels and fostering active processing.

Discussion forums were another tool lecturers used to encourage engagement and critical thinking. These asynchronous spaces allowed students to reflect, question, and construct knowledge collaboratively. A participant explained:

*“We use discussion forums for topics that might be troublesome. We check the patterns, and then we use that as a discussion. Sometimes a student will initiate a topic, and sometimes, as lecturers, we will assist.” (L3C2)*

This aligns with Garrison and Vaughan’s (2008) view that meaningful learning in digital environments is social in nature. By prompting reflection and collaborative problem-solving, discussion forums supported Mayer’s principle of active processing, which posits that learning occurs when students actively select, organise, and integrate new information.

#### 5.1.2 Cognitive load and multimedia design

Although multimedia tools offer rich opportunities for engagement, participants cautioned that too many or the wrong tools could overwhelm students and impede knowledge retention. Several participants acknowledged that when multimedia is used without careful planning, students can become distracted or

confused. One lecturer highlighted the importance of “bite-sized” learning, explaining that short videos and quizzes helped students manage cognitive load and remain focused.

The above comments support the Cognitive Load Theory, which emphasises the need to manage intrinsic, extraneous and germane load for effective learning (Sweller et al., 2019). Extraneous load, in particular, can arise from redundant text or irrelevant images. Sharif et al. (2025) similarly argue that multimedia that is not pedagogically aligned risks creating superficial engagement rather than deep understanding.

The findings also show how participants used the signalling principle (according to the CTLM) to guide students’ attention and reduce cognitive overload. In this regard, a participant said:

*“I record my lessons using TippyTube (YouTube) and upload my PowerPoint presentations for my students. They can watch them at a time that is convenient for them.” (L4C1)*

Another participant added:

*“Announcements serve an important purpose; for instance, if lecturers identify errors in their tutorial letters, they announce them and share the corrections. (L2C3)*

### 5.1.3 Enhancing engagement through synchronous tools

Synchronous tools such as Microsoft Teams played a key role in mediating cognitive engagement by enabling real-time interaction and immediate feedback. Participants shared those live sessions, when recorded and shared, extended learning opportunities. One dean explained:

*“Wi-Fi connectivity enables remote online teaching and learning as well as pedagogical engagements.” (D4)*

These findings support Laurillard’s (2012) argument that technology-mediated interaction enhances the nature of learning, allowing students to test ideas, receive feedback, and refine their understanding. Moreover, recorded sessions allow for opportunities for spaced retrieval, an evidence-based strategy known to enhance long-term memory (Mayer, 2008). Participants shared that students frequently revisited recordings to consolidate their learning and clarify difficult information and concepts.

## 5.2 Theme 2: Pedagogical strategies for active learning in digital environments

The second theme examined the teaching strategies lecturers use to promote active learning in ODeL, focusing on how they integrated multimedia into their teaching and learning. The findings show that participants are increasingly moving beyond traditional transmission models toward more interactive, student-centred approaches that use multimedia to support engagement, collaboration, and application. However, we found that this transition was

uneven, constrained by varying levels of pedagogical knowledge and institutional support. Three sub-themes emerged.

### 5.2.1 *Designing for interaction and participation*

Participants described how they designed learning activities that require students to interact with content, peers and lecturers. These strategies included discussion forums, collaborative online activities, and iterative questioning cycles. As an example, one dean explained:

*“The benefit of how everyone can post a topic or activities helps create and start engagement. Lecturers can upload activities or PowerPoint slides and activate student discussions by setting the theme and following up with reluctant students.” (D2)*

The above approaches align with Laurillard’s (2012) argument that digital pedagogies should support dialogue, collaboration, and knowledge construction rather than content transmission. Similarly, Darling-Hammond et al. (2020) emphasise that multimedia alone is not sufficient; it needs deliberate strategies that promote critical thinking and active engagement.

Lecturers reported that they used announcements and discussion forums to create iterative cycles of questioning and feedback. For example, when prompted on how this was done, shared:

*“We post questions on the discussion forum, monitor student responses, and then clarify needed issues before we close the engagement and move to the next question. Announcements are used to inform students.” (L3C1)*

The iterative design reflects Mayer’s principle of segmenting, which suggests that breaking complex content into smaller chunks facilitates cognitive processing and reduces overload.

### 5.2.2 *Integrating multimedia into assessment and feedback*

Participants described how they embedded multimedia into assessment and feedback to promote deep learning. Online quizzes, for example, were widely used to encourage retrieval practice and provide immediate feedback. On the other hand, video-based assignments prompted students to apply theoretical knowledge to practical scenarios. In this regard, a lecturer shared:

*“Our take-home exams were online, and we used the invigilator app as a proctoring tool.” (L4C2)*

And

*“Assessments, forums, announcements, lessons, additional resources, statistics, marking, scheduler for online classes... I use video links in my lessons to better explain concepts... and in my assignments, I give video links... and base practical application questions on the videos.” (L2C1)*

The integration of multimedia into assessment echoes Mayer's principle of active processing by requiring students to engage with content meaningfully. It also reflects Garrison and Vaughan's (2008) view that active learning environments must integrate assessment as an ongoing component of the learning process.

### 5.2.3 Capacity building and pedagogical adaptation

Despite innovative practices participants shared, they also acknowledged challenges in designing effective multimedia-based pedagogy. Limited digital literacy, insufficient training, and inadequate institutional support constrained their ability to fully leverage multimedia tools. One participant shared:

*"During lessons, constant technological challenges and glitches require academics to prepare their lessons in advance and ensure they have the needed knowledge and skills at the right time to minimise panic." (L3C3)*

Another stated:

*"The university encountered many challenges regarding ICT support as lecturers were not sure how to use certain platforms, such as the lessons tool on the LMS or Microsoft Teams." (S1)*

The finding supports the research by Mafuhure et al. (2025) and Ohei et al. (2023), who both found that many lecturers in South African ODeL institutions lack the pedagogical knowledge and digital competencies necessary to design effective multimedia-enhanced learning experiences. As a result, some continue with text-based instruction and content transmission, with limited opportunities for interactive learning.

The study also revealed the importance of continuous professional development (CPD) in building lecturers' capacity to integrate multimedia effectively. Workshops on Moodle, Microsoft Teams, assessment design, and digital pedagogy were cited as critical support. For example, a lecturer shared:

*"The workshops we attended since the pandemic have provided me with various options for teaching students and interacting with colleagues. They have also helped me to create an inclusive teaching and learning environment. I found that students quickly adapt and can utilise online platforms in many ways." (L1C2)*

Based on a question about multimedia-related support offered to staff members, training opportunities were mentioned, such as "plenty of multimedia training sessions" (S3), such as Camtasia, Microsoft Teams, and the uploading of videos. This finding aligns with the conclusions of a study by Hodroy et al. (2021), highlighting the significance of professional development when integrating multimedia into teaching and learning. Such training will empower lecturers to re-evaluate their teaching practices (Laurillard, 2012).

### 5.3 Theme 3: Equity, access, and student success in ODeL

The third theme addressed the implications of multimedia integration for equitable access and student success. The responses were based on questions related to the benefits and challenges of multimedia integration in teaching and learning. The findings reveal that while multimedia tools have the potential to democratize learning and bridge educational gaps, structural inequalities in access to devices, data, connectivity, and digital literacy continue to pose significant barriers. Four sub-themes were derived from this theme.

#### 5.3.1 Connectivity, infrastructure, and digital access

Participants highlighted several barriers related to infrastructure, such as unstable internet connections, devices, and insufficient data, which all limited students' access to multimedia content. For example, a dean shared:

*“Data and bandwidth challenges were encountered by academics and students who live in areas with no fibre or insufficient connectivity. However, the data allocation [by the university] was a positive incentive.”*  
(D3)

Another said:

*“The challenges are with digital devices, as many of them are old and outdated with limited functionality.”* (D1)

In this regard, a study by Zongozzi and Ngubane (2025) investigated the persistent digital divide in South African higher education, caused by students in rural and low-income areas facing bandwidth challenges and inadequate access to devices. Imran (2023) similarly cautions that without targeted interventions, increased reliance on digital tools may exacerbate inequalities rather than mitigate them.

#### 5.3.2 Sub-theme 2: Strategies for inclusion and equitable participation

In response to these challenges, lecturers employed creative strategies to extend communication channels and support students in low-connectivity contexts. Social messaging platforms were used to supplement official learning management system communication to reach students quickly. As one lecturer explained:

*“For specific module-related content and information, WhatsApp is the main platform I use for my students, while we often use Facebook for more general communication.”* (L1C3)

Another stated:

*“We created support videos for teaching and learning and would upload them on YouTube for students to watch them at a convenient time when they have connectivity.”* (S3)

The use of alternative communication channels demonstrates the awareness of the need for flexibility and multiple entry points in ODeL environments. It also aligns with the study of Viljoen et al. (2024), recommending that institutions should develop low-bandwidth multimedia solutions and adaptive content formats such as downloadable videos and audio recordings, to ensure equitable access.

Institutional support initiatives and related policies, such as negotiating reduced data costs with mobile providers, were also mentioned as critical interventions. This aligns with the call of Waang (2023) for ODeL institutions to adopt policies that address inequities and promote inclusive access to digital learning. While participants in this study praised the university for their negotiations with service providers to provide free data, they also noted that more comprehensive policies addressing device access, connectivity, and ongoing support for students and lecturers were needed. In this regard, Imran (2023) argues that without policy support, digital inequities will continue to undermine the transformative potential of multimedia in ODeL.

### 5.3.3 Digital literacies and student readiness

Participants further reported disparities in students' digital literacy, which affected their ability to navigate multimedia resources and fully participate in online learning. Some students lacked basic skills, such as using word processing software or uploading assignments, highlighting the need for targeted digital literacy programmes. One participant asked for the introduction of a compulsory, credit-bearing module to address such gaps:

*"We observed that students lack basic digital skills. There is a need for a compulsory digital and academic literacies module for first-time entrants." (L2C1)*

This aligns with Darling-Hammond et al.'s (2020) study, indicating that equitable access to technology is insufficient without the necessary skills to use it effectively. Bridging digital literacy gaps is crucial for encouraging active processing, as defined by Mayer (2013), which requires students to engage deeply with the content.

## 5.4 Summary of the findings

The findings reveal how multimedia tools, pedagogical strategies, and institutional conditions interact to shape cognitive engagement, teaching practices and equity in ODeL, with specific reference to the South African context. The three themes show that multimedia integration enriches learning opportunities but also exposes persistent challenges in design, competence, and access.

Theme 1 showed that multimedia tools are central to ODeL teaching and learning. Moodle and related platforms serve as the main hubs for media integration, discussion forums, and synchronous interaction. When used purposefully, these tools enhanced comprehension, attention, and knowledge retention. However, participants cautioned that unstructured multimedia use could overwhelm students, highlighting the need for short, well-organised content that supports focus and understanding. Synchronous tools such as Microsoft Teams were also

valuable for interaction, feedback, and revisiting recorded sessions, reinforcing learning and engagement.

Theme 2 indicated a gradual shift from teacher-centred to learner-centred pedagogies. Lecturers increasingly designed activities that promote collaboration, questioning, and reflection through forums, quizzes, and video-based tasks. Multimedia was also integrated into assessment and feedback to strengthen participation and authentic learning. However, limited digital competence and inconsistent training are limited innovation. Continuous professional development emerged as key to improving lecturers' preparedness and students' digital literacy and readiness.

Theme 3 highlighted that equitable access remains a major challenge. Many students continue to face bandwidth limitations and insufficient access to devices. Lecturers addressed these issues by using flexible communication tools like WhatsApp and Facebook and related low-bandwidth alternatives for content delivery. Institutional interventions such as free data and partnerships with service providers helped but were not enough to ensure inclusion. Participants stressed that improving students' digital literacy is essential for full engagement in multimedia-enhanced learning.

## **6. Conclusion and Recommendations**

This study explored three key questions: how multimedia tools mediate cognitive engagement and knowledge retention, which pedagogical strategies lecturers adopt to facilitate active learning in digital environments, and what the implications of multimedia integration are for equitable access and student success in ODeL contexts. The findings show that multimedia, when designed and implemented thoughtfully, can significantly enhance cognitive engagement by supporting dual-channel processing, reducing extraneous load, and facilitating active processing, as argued by Mayer and Sweller. Through embedded video, discussion forums, and synchronous platforms, lecturers were able to engage students in deeper learning.

The study further revealed that lecturers are moving toward more interactive and student-centred pedagogies. Strategies such as collaborative discussion forums, staged questioning, and multi-media-based assessments demonstrate how pedagogy and technology can intersect to create rich learning experiences. However, this transition to more interactive approaches remains uneven, constrained by lecturers' varying levels of digital competencies, limited training, and gaps in institutional strategies for support. Equity emerged as a central concern, highlighting that the transformative potential of multimedia cannot be realised without addressing constraints related to infrastructure, connectivity, and disparities in digital literacy.

While this study provides valuable insights into multimedia integration in ODeL, it has several limitations. First, the single case study at one South African ODeL institution limits its generalisability. Second, the study relied on self-reported data from lecturers, academic leaders and support staff; it did not capture students'

perspectives. Third, while the study identified links between multimedia use, cognitive engagement, and equity, it did not empirically measure learning outcomes, which is an opportunity for further research, possibly using a mixed-methods approach.

In addressing the research questions, the study showed that technology alone is not the solution; rather, it is the thoughtful interplay between cognitive theory, pedagogical innovation, and equitable access that creates meaningful and sustainable learning experiences. As ODeL continues to evolve, institutions that embrace this integrated approach will be best positioned to deliver on the promise of accessible, engaging, and transformative education for all.

Lastly, based on the findings of the study, the following four recommendations are proposed:

#### **Lecturer Training**

Develop a structured multimedia programme for lecturers focusing on cognitive load management, interactive design, and inclusive multimedia use. Such training should be certified and form part of lecturers' professional development.

#### **Low-bandwidth Policy**

Adopt a clear institutional policy promoting low-data multimedia delivery. All materials should include compressed videos with audio-only versions, and downloadable text formats. The policy should encourage mobile-friendly and offline access and continue partnerships with mobile providers for zero-rated platforms.

#### **Design and Mentorship Support**

Establish multimedia design support units in each College to assist lecturers with multimedia creation, design alignment, and quality assurance. Regular mentorship sessions can help staff share low-bandwidth innovations and strengthen digital pedagogy capacity.

#### **Student Digital Literacy**

Introduce a compulsory first-year module on digital and academic literacies to equip students with basic ICT, multimedia learning, and self-directed learning skills. The module should also cover responsible AI tools and low-data study strategies to promote inclusive participation.

### **7. Acknowledgments**

The authors wish to acknowledge the use of Grammarly in the writing of this paper. This tool was used to help improve the language and grammar in the paper.

## 8. References

- Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, 11(4), 589-597. <https://doi.org/10.1080/2159676X.2019.1628806>
- Clark, R. C., & Mayer, R. E. (2023). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning*. John Wiley & Sons.
- Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage Publications.
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.
- Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 97-140. <https://doi.org/10.1080/10888691.2018.1537791>
- Garrison, D. R., & Vaughan, N. D. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. John Wiley & Sons.
- Golden, A. R., Srisarajivakul, E. N., Hasselle, A. J., Pfund, R. A., & Knox, J. (2023). What was a gap is now a chasm: Remote schooling, the digital divide, and educational inequities resulting from the COVID-19 pandemic. *Current Opinion in Psychology*, 52, 101632. <https://doi.org/10.1016/j.copsyc.2023.101632>
- Hodroj, A., Ibrahim, M., & Hadjadj-Aoul, Y. (2021). A survey on video streaming in multipath and multihomed overlay networks. *IEEE Access*, 9, 66816-66828. <https://doi.org/10.1109/ACCESS.2021.3076464>
- Huber, S. G., & Helm, C. (2020). COVID-19 and schooling: evaluation, assessment and accountability in times of crises – reacting quickly to explore key issues for policy, practice and research with the school barometer. *Educational Assessment, Evaluation and Accountability*, 32(2), 237-270. <https://doi.org/10.1007/s11092-020-09322-y>
- Hutchings, P., Huber, M. T., & Ciccone, A. (2011). *The scholarship of teaching and learning reconsidered: Institutional integration and impact* (Vol. 21). John Wiley & Sons.
- Ibrahim, M. (2012). Implications of designing instructional video using cognitive theory of multimedia learning. *Critical Questions in Education*, 3(2), 83-104. [https://academyedstudies.files.wordpress.com/2014/12/mohamed\\_ibrahim\\_submissionfinal.pdf](https://academyedstudies.files.wordpress.com/2014/12/mohamed_ibrahim_submissionfinal.pdf)
- Imran, A. (2023). Why addressing digital inequality should be a priority. *The Electronic Journal of Information Systems in Developing Countries*, 89(3), e12255. <https://doi.org/10.1002/isd2.12255>
- Kiat, T. Y., Jumintono, J., Kriswanto, E. S., Sugiri, S., Handayani, E., Anggarini, Y., ... & Rofik, M. (2020). The effectiveness of multimedia learning on academic achievement in reproduction topic science subject. *Universal Journal of Educational Research*, 8(8), 3625-3629. <https://doi.org/10.13189/ujer.2020.080839>
- Kumi-Yeboah, A., Kim, Y., Sallar, A. M., & Kiramba, L. K. (2020). Exploring the use of digital technologies from the perspective of diverse learners in online learning environments. *Online Learning*, 24(4), 42-63. <https://doi.org/10.24059/olj.v24i4.2323>
- Lai, A., Chen, C., & Lee, G. (2018). An augmented reality-based learning approach to enhancing students' science reading performances from the perspective of the cognitive load theory. *British Journal of Educational Technology*, 50(1), 232-247. <https://doi.org/10.1111/bjet.12716>
- Li, C., & Lalani, F. (2020, April). The COVID-19 pandemic has changed education forever. This is how. In *World Economic Forum* (Vol. 29). Available: The rise of online

- learning during the COVID-19 pandemic | World Economic Forum (weforum.org).
- Laurillard, D. (2012). *Teaching as a design science: building pedagogical patterns for learning and technology* (1st ed.). Routledge. <https://doi.org/10.4324/9780203125083>
- Lincoln, Y. S. & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage Publications.
- Mafuhure, T., Phahlane, M., & Mbohwa, C. (2025). Fusing self-regulated learning and machine learning to enhance open and distance elearning systems. a systematic review. *Aceh International Journal of Science and Technology*, 14(2), 172-188. <https://doi.org/10.13170/aijst.14.2.47181>
- Mapolisa, T. (2022). Quality assurance practices in open and distance e-learning (ODEL) Institutions. *Leading and Managing Open and Distance e-Learning (ODEL) Institutions in Africa*, 193.
- Mayer, R. E. (2008). Applying the science of learning: evidence-based principles for the design of multimedia instruction. *American Psychologist*, 63(8), 760.
- Mayer, R. E. (2013). Ten research-based principles of multimedia learning. In *Web-based learning* (pp. 371-390). Routledge.
- Mayer, R. E. (2024). The past, present, and future of the cognitive theory of multimedia learning. *Educational Psychology Review*, 36(1). <https://doi.org/10.1007/s10648-023-09842-1>
- McMillan, J.H., & Schumacher, S. 2010. *Research in Education: Evidence-Based Inquiry* (7th edition). New Jersey: Pearson.
- Núñez-Canal, M., de Obesso, M. D. L. M., & Pérez-Rivero, C. A. (2022). New challenges in higher education: A study of the digital competence of educators in Covid times. *Technological Forecasting and Social Change*, 174, 121270. <https://doi.org/10.1016/j.techfore.2021.121270>
- Ohei, K. N., Mantzaris, E., Ntshangase, B. A., & Olutade, E. O. (2023). Incorporating new technologies into teaching in South Africa. *International Journal of Research in Business and Social Science* (2147- 4478), 12(6), 286-295. <https://doi.org/10.20525/ijrbs.v12i6.2715>
- Sailin, S. N., & Mahmor, N. A. (2018). Improving student teachers' digital pedagogy through meaningful learning activities. *Malaysian Journal of Learning and Instruction*, 15(2), 143-173. <https://doi.org/10.32890/mjli2018.15.2.6>
- Sharif, A. F., Moustafa, N. M., Abdo, S. A. E., Alosari, S., & Al-Dress, A. (2025). Beyond curriculum reform: the influence of integration on communication and presentation skills in medical students: a mixed-method study. *Advances in Medical Education and Practice*, Volume 16, 1077-1101. <https://doi.org/10.2147/amep.s525930>
- Sweller, J., Merriënboer, J. J. G. v., & Paas, F. (2019). Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review*, 31(2), 261-292. <https://doi.org/10.1007/s10648-019-09465-5>
- Taher, R., & Bentri, A. (2024). Development of interactive media using Macromedia Flash 8 software in natural sciences subjects in elementary schools. *AL-ISHLAH: Jurnal Pendidikan*, 16(2). <https://doi.org/10.35445/alishlah.v16i2.4786>
- Tordet, C., Fernandez, J., & Jamet, É. (2024). The effects of embedded quizzes on self-regulated processes and learning performance during a multimedia lesson. *Journal of Computer Assisted Learning*, 41(1). <https://doi.org/10.1111/jcal.13083>
- Valley, J., & Joseph, S. (2024). Cognitive insights: exploring the influence of segmented documentary videos on students' brain activity during encoding and retrieval of information. *Creative Education*, 15(07), 1473-1492. <https://doi.org/10.4236/ce.2024.157089>

- Venkatesh, V., Brown, S. A., & Sullivan, Y. (2016). Guidelines for conducting mixed-methods research: an extension and illustration. *Journal of the Association for Information Systems*, 17(7), 435-494. <https://doi.org/10.17705/1jais.00433>
- Viljoen, M., Seris, N., Shabalala, N., Ndlovu, M., de Vries, P. J., & Franz, L. (2024). Adapting an early autism caregiver coaching intervention for telehealth delivery in low-resource settings: A South African study of the 'what' and the 'why'. *Autism*, 29(5), 1246-1262. <https://doi.org/10.1177/13623613241300774>
- Waang, P. (2023). Maximizing the potential of multimedia in Indonesia: Enhancing engagement, accessibility, and learning outcomes. *Journal of Appropriate Technology*, 9(3), 235-245. <https://doi.org/10.37675/jat.2023.00409>
- Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). sage.
- Zepp, L., Trezek, B. J., & Leko, M. M. (2024). Preparing special educators to teach reading using multimedia instruction: a literature review. *Journal of Special Education Technology*, 39(4), 500-512. <https://doi.org/10.1177/01626434241232121>
- Zongozzi, J. N., & Ngubane, S. A. (2025). Equitable access to digital higher education for students with disabilities in South Africa. *African Journal of Disability*, 14, 1525. <https://doi.org/10.4102/ajod.v14i0.1525>