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Transforming Rural University Learning Spaces: Integrating Technology in Traditional Lecture Halls for Equitable Education

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Abstract. This study investigates integrating digital technologies inside standard classroom environments at a resource-constrained rural South African university to enhance equitable education. Drawing from the Technology Acceptance Model (TAM), Constructivist Learning Theory, and Diffusion of Innovation (DOI) Theory, this quantitative study examines perceptions and effectiveness of technology integration through structured questionnaires completed by 167 participants (students, lecturers, and support staff). Statistical analyses (Pearson correlation, ANOVA, regression) revealed significant relationships between the perceived usefulness of technology and student engagement ($r = 0.63$, $p < 0.01$), alongside notable group differences ($F(2, 164) = 7.34$, $p < 0.001$). Despite positive attitudes, hurdles such as inadequate infrastructure, constrained training, and insufficient institutional support were identified. The study concludes with strategic policy recommendations to address the barriers and foster sustainable technological integration.

Keywords: Technology integration, educational equity, digital literacy, rural-based higher education, student engagement, infrastructure barriers

1. Introduction

In recent decades, digital technologies have profoundly reshaped higher education systems worldwide. From blended learning platforms and interactive whiteboards to artificial intelligence (AI)-driven learning analytics and remote conferencing tools, educational institutions have increasingly embraced technological integration to improve teaching effectiveness, , often struggle to implement similar innovations due to longstanding infrastructural deficits, policy gaps, and disparities in digital literacy (Mhlanga & Moloi, 2020; Osei, 2021). In sub-Saharan Africa, higher education institutions face critical challenges such as inadequate funding promote student engagement, and enhance learning outcomes (Scherer, Siddiq, & Tondeur, 2019; Granić & Marangunić, 2019). These developments are particularly pronounced in high-income countries, where robust digital infrastructure, widespread internet access, and continuous professional development for staff underpin systemic adoption (OECD, 2020). Conversely, universities in developing contexts, especially those located in rural settings for ICT infrastructure, inconsistent power supply, limited internet access, and insufficiently trained personnel capable of leveraging educational technologies for transformative teaching (Butcher & Hoosen,

2019). These issues perpetuate digital exclusion and widen the pedagogical division between rural and urban learning environments.

In South Africa, this digital divide is particularly stark between historically advantaged and disadvantaged institutions. Urban universities have made substantial strides in adopting online learning management systems, digital lecture capture tools, and e-assessment platforms. Meanwhile, many rural-based institutions continue to rely heavily on traditional, chalk-and-talk pedagogies within outdated lecture halls, limiting their capacity to respond to the demands of the Fourth Industrial Revolution (4IR) and expectations of 21st-century learners (Van Wyk, 2024; Ngubane-Mokiwa & Khoza, 2021). Despite national strategies advocating for technological reform such as the National Development Plan 2030, the White Paper for Post-School Education and Training (DHET, 2013), and the Draft National Data and Cloud Policy (DCDT, 2021), universities continue to face significant challenges in embedding digital tools into mainstream pedagogical practice. While there is growing literature on the implementation of e-learning during the COVID-19 pandemic, little attention has been given to the transformation of traditional lecture halls through embedded technological integration. Most studies focus on fully online or hybrid models, overlooking how physical classroom spaces can be adapted for digital engagement, particularly in rural contexts where digital migration is slower and resource constraints are greater (Mlitwa, 2020; Seleke, 2021). This neglect creates a critical knowledge gap and undermines national and institutional aspirations for inclusive, equitable, and future-ready higher education.

1.1 Significance and Rationale of the Study

The imperative drives this study to transform rural university learning environments by investigating the integration of digital technologies into traditional lecture halls. In the context of this resource-constrained rural university, such a revolution is not merely a technological advancement but a strategic step toward achieving pedagogical equity, student engagement, and institutional resilience. By exploring the insights and experiences of students, lecturers, and supporting staff, this research offers empirical evidence on the extent to which technological tools enhance learning, the barriers impeding their adoption, and the institutional conditions necessary for successful implementation. The significance of this study is based on its potential to inform evidence-based policy interventions and contextually responsive educational practices. Focusing on a resource-constrained rural South African university contributes to decolonial and developmental discourses in higher education, advocating for the democratisation of digital innovation beyond privileged, urban centres. Furthermore, the study aligns with national goals to prepare competent graduates in a rapidly evolving digital economy, as outlined in South Africa's Draft National Data and Cloud Policy and Higher Education ICT White Paper (DCDT, 2021; DHET, 2013). Ultimately, this study aims to advance the discourse on equitable digital transformation in South African higher education by answering a fundamental question:

> *How can traditional lecture halls in resource-constrained rural universities be transformed into digitally enhanced learning spaces that foster engagement, equity, and educational excellence?*

2. Literature Review

2.1 Technology Integration in Higher Education: Global Trends

Over the past two decades, integrating digital technologies in higher education has fundamentally reshaped teaching and learning practices worldwide. In technologically advanced contexts such as the European Union, East Asia, and North America, universities have widely adopted Learning Management Systems (LMS), interactive classroom technologies, and data-driven adaptive learning tools (Granić & Marangunić, 2019; OECD, 2020). Evidence suggests that these tools contribute to increased student engagement, support differentiated instruction and enable the real-time monitoring of learning progress (Alenezi, 2021; Jung & Lee, 2022). However, as Selwyn (2020)

cautions, the global discourse on educational technology is often underpinned by techno-optimism that overlooks contextual challenges. While studies confirm the pedagogical value of digital tools, their effectiveness is highly dependent on access, institutional readiness, and alignment with pedagogical goals. The mere availability of digital infrastructure does not give assurance of enhanced learning outcomes. Instead, effectiveness hinges on how such tools are deployed within responsive and student-centred teaching frameworks (Kilag, Mena, & Zuluaga, 2023).

2.2 Digital Transformation in African Universities

In African higher education contexts, digital transformation efforts are often shaped by a tension between progressive national policies and structural constraints on the ground. While African Union initiatives such as the Continental Education Strategy for Africa (CESA 2016–2025) encourage the adoption of digital technologies, universities continue to grapple with infrastructural deficits, inconsistent connectivity, and a digital literacy gap affecting both students and faculty (Mohamed Hashim, Alghamdi, & Abdelmalek, 2022). A survey by the Association of African Universities (AAU, 2021) found that over 60% of institutions across sub-Saharan Africa identified ICT infrastructure and staff development as major obstacles to digital innovation. Empirical studies from Nigeria, Ghana, Kenya, and Tanzania confirm that technological tools are underutilised, with lecturers often reverting to traditional methods due to unfamiliarity with digital pedagogies (Osei, 2021; Oketch, 2020). Additionally, although national policies promote ICT access, implementation at the institutional level remains fragmented and underfunded (Uleanya & Ajani, 2022). These findings underscore the need for integrated digital strategies that address both infrastructural and human capacity constraints. Scholars such as Akpan and Ita (2022) argue for the transformation of physical learning spaces to support blended and hybrid modes of instruction, yet most African universities still rely on outdated lecture halls not suited to digital innovation.

2.3 South African Context: Policy and Practice Disjunction

South Africa presents a unique case where progressive policy frameworks co-exist with deeply entrenched inequalities in access to education and technology. Key policies such as the White Paper for Post-School Education and Training (DHET, 2013) and the Department of Communications and Digital Technologies (DCDT, 2021) articulate an ambitious vision for digitally enhanced education. These policies advocate for ICT integration, digital literacy development, and the reconfiguration of learning environments to reflect the demands of the Fourth Industrial Revolution (4IR).

Despite these policy intentions, implementation remains uneven—particularly in historically disadvantaged and rural-based institutions (Ngubane-Mokiwa & Khoza, 2021; Van Wyk, 2024). Urban universities such as UCT and Wits have made considerable progress in integrating technologies across disciplines, but some rural institutions continue to face limited infrastructure, erratic power supply, and staff development challenges. According to Pika and Reddy (2022), this misalignment between policy and practice reflects a broader failure to account for the operational realities of under-resourced campuses. The COVID-19 pandemic brought this divide into sharper focus. While universities scrambled to migrate to emergency remote teaching, rural students and lecturers struggled with limited access to devices and data (Maringe & Kaunda, 2021). Post-pandemic, there has been growing recognition that digital transformation must include investment in physical classroom infrastructure and not be confined to online learning initiatives. As Mlitwa (2020) notes, “transformation must be structural, systemic and pedagogical, not merely technological.”

2.4 The Under-Theorisation of Physical Learning Environments

Most existing literature on technology in education focuses on online and blended learning systems, overlooking the physical transformation of traditional lecture halls through embedded digital technologies. Studies tend to assume that digital innovation is

synonymous with online delivery, thereby neglecting the potential of in-person spaces to become interactive, digitally supported learning hubs (Aluko, 2020). This omission is particularly problematic for rural universities where fully online models are often impractical due to bandwidth constraints and low device penetration. In such contexts, digitally augmented lecture halls represent a viable and scalable strategy for improving learning experiences. However, empirical research on how such spaces are used, perceived, and sustained, especially in the Global South, is extremely limited. This represents a significant gap in the literature.

2.5 Framing the Research Gap

Although a robust body of literature explores e-learning adoption, a paucity of empirical research examines how digital technologies are integrated into traditional, in-person lecture spaces, particularly within rural higher education institutions in South Africa. Furthermore, little is known about how various stakeholders (students, lecturers, support staff) perceive these technologies and the institutional conditions enabling or inhibiting their adoption. This study responds directly to this gap by focusing on one resource-constrained rural University's efforts to digitise traditional learning environments. Unlike most studies that assess technology at the level of platforms or content delivery, this research investigates how physical lecture spaces are reimagined to support digital engagement, drawing on the intersecting frameworks of the Technology Acceptance Model (TAM), Constructivist Learning Theory, and the Diffusion of Innovation Theory (DoI).

3. Theoretical Framework

This study is anchored in three interrelated theoretical models: the Technology Acceptance Model (TAM), Constructivist Learning Theory, and the Diffusion of Innovation (DoI) Theory. Together, these frameworks offer a robust lens for examining how technology is adopted, perceived, and utilised within rural university lecture halls. Their integration enables a nuanced understanding of the psychological, pedagogical, and organisational dynamics influencing digital transformation in under-resourced learning environments. These theories are selected for their complementarity. TAM explains the individual user's decision-making processes concerning technology use, Constructivism addresses the pedagogical potential of digital tools, and DoI Theory provides insight into the institutional and systemic diffusion of innovation. In combination, they create a multi-layered framework suitable for understanding whether technology is adopted and how and why it is adopted or resisted within the sociotechnical context of rural higher education.

3.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model, developed by Davis (1989), is a seminal framework for the identification of how users accept and use new technologies. TAM suggests that two primary constructs, perceived usefulness (PU) and perceived ease of use (PEOU), influence users' attitudes towards a given technology, predicting their behavioural intention to use it. In educational contexts, TAM has been used extensively to study students' and lecturers' adoption of Learning Management Systems (LMS), digital content platforms, and classroom-based tools such as interactive whiteboards and response systems (Granić & Marangunić, 2019; Scherer, Siddiq, & Tondeur, 2019).In rural university contexts, the TAM framework is particularly relevant given the mixed levels of technological exposure among staff and students. Studies have shown that when users perceive educational technology as improving efficiency and learning outcomes, they are more likely to overcome barriers such as low digital literacy or limited training (Jung & Lee, 2022). However, when perceived usefulness is low, often due to infrastructural constraints or poorly contextualised tools, adoption rates decline sharply. This study, therefore, utilises TAM to evaluate how rural university stakeholders perceive the functionality and educational value of lecture hall technologies.

3.2 Constructivist Learning Theory

Constructivist Learning Theory, as developed by Vygotsky (1978), asserts that learning is an active, social, and situated process. Learners construct knowledge through experiences, interactions, and reflections rather than passively absorbing facts. In technologically mediated environments, digital tools become enablers of such learning by facilitating collaboration, exploration, and immediate feedback (Kilag, Mena, & Zuluaga, 2023). Technologies such as simulations, digital storytelling apps, collaborative whiteboards, and mobile learning platforms allow students to engage more deeply and meaningfully with course content. The constructivist framework is crucial in analysing the pedagogical shift that technology integration demands. In rural universities, where traditional lecture formats remain dominant, introducing interactive tools can create opportunities for participatory learning provided lecturers can redesign their instruction accordingly (Ngubane-Mokiwa & Khoza, 2021). However, the success of such approaches is influenced not just by access to technology, but also by the pedagogical orientation of educators. As such, this study interrogates whether the technologies used in resource-constrained university lecture halls enable constructivist practices or merely replicating traditional didactic models through digital means.

3.3 Diffusion of Innovation (DoI) Theory

Everett Rogers' Diffusion of Innovation Theory (2003) suggests a macro-level framework for understanding how innovations, such as educational technologies, spread within organisations and communities. DoI categorises adopters into five groups: innovators, early adopters, early majority, late majority, and laggards. It also summarises five stages of adoption: knowledge, persuasion, decision, implementation, and confirmation. This model helps to explain why and how some individuals or institutions embrace innovation sooner than others, and what factors may accelerate or hinder the process. In rural higher education, diffusion is often slowed by systemic barriers such as funding constraints, bureaucratic inertia, and lack of training opportunities (Osei, 2021). Within this resource-constrained rural university, for example, even where technology is available, the absence of consistent support structures often results in underutilisation. According to Pika and Reddy (2022), successful innovation diffusion in South African universities depends on strong leadership, continuous professional development, and alignment between institutional strategy and technology investment. By applying DoI Theory, this study seeks to identify the points at which diffusion breaks down and what mechanisms may help sustain innovation in teaching spaces.

3.4 Integrative Framework and Relevance to the Study

Together, TAM, Constructivism, and DoI provide a triangulated framework for examining both individual and institutional dynamics of technology integration. TAM addresses the user's perceptions and attitudes; Constructivism foregrounds the pedagogical purpose of technology; and DoI situates adoption within a broader organisational ecosystem. This integration is essential for analysing the complexities of digital transformation in traditional lecture halls, especially within a rural university where technological access does not automatically translate into meaningful use. Figure 1 below demonstrates the interrelationship between the TAM, Constructivism and DoI.

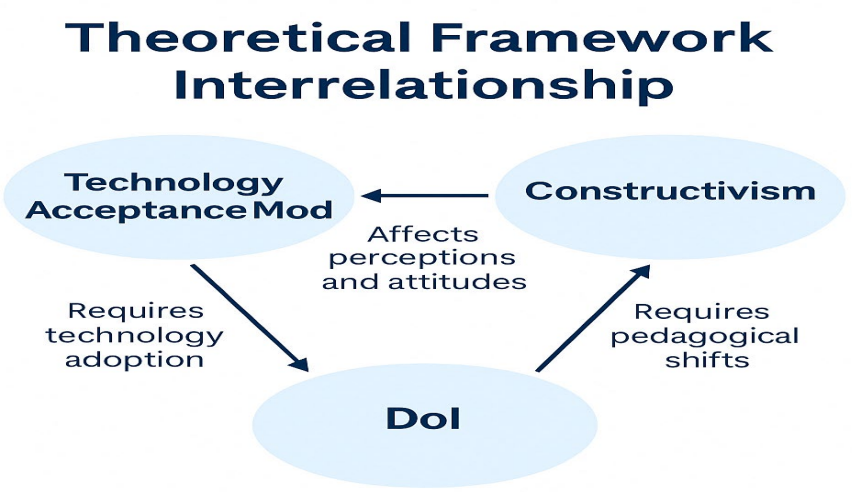

Figure 1: Interrelationship of the Technology Acceptance Model (TAM), Constructivist Learning Theory, and Diffusion of Innovation (DoI) Theory as applied in this study. (Source: Author's conceptual design)

Importantly, these frameworks also allow for critical evaluation of institutional readiness, a key determinant of whether digital transformation is sustainable. As Van Wyk (2024) argues, post-pandemic recovery in South African universities must move beyond emergency digital responses to embed enduring, equity-oriented pedagogical reforms. This theoretical framework thus supports the study's aim of investigating whether technologies are present in a rural university context and how they are understood, deployed, and sustained in ways that advance educational equity and quality.

4. Methodology

This study adopted a quantitative cross-sectional survey design, which is suitable for examining many participants' perceptions, attitudes, and experiences at a single point in time (Creswell & Creswell, 2018). The design allows for identifying trends, relationships, and statistically significant differences between groups (e.g., students, lecturers, and support staff). It was selected to provide empirical insights into the extent and nature of digital technology adoption within traditional lecture halls at a rural-based university in South Africa. Using a quantitative approach is predominantly relevant in tertiary education transformation, where measurable indicators, such as levels of digital readiness, perceived usefulness, and user engagement, are essential for informing institutional policy (Cohen, Manion, & Morrison, 2018). This design aligns with similar technology adoption studies that utilised the Technology Acceptance Model (TAM) and Diffusion of Innovation Theory (DoI) as foundational theoretical frameworks (Scherer, Siddiq, & Tondeur, 2019; Rogers, 2003).

4.1 Research Setting and Context

The study was conducted at a rural-based comprehensive university with multiple campuses across the Eastern Cape Province of South Africa. This university has been characterised by significant disparities in technological infrastructure across its urban and rural campuses, reflecting broader systemic inequalities within the South African tertiary education system (Ngubane-Mokiwa & Khoza, 2021). The specific campus, selected as the primary research site, offers an instructive case for understanding digital integration challenges in rural lecture halls. Although the university has made incremental investments in Information and Communication Technologies (ICTs), many of its teaching spaces remain under-equipped, and digital innovation is inconsistently applied across departments. This study focused on lecture halls that had some form of digital upgrade

(e.g., projectors, Wi-Fi access, or smart screens), to assess how these tools were perceived and used by various stakeholders.

4.2 Population and Sampling

The study population included three groups: undergraduate students, academic lecturers, and administrative or technical support staff directly involved in the use, maintenance, or facilitation of educational technology. A stratified random sampling strategy was adopted to ensure fair representation across these groups (Bryman, 2016). This approach helps to avoid sample bias and enables comparison between user categories, a key analytical goal of this study. A total sample of 167 participants was selected: 144 students, 14 lecturers, and 9 support staff members. This sample size exceeds the minimum required for statistical power in social research contexts and allows for the application of parametric tests such as Analysis of Variance (ANOVA) and regression analysis (Field, 2018). Participation was voluntary, and voluntary consent was received from all respondents before data collection.

4.3 Instrumentation and Validation

Data acquisition was carried out using a structured, self-administered questionnaire comprising 30 Likert-scale items and 3 open-ended questions. The instrument was developed based on validated constructs from the Technology Acceptance Model (TAM), Constructivist Learning Theory, and Diffusion of Innovation (DoI) Theory. Constructs measured included: perceived usefulness, perceived ease of use, digital engagement, pedagogical responsiveness, and institutional support for innovation. A pilot study was conducted with 15 respondents from a comparable faculty to ensure reliability. The instrument's internal consistency was measured using Cronbach's alpha, which yielded a value of 0.86, indicating high reliability (Tavakol & Dennick, 2011). Face validity was ensured through expert review by three senior educational technology researchers who confirmed that the items were contextually relevant, logically ordered, and unambiguous.

4.4 Data Collection Procedures

Data collection was conducted over three weeks in August 2024. The questionnaire was distributed electronically to target groups via the university's official LMS and email. Where internet access was unreliable, physical copies of the questionnaire were provided to students and support staff. Responses were manually entered into a central database to ensure data standardisation for statistical analysis. To enhance response quality and ethical compliance, a digital cover letter accompanied each questionnaire, explaining the study's purpose, guaranteeing confidentiality, and securing informed consent. Data were collected anonymously, without any identifiable information, and all responses were anonymised. Ethical clearance was attained from the Institutional Research Ethics Committee under reference number WSU2025/TECH001.

4.5 Data Analysis Techniques

Quantitative data were analysed using IBM SPSS (Statistical Package for the Social Sciences), version 28. Descriptive statistics (means, frequencies, and standard deviations) were used to summarise participant responses. Inferential analyses were performed to assess relationships between key variables and test group differences. Pearson correlation was used to examine associations between perceived usefulness and learner engagement. One-way ANOVA was used to test for significant differences across stakeholder groups (students, lecturers, and support staff). Finally, multiple linear regression was applied to predict the impact of key variables, such as institutional support and digital readiness, on engagement levels. All tests were conducted at a 95% confidence level, with p-values < 0.05 considered statistically significant (Field, 2018).

5. Findings

5.1 Descriptive Analysis of Technology Perceptions and Usage

The descriptive statistics revealed overall positive attitudes toward integrating digital technologies in lecture halls across all stakeholder groups. Among students (n = 144), 72% agreed or strongly agreed that digital tools such as projectors, smart screens, and Wi-Fi-enabled spaces enhanced their engagement in class. Similarly, 68% of lecturers (n = 14) reported that the availability of basic digital infrastructure improved their teaching delivery and student interaction. Support staff (n = 9) were more ambivalent, with only 44% agreeing that their departments had adequate capacity to support technology-based teaching and learning. Figure 2, below, presents a graphical illustration of stakeholder perceptions of digital engagement and mean scores across technology adoption constructs.

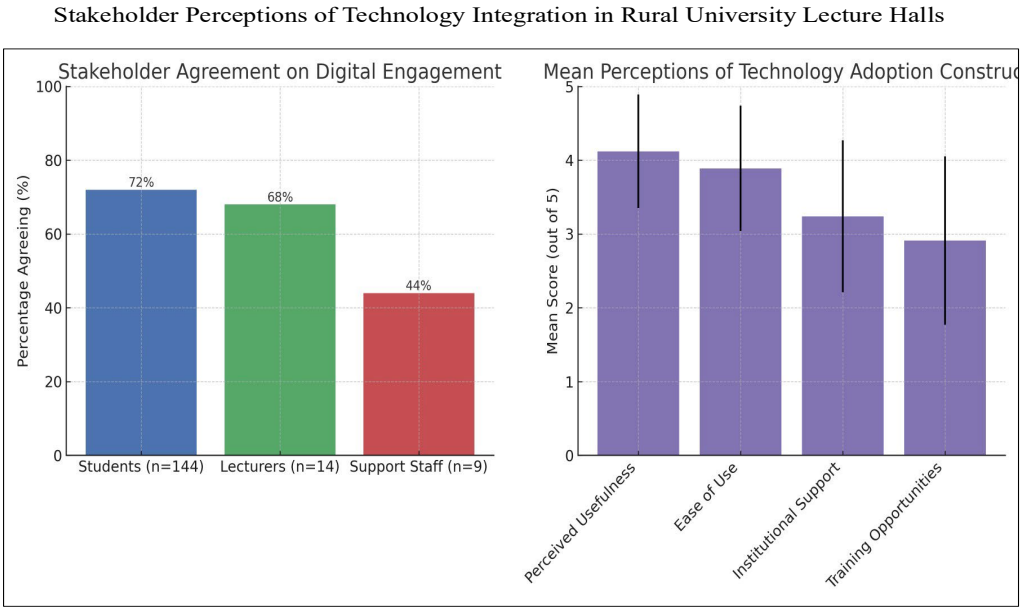

Figure 2: Stakeholder agreement (%) and mean scores for key technology adoption constructs in a Rural University context. (Data source: Author's fieldwork, 2024)

Mean scores across key constructs indicated moderate to high perceptions of perceived usefulness (M = 4.12, SD = 0.77) and ease of use (M = 3.89, SD = 0.85). This suggests that most users believed that available technologies positively influenced the learning experience. However, scores for institutional support (M = 3.24, SD = 1.03) and training opportunities (M = 2.91, SD = 1.14) were notably lower, indicating systemic barriers to sustainable implementation. These outcomes correspond with previous research in rural universities, which found that while technology can enhance learning, its effectiveness depends heavily on organisational readiness and ongoing professional support (Osei, 2021; Pika & Reddy, 2022).

5.2 Pearson Correlation Results

The Pearson correlation analysis demonstrated significant relationships between several key constructs. Most notably, there was a strong, positive correlation between perceived usefulness of digital tools and student engagement ($r = 0.63$, $p < 0.01$). This implies that the more students and lecturers perceived digital tools as useful, the more likely students were to engage meaningfully in lectures. A moderate correlation was also observed between ease of use and lecturer motivation to innovate ($r = 0.45$, $p < 0.05$), suggesting that intuitive digital interfaces may reduce resistance to pedagogical innovation. Figure 3 below presents a graphical illustration of the Pearson Correlation Results.

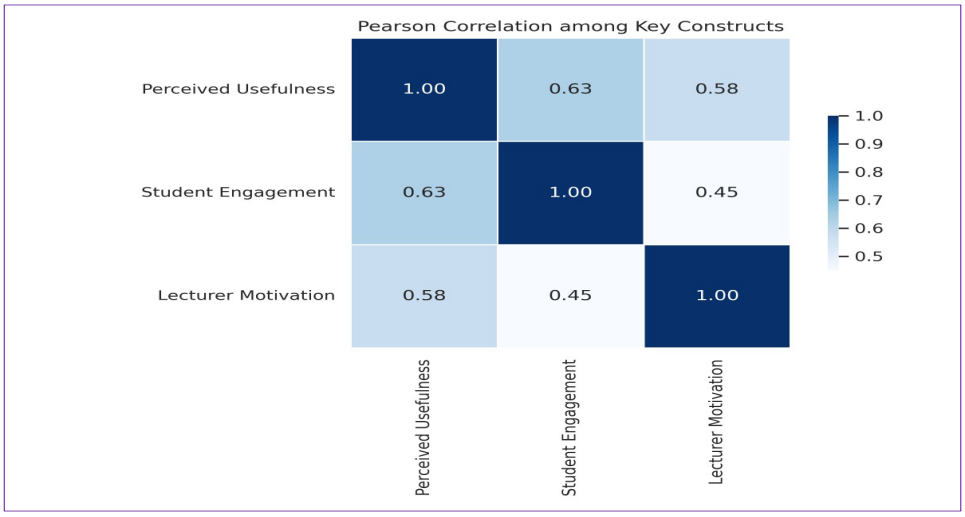

Figure 3: Pearson correlation heatmap illustrating relationships among perceived usefulness, student engagement, and lecturer motivation. (Data source: SPSS output, 2024)

These findings reinforce the foundational propositions of the Technology Acceptance Model (TAM), which suggests that perceived usefulness and ease of use are critical antecedents of technology adoption (Davis, 1989; Scherer et al., 2019). Within a rural university setting, where access to advanced systems may be limited, existing tools' simplicity and direct applicability significantly enhance their uptake. The data suggest that expanding access alone is not enough; users must also be equipped with digital fluency to fully realise the pedagogical benefits of technology.

5.3 ANOVA Findings: Differences Across Stakeholder Groups

A one-way Analysis of Variance (ANOVA) was conducted to test for statistically significant differences between students, lecturers, and support staff in their perceptions of digital technology. The results indicated a significant difference in perceptions of institutional support for digital integration, $F(2, 164) = 7.34$, $p < 0.001$. Post hoc Tukey HSD tests showed that students and lecturers perceived significantly more support than support staff. Figure 4, below, is a graphical presentation of the ANOVA results on stakeholder perceptions of institutional support.

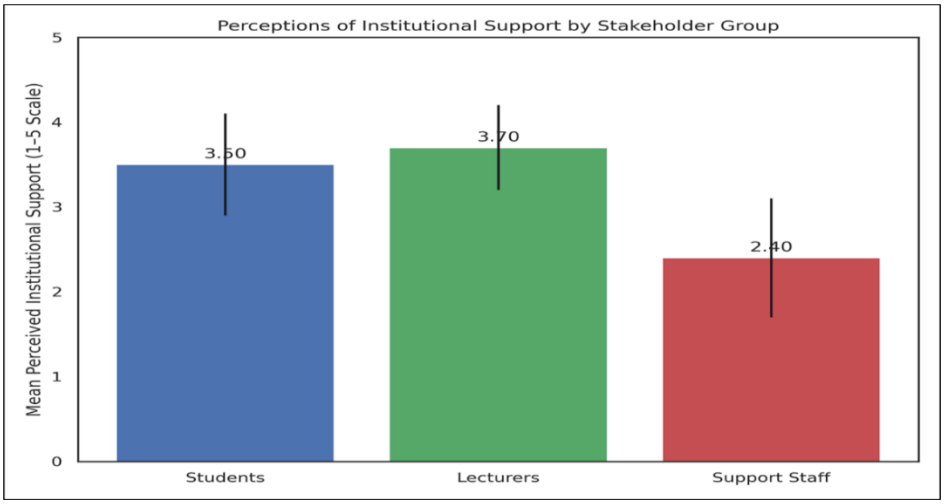

Figure 4: ANOVA results comparing perceptions of institutional support for digital integration among students, lecturers, and support staff. (Data source: SPSS output, 2024).

This disparity may reflect differing access levels to institutional communication, planning, and training. Students and lecturers are often the primary beneficiaries of ICT upgrades, while support staff are frequently excluded from strategic conversations despite being essential to maintenance and implementation. As Rogers (2003) explains in his Diffusion of Innovation Theory, systemic adoption requires consistent involvement of all stakeholders, including those tasked with supporting innovation. If this misalignment persists, it may undermine the long-term viability of digital integration in the resource-constrained rural university lecture halls.

5.4 Regression Analysis: Predictors of Learner Engagement

A multiple regression analysis was performed to determine the predictive power of key variables on student engagement. The model included three independent variables: perceived usefulness, ease of use, and institutional support. The overall regression was significant, $F(3, 163) = 15.74$, $p < 0.001$, and explained 38% of the variance in student engagement ($R^2 = 0.38$). Figure 5 below presents the Predictors of Learner Engagement

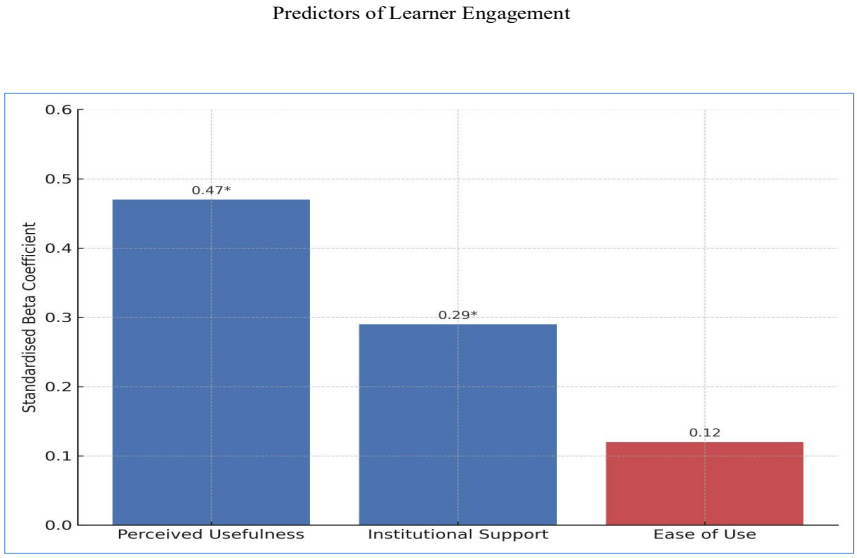

Figure 5: Multiple regression analysis showing the predictive strength of perceived usefulness, institutional support, and ease of use on learner engagement. Asterisks (*) indicate statistically significant predictors ($p < 0.05$). (Data source: SPSS output, 2024)

Among the predictors, perceived usefulness emerged as the strongest ($\beta = 0.47$, $p < 0.001$), followed by institutional support ($\beta = 0.29$, $p < 0.01$). Ease of use, while positively associated, was not statistically significant in the final model ($\beta = 0.12$, $p = 0.08$). These results validate the TAM framework and suggest that while usability matters, perceptions of value-added learning and institutional enablement are more critical drivers of sustained student engagement in digitally enabled classrooms. Similar conclusions were drawn by Alenezi (2021) and Jung & Lee (2022), who found that perceived educational impact was a more robust predictor of engagement than user interface simplicity.

6. Discussions

6.1 Aligning Findings with the Technology Acceptance Model (TAM)

The findings of this study substantiate the foundational tenets of the Technology Acceptance Model (TAM), which posits that users' intention to adopt and utilise technology is driven by their perceptions of usefulness and ease of use (Davis, 1989). The strong, statistically significant correlation ($r = 0.63$) between perceived usefulness and

student engagement confirms TAM's predictive utility in educational settings (Scherer, Siddiq, & Tondeur, 2019). In the regression analysis, perceived usefulness ($\beta = 0.47$, $p < 0.001$) emerged as the most significant predictor of engagement, reinforcing the argument that learners are more likely to participate actively when they perceive digital tools as enhancing learning outcomes.

The study also found a moderate ease of use among participants, though this factor did not significantly predict engagement in the regression model. This outcome suggests perceived educational value may override usability concerns in resource-constrained rural university environments. Similar results were noted by Alenezi (2021), who found that under-resourced university students tend to tolerate technical limitations if they believe the technology contributes meaningfully to their academic success.

6.2 Constructivist Implications for Pedagogical Transformation

The findings also reflect elements of Constructivist Learning Theory, particularly the role of learner engagement and knowledge construction through active participation. Students reported that technologies such as smart screens and internet-enabled devices facilitated more interactive and visual learning modes. These align with constructivist principles, which advocate for student-centred, exploratory, and collaborative learning environments (Vygotsky, 1978; Kilag, Mena, & Zuluaga, 2023). However, the lack of pedagogical support and low scores for training opportunities ($M = 2.91$, $SD = 1.14$) indicate that many lecturers are not adequately prepared to design constructivist learning experiences using digital tools. In many instances, technologies are used as content delivery mechanisms rather than tools for transforming pedagogy. This reflects the findings of Ngubane-Mokiwa and Khoza (2021), who argue that without targeted and sustained professional development, adopting educational technologies often reinforces traditional, didactic teaching methods rather than promoting innovative, learner-centred instructional practices.

6.3 Organisational Barriers and the Diffusion of Innovation (DoI) Theory

The one-way ANOVA revealed significant discrepancies in perceived institutional support among students, lecturers, and support staff ($F(2, 164) = 7.34$, $p < 0.001$), with support staff feeling notably excluded from digital initiatives. This gap highlights the relevance of Rogers' (2003) Diffusion of Innovation Theory, which emphasises that successful innovation diffusion requires the inclusion and alignment of all organisational stakeholders. According to the theory, innovations progress through awareness, persuasion, decision, implementation, and confirmation stages. In the case of this resource-constrained rural university, there appears to be a partial diffusion process where students and lecturers are moving toward implementation. Still, institutional mechanisms, particularly support and training, have not yet reached the confirmation stage. As Pika and Reddy (2022) contend, policy intentions alone are insufficient to drive meaningful digital transformation in higher education. Effective implementation must be underpinned by a coherent institutional change strategy, robust and context-appropriate ICT infrastructure, and inclusive stakeholder engagement that ensures all actors are meaningfully involved in the change process.

6.4 Contextualising in the Rural South African Higher Education Environment

The digital transformation journey at this particular university exemplifies broader challenges rural-based South African institutions face. Despite positive attitudes toward digital integration, systemic barriers such as inadequate infrastructure, sporadic electricity, and inconsistent Wi-Fi connectivity continue to hinder implementation. These findings are consistent with Mlitwa (2020), who documented similar technological readiness challenges in other rural South African campuses. Furthermore, while national policies such as the White Paper for Post-School Education and Training (DHET, 2013) and the Department of Communications and Digital Technologies (DCDT, 2021) advocate for digitally inclusive higher education, the implementation gap at the institutional level

remains pronounced. The present study confirms that policy coherence, resourcing, and practical execution must be aligned to translate digital potential into pedagogical and academic impact.

6.5 Triangulating Quantitative and Qualitative Insights

The open-ended responses from students, lecturers, and support staff revealed critical nuances that enriched the quantitative findings. Students acknowledged the motivational benefits of digital tools but also expressed concerns about inconsistent access and unreliable infrastructure. Lecturers emphasised their desire to innovate but cited a lack of training, time, and institutional direction. Support staff voiced frustration with limited involvement in strategic planning and irregular equipment maintenance. These narratives suggest that successful digital transformation must move beyond technological provision to institutional leadership, culture, and continuous professional development. As Selwyn (2020) argues, educational technology implementation is not merely a technical exercise; it is deeply social, political, and pedagogical. Sustainable integration requires cultivating an inclusive, well-supported, and contextually sensitive culture of innovation.

7. Conclusion

This study has critically examined the integration of digital technologies into traditional lecture halls at a rural South African higher education institution. Anchored in the Technology Acceptance Model (TAM), Constructivist Learning Theory, and Diffusion of Innovation (DoI) Theory, the research revealed that students and lecturers generally perceive digital tools as beneficial for enhancing engagement and teaching effectiveness. Quantitative analysis confirmed perceived usefulness as the strongest predictor of learner engagement, with institutional support also playing a significant role. However, the findings also illuminate critical structural limitations that inhibit meaningful and sustained technology integration. These include inadequate lecturer training, insufficient infrastructural support, and marginalisation of support staff in digital implementation strategies. While policy frameworks at the national level articulate progressive digital transformation goals, the institutional capacity to realise these objectives, especially in rural contexts, remains uneven and fragmented. The study contributes to a growing body of scholarship advocating for context-sensitive, equity-oriented digital reform in South African higher education. It confirms that successful technology integration into learning environments requires more than the mere provision of tools; it necessitates institutional leadership, pedagogical reimagining, and inclusive stakeholder engagement. Without these elements, digital adoption risks becoming performative rather than transformative.

8. Implications for practice

The findings of this study underscore the urgent need for rural-based universities in South Africa to adopt comprehensive, context-sensitive strategies for integrating digital technologies into traditional learning environments. One key implication is the importance of institution-wide digital transformation policies that are not only aligned with national frameworks such as the White Paper for Post-School Education and Training (DHET, 2013) and the Department of Communications and Digital Technologies (DCDT, 2021) but also responsive to the unique infrastructural and human resource challenges faced by under-resourced campuses. Institutional planning must account for sustained investment in infrastructure, training, support services, and maintenance to ensure the' longevity and meaningful impact of technological innovations. Equally significant is the imperative to build the capacity of academic staff through continuous professional development (CPD). The study's findings reveal a clear gap in lecturer training, suggesting that many educators are open to using digital tools but often lack the pedagogical orientation required to do so effectively. Therefore, professional development should address the technical skills needed to operate digital platforms and equipment and engage lecturers in rethinking their instructional design through student-centred, constructivist methodologies. Such training should be iterative and supported through peer collaboration, communities of practice, and

mentorship structures embedded within institutional culture. Furthermore, meaningful digital transformation requires equitable access to infrastructure and digital resources. Retrofitting lecture halls with stable internet connectivity, interactive projectors, and reliable electricity is not a luxury but a necessity for bridging the urban-rural educational divide. These infrastructural upgrades must be accompanied by resource allocation models that consider the digital disparities among students, many of whom come from disadvantaged backgrounds with limited access to personal devices and data. By adopting inclusive design principles that accommodate learners with varying levels of digital literacy and connectivity, universities can ensure that technological integration contributes to rather than undermines educational equity.

Institutional leadership must also focus on cultivating a culture of innovation that includes all stakeholders, particularly administrative and support staff, who are often overlooked in digital planning processes despite their crucial roles in implementation and maintenance. Including support staff in decision-making processes and strategic planning sessions will enhance operational coherence and morale. Moreover, fostering interdisciplinary collaboration between lecturers, students, IT specialists, and curriculum designers can generate locally relevant, innovative teaching solutions. Lastly, a robust monitoring and evaluation (M&E) mechanism is essential for tracking the effectiveness of digital initiatives. Institutions should regularly audit digital readiness and user satisfaction, supported by data-driven tools such as learning analytics dashboards and feedback surveys. These M&E systems will enable universities to respond dynamically to implementation challenges, identify areas for improvement, and iteratively enhance the impact of digital transformation on teaching and learning quality.

References

Alenezi, A. (2021). Effectiveness of technology-enhanced learning in higher education: A systematic review. *Journal of Educational Technology Systems, 49*(3), 339–360. https://doi.org/10.1177/0047239520959119.

Bryman, A. (2016). Social research methods (5th ed.). Oxford: Oxford University Press.

Butcher, N., & Hoosen, S. (2019). Harnessing OER to strengthen ICT infrastructure in African universities. *Commonwealth of Learning.* https://oasis.col.org/handle/11599/3273

Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education (8th ed.). London: Routledge.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.).* Thousand Oaks, CA: SAGE.

Czerniewicz, L., & Brown, C. (2014). The habitus and technological practices of rural students: A case study. *South African Journal of Education, 34*(2), 1–14. https://doi.org/10.15700/201412071140

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Department of Communications and Digital Technologies (DCDT). (2021). Draft National Data and Cloud Policy. Pretoria: Government of South Africa. https://www.gov.za/sites/default/files/gcis_document/202104/44389gon206.pdf

Department of Higher Education and Training (DHET). (2013). White Paper for Post-School Education and Training: Building an expanded, effective and integrated post-school system. Pretoria: DHET.

Field, A. (2018). *Discovering statistics using IBM SPSS statistics (5th ed.).* London: SAGE.

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology, 50*(5), 2572–2593. https://doi.org/10.1111/bjet.12864

Jung, I., & Lee, Y. (2022). Exploring digital readiness in university classrooms. *Education and Information Technologies, 27,* 1535–1551. https://doi.org/10.1007/s10639-021-10653-4

Kilag, D., Mena, R., & Zuluaga, M. (2023). Interactive learning in technology-enhanced classrooms. *Teaching and Teacher Education, 126,* 104001. https://doi.org/10.1016/j.tate.2023.104001

Maringe, F., & Kaunda, L. (2021). Digital learning inequalities and COVID-19: A wake-up call for South African higher education. Higher Education Research & Development, 40(5), 957–961. https://doi.org/10.1080/07294360.2021.1955663

Mhlanga, D., & Moloi, T. (2020). COVID-19 and the digital transformation of education: What are we learning on 4IR in South Africa? *Education Sciences, 10*(7), 180. https://doi.org/10.3390/educsci10070180

Mlitwa, N. B. W. (2020). Readiness or not: University lecturers' readiness for mobile learning. *South African Journal of Higher Education, 34*(3), 158–177. https://doi.org/10.20853/34-3-3331

Ngubane-Mokiwa, S. A., & Khoza, S. B. (2021). Decolonising technology-enhanced learning in South African universities. *Education and Information Technologies, 26*, 5983–5999. https://doi.org/10.1007/s10639-021-10564-4

OECD. (2020). The impact of COVID-19 on education: Insights from education at a glance 2020. Paris: OECD Publishing.

Osei, C. (2021). Institutional barriers to digital transformation in West African universities. *International Journal of Educational Technology in Higher Education, 18*(1), 45–59. https://doi.org/10.1186/s41239-021-00273-z

Pika, M., & Reddy, C. (2022). From digital policy to practice: South African universities and the challenge of implementation. *Perspectives in Education, 40*(3), 1–16. https://doi.org/10.18820/2519593X/pie.v40.i3.1

Rogers, E. M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The Technology Acceptance Model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education, 128*, 13–35. https://doi.org/10.1016/j.compedu.2018.09.009

Seleke, B. (2021). Scaffolding teachers' professional development for the infusion of indigenous knowledge transfer in the Technology classroom (Unpublished PhD thesis). North-West University, South Africa.

Selwyn, N. (2020). *Should robots replace teachers? AI and the future of education.* Cambridge: Polity Press.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2, 53–55. https://doi.org/10.5116/ijme.4dfb.8dfd

Van Wyk, M. M. (2024). Reimagining post-pandemic pedagogy in rural South African universities. *South African Journal of Education, 44*(1), 1–12. https://doi.org/10.15700/saje.v44n1a2214

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.