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Investigating Emerging Technologies for Curriculum Delivery in a Rural South African University through the Lens of Diffusion of Innovation

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ABSTRACT
This study explores the access and adoption of emerging technologies for curriculum delivery in a rural South African university through the diffusion of innovation lens. It explores how first-year undergraduate students at the selected rural university experience the integration of digital tools into their learning experiences. Located in the rural higher education context, the research focuses on the interplay between the access of emerging technologies and the persisting digital divide. Qualitative design data collection was done using semi-structured interview questions with 20 students from four faculties, namely Education; Humanities and Social Sciences; Science and Agriculture; and Commerce and Law. The study adopts Diffusion of Innovation Theory as the theoretical framework that underpins how learners encounter, adopt and interpret technological innovations for curriculum delivery. Results reveal patterns of adoption based on the constraints of limited digital infrastructure, old devices, and a non-existent support structure. Part of the students' comments included dependency on informal peer learning, with frustration dealing with inconsistent connectivity and training access. This interaction is also urgent for context-specific technology orientation programs and needs for strategic infrastructure development and pedagogical models which are inclusive and sensitive to rural realities in the fight to narrow the digital divide.

KEYWORDS
Digital divide; emerging technologies; diffusion of innovation; rural universities; curriculum delivery.

INTRODUCTION

With the global acceleration of digital transformation in higher education, some universities are deemed to integrate new technologies into curriculum delivery (Nkabule, 2023). However, this change is not experienced uniformly, especially in rural institutions within developing contexts such as South Africa (Ajani, 2024; Aruleba & Jere, 2022). While digital learning is touted to bring equity to education, its implementation in places with challenged environments further exhibits disparities in access, infrastructure, and digital literacy (Agumba et al., 2023; Asongu & Odhiambo, 2019; Magocha et al.,2025). The selected rural university exemplifies the tension between national directives for digital education and the infrastructural and socio-economic limitations that obstruct meaningful adoption of educational technologies (Agumba et al., 2023; Ajani & Ngema, 2024).

According to Blose (2025), more attention is being paid to digital transformation in academic research, yet there remains an enormous deficit that looks at how students in rural universities experience and interpret the adoption of emerging technologies for curriculum delivery. Much of the literature privileges urban or well-resourced institutions and thereby eclipses the nuanced reality of rural learners (Ajani, 2025; Animashaun et al., 2024). The studies also often concentrate on technological access and less so on the socio-cultural, and pedagogical environments that shape adoption (Ajani & Govender, 2025; Berger, 2020). This study intends to fill that very gap by examining the lived experiences of first-year undergraduate students at the selected rural university as they engage with digital tools within the constraints of an inadequate infrastructure and technical support from an institution.

The Diffusion of Innovation theory (DOI), by Rogers (2003) underpins the theoretical foundation of this study and comes in handy to analyse how people and communities adopt newer technologies. According to Rogers, some factors about adoption are relative advantage, compatibility, complexity, trialability, and observability (Kurt, 2023; Sahin, 2006). In the case of rural universities, these factors are tempered with infrastructural deficiencies, digital illiteracy, and socio-economic constraints. It has been exceptionally well used to study technology adoption in education, especially in under-resourced settings (Dooley, 1999; Parisot, 1995). The DOI framework hereby guides this study in analysing how students at the selected rural university perceive, try, and integrate emerging technologies into their academic routines.

Given the nature of this study, which explores students' experiences, the study adopted a qualitative research design, as it describes the interaction between lived experience and socio-cultural factors crucial to understanding technology adoption. Semi-structured interviews were conducted for twenty-first-year students in four faculties, including Education, Humanities and Social Sciences, Science and Agriculture, and Commerce and Law, yielding narrative data that elaborately looks at issues concerning how learners relate to digital tools. The relevance of qualitative research in grasping the complex nature of educational innovation in rural environments has been emphasized in previous studies (Creswell, 2014; Kumar, 2019). This study, therefore, expands on those findings by focusing not just on the impediments in adoption

but also on ways of resisting and navigating such digital learning environments (Ajani, 2023; Ajani & Govender, 2023).

Hence, it closes a key lacuna by intersecting digital transformation with rural educational contexts, thus promoting a more inclusive outlook on curriculum delivery in South African higher education by bringing to the fore the voices of students often absent from the mainstream digital education discourse. By linking the Diffusion of Innovation Theory to qualitative data, a contextual lens is cast on the challenges and opportunities presented by emerging technology in rural universities. Such an understanding holds the key to shaping policy, institutional strategies, and pedagogy toward narrowing the digital divide and ensuring equitable quality education access.

LITERATURE REVIEW

In curriculum delivery, the need for emerging technology infusion grows in rural South African universities, as it is fast becoming a global imperative for digital equity. The selected rural university and other rural-based institutions face peculiar challenges in adopting digital tools due to infrastructural deficiencies, socio-economic disparities, and poor policy implementation (Agumba et al., 2023; Aruleba & Jere, 2022). Their continuous throttling of education opportunities to make learning available to learners from marginalized communities is mainly because of the digital divide that these institutions are contributing to (Asongu & Odhiambo, 2019). The rural context puts a big restriction on access to digital infrastructure, such as internet connectivity and hardware (Animashaun et al., 2024). Major considerations for rural digital development, in the view of Aruleba and Jere (2022), are inadequate policy efforts and funding. This kind of infrastructural situation not only limits access of students to learning but also prevents the effective usage of pedagogical innovations and, thus, widens the rural-urban digital chasm.

Emerging technologies such as artificial intelligence, virtual learning environments, and cloud-based platforms, if well implemented, could effectively address serious educational challenges. However, in rural universities, such technologies are most often underutilised or misused due to a lack of preparedness and poor contextualisation (Ajani, 2024; Ajani & Ngema, 2024). They, therefore, create further fragmentation within curriculum delivery and limit dimensions of student engagement via digital learning tools. Ajani (2025) notes that rural students often come to university with very poor digital literacy and little previous experience in structured digital learning. Such students are made to become vulnerable because they not only lack the instrumental knowledge to navigate these spaces but are also restricted through lack of capability to give value to the experience. Many universities, the problem gets complicated by their failure to implement orientation activities that are sensitive to the reality of their socio-cultural setting (Berger, 2020).

Rogers' Diffusion of Innovations theory (2003) is precisely what one requires to examine how rural students adopt and use technological innovations. According to Rogers, the diffusion

process is influenced by perception as to usefulness, ease of use, trialability, and observability. In rural universities, such aspects are usually deficient or irrelevant, making the adoption process uneven and inconsistent (Sahin, 2006). The adoption of technology in rural education has been subject to numerous studies. Scholars such as Dooley (1999) assert that such holistic models ought to consider more than just technological aspects; they should also reflect social, cultural, and institutional forces that interact with the diffusion of innovation theory. This translates to an argument by Ajani and Govender (2025), who call for a reconceptualisation of digital transformation within inclusive and responsive frameworks at local levels. However, all this diverges when it comes to implementing successful technology adoption.

Ajani and Dlomo (2025) claim that such a lack of support lowers chances for a successful technology adoption on technical and pedagogical grounds. In many cases, Ajani and Dlomo note, students must find their own way, making the experience inconsistent across faculties and courses and severely limiting its pedagogical value. The gaps are then filled with peer learning and informal networks in which students help each other navigate learning platforms, showing the strengths and shortcomings of institutional support (Ajani, 2023). This hardly helps but tends to undermine the failed attempts of this institution at institutionalizing digital competence into academic processes. Literature further reveals the induction of ethical and socially responsive principles in the digital transformation of rural universities. AI and digital tools should not reproduce inequalities, but rather transcend them, argue Ajani, Gamede, and Matiyenga (2025). This requires wisely formulated policies, inclusive training systems, and community sensitization (Tapala, 2024).

Emerging technologies in education depend chiefly on institutional leadership and policy coherence. Adams, Johansson de Silva, and Razmara (2013) visualise a very pressing need to align the development of digital skills with national strategies in educational reforms and socio-economic development. This is, in fact, a critical yet underdeveloped aspect in the rural settings. Then, the literature speaks to professional development of educators. Without such training, many teachers will struggle to integrate the technology into their pedagogical practices (Ajani & Govender, 2023; Ajani, 2024). According to Sherry and Gibson (2002), teacher leadership and participation in digital transformation efforts are key to institutional change. If context is to be defined as relevant to lived experience as an aspect of rural student experience, there will emerge a clear demand for any number of these innovations to be well contextualised within student lived experience (Chimbi & Jita, 2023). Access, pedagogy, and innovation must be negotiated very well to ensure truly meaningful, fair, and sustainable educational returns in rural South African universities.

The present study is framed according to Rogers' Diffusion of Innovations (DOI) theory that demarcates the progressive understanding of how people and communities accept innovative technologies over time (Rogers, 1962; 2003). This model is of great importance to rural South African universities, where digital inequalities regulate the access, speed, and nature of technology adoption. Here, the DOI framework provides an account of the conditions

favouring rejection, acceptance, or recontextualisation of emerging educational technologies on the part of students. Rogers emphasises that innovations are diffused through a population via five categories of adopters, namely innovators, early adopters, early majority, late majority, and laggards. Each category offers various levels of acceptance or resistance to innovative technology, based on perceptions regarding relative advantages, compatibility, complexity, trialability, and observability (Sahin, 2006; Kurt, 2023). These criteria, in this study, are employed in assessing student perceptions and usages of digital tools employed at the selected rural university for curriculum delivery purposes.

Educationally relevant technologies include cloud platforms, digital learning management systems, and mobile applications (Ajani, 2023; Animashaun et al., 2024). The DOI framework allows for analysis of whether students considered these technologies to be to some extent of relative advantage to academic experience, to be compatible with their needs and contexts, and to be not painful to manipulate. Trialability and observability of technology become important in contemporary rural settings. When a student watches the benefits resulting from the trial processes of trialing a learning platform without commitments via peer usage, adoption is more likely (Dooley, 1999; Parisot, 1995). The lack of onboarding in rural institutions blocks out these experimentations. Peer interaction and social systems strongly support the diffusion of innovation (Medlin, 2001; Sherry & Gibson, 2002). In this regard, informal peer mentoring at the selected rural university acts as a substitute for institutional training and thus evidencing a decentralised, organic adoption of digital learning technologies. This further vindicates Rogers' claim that diffusion processes heavily depend on interpersonal networks.

This is also relevant to the actual adoption rate towards innovation-decision process through knowledge, persuasion, decision, implementation, and confirmation. As Stuart (2000) and Berger (2020) explain it, one is to be aware of technology, pursue profits from it, decide whether to implement it, implement the technology within a learning setting, and be affirming its value. More so for several students at rural universities that hinder this progression through infrastructural and pedagogical barriers. Support and readiness from institutions will also highly influence the diffusion of innovation. Rogers (2003) would argue that it is when strong leadership and allocation of resources is present in an environment where innovations will then be accepted. However, at rural South African universities, infrastructure deficits, digital illiteracy, and a lack of professional development programmes for educators would constrain innovation and maintain the status quo of digital exclusion (Agumba et al., 2023; Aruleba & Jere, 2022).

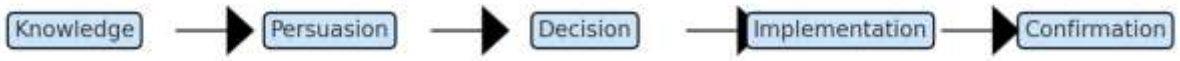
The DOI perspective allows people to think more critically about the conflicting systemic inequities: TECHNOL is neither defined by Asongu and Odhiambo (2019) as a building block of inequality nor as an impediment to the adjustment of such inequality. This study, therefore, incorporates DOI not only to explain adoption patterns but also to critique the ethical and infrastructural frameworks within which innovations occur. The theory of Rogers resonates

strongly with current debates in African education development as digital access is today beginning to become a right (Agumba et al., 2023; Ajani, 2025). The capacity of emerging technologies to ever fully bridge curriculum gaps for learners in marginalised settings, therefore, rests squarely on whether equity features in the adoption strategy.

From its consideration of the learner's individual experience within the wider social and institutional structures, it is particularly useful. Further, these functions allow us to see an innovation's acceptance in local cultural, infrastructural, and situational realities, expanding our understanding of educational technology adoption in under-resourced universities. In short: The Diffusion of Innovation theory by Rogers presents a balanced and flexible conceptual arrangement that takes into consideration both reception and interpretations of emerging technologies by learners in a rural university context. **Fig. 1** below explains this social system model, from where individual perceptions and systemic conditions should consequently give full glare to the highly expected complexity and interplay of factors that bedevil sleek delivery of curriculum in this digital age.

Figure 1.

Rogers' Innovation-Decision Process



(Adopted from Roger, 2003).

From the above **Fig. 1**, this five-stage model shows how individuals pass through awareness to the full incorporation of the innovation in their daily routine. In the present study, it will be used as an interpretive framework to explore how students at the rural university engage with, and adopt, emerging technologies for curriculum delivery.

Aims of the Study

This study will use Rogers' diffusion of innovation theory as an analytical framework to investigate how first-year undergraduate students at a selected rural South African university, access and adopt emerging technologies for curriculum delivery. The study intends to see how infrastructural, socio-economic, and pedagogical factors interplay to affect the adoption of technologies in rural higher education contexts. Hence, this study is guided by three key research questions:

Research Questions

1. What are first-year undergraduate students' experiences in terms of access and adoption of technology for curriculum delivery at a rural South African university?
2. What are the infrastructural, socio-economic, and institutional factors influencing students' progression through the stages of the Innovation-Decision Process by Rogers?
3. How might institutional strategies align with the Diffusion of Innovation framework to facilitate technology adoption in an equitable and context-sensitive manner within a rural higher education setup?

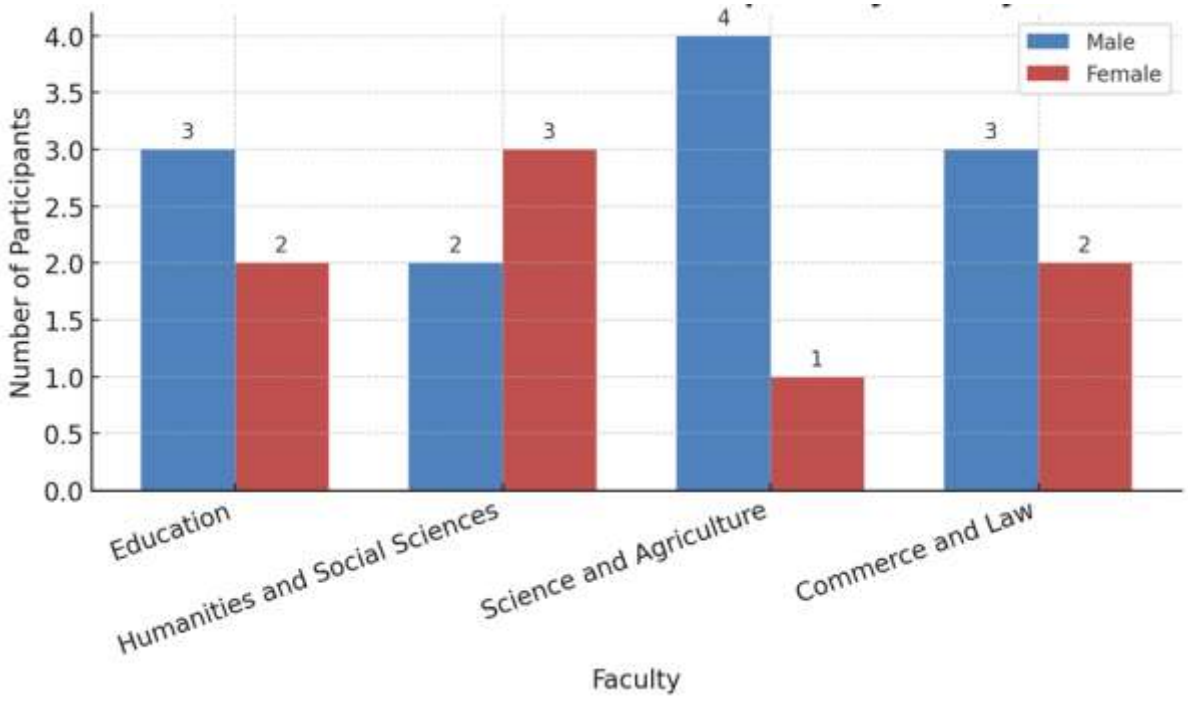
METHODS

Using a qualitative method, this study sought to explore how first-year undergraduate students at the selected rural university in KwaZulu-Natal province, South Africa, undergo the adoption and access to emerging technologies in curriculum delivery. Qualitative methods are suitably applied in studying complex social phenomena because they allow the investigation into lived experiences, perceptions, and adaptive strategies within certain context-specific environments (Creswell, 2014; Kumar, 2019). The study was theoretically framed through the lens of Rogers' (2003) Diffusion of Innovation theory, which looks at how students experience, trial, and incorporate instructional technologies within a rural university setting.

Semi-structured interviews were used for data collection because they emphasized flexibility to probe answers given by respondents while remaining consistent during the interviews (Creswell, 2014). The interview guide was based on the stages in the innovation-decision process as described by Rogers: knowledge, persuasion, decision, implementation, and confirmation, as well as the five core attributes of an innovation: relative advantage, compatibility, complexity, trialability, and observability (Kurt, 2023; Sahin, 2006). Socio-technical implications of infrastructure access, peer influence, and institutional support were also considered, which are vital to rural technology adoption (Ajani, 2025; Aruleba & Jere, 2022).

Twenty first-year undergraduate students were purposively sampled from four faculties, Education; Humanities and Social Sciences; Science and Agriculture; and Commerce and Law (**Fig. 2** below).

Fig. 2: *Gender distribution of participants, by faculty*.



The sample was gender balanced and included students from various socio-economic backgrounds to provide representativeness. Each of the participants was interviewed

individually in English, the primary language of instruction in the university, for approximately 45 to 60 minutes. The interviews were carried out in quiet campus locations, keeping privacy in mind, so respondents would feel comfortable and maintain confidentiality. Ethical clearance was secured from the University Research Ethics Committee, and informed consent was given by all participants in line with institutional and national guidelines on research.

To ensure reliability and validity of results, various methods were employed. All interviews had audio recordings, which were transcribed word for word. The transcripts were anonymized and verified for accuracy. Thematic coding was used to analyse data following Saldana's (2016) approach of recognizing patterns and grouping them under broader themes. NVivo software was employed to organize data, along with manual coding and memo writing to heighten reflexivity and thematic sensitivity. Further credibility of findings was established through triangulation between faculties and demographic categories (Kumar, 2019). Member checking was done by presenting summaries of key findings to a subgroup of participants to verify the accuracy of interpretations. Furthermore, peer debriefing enhanced analytical rigor through consultation with academic supervisors.

The study remained attentive to the contextual and socio-economic constraints faced by participants, many of whom did not have access to reliable internet or personal digital devices. The socio-economic realities of the participants were a consideration in interpreting the findings to ensure ecological validity. While the small sample size and focus on a single institution may limit the study's generalizability, qualitative data's depth and richness offer compelling insights into the complexities of digital adoption within marginalised educational contexts (Berger, 2020). The adopted methodological approach is a testament to the value the researchers put on ethical, contextually grounded, and theoretically informed inquiry into the adoption of technology in rural higher education.

RESULTS

Semi-structured interviews with 20 first-year undergraduate students at the selected rural university provided material for this study. A thematic analysis identified five prominent themes that give voice to the diversity experienced by students in accessing and adopting emerging technologies that are intended for curriculum delivery within the context of a rural university. They are: (1) Infrastructural Inequality; (2) Socio-Economic Constraints; (3) Digital Literacy Gaps; (4) Peer-led Support and Informal Learning Networks; and (5) Perceptions of Innovation and Institutional Readiness. The themes are further presented in Table 1 (see Appendix) and explained subsequently.

Theme 1: Access to Infrastructure

One recurrent problem that bordered technology adoption was the lack of basic digital infrastructure. Students constantly lamented unreliable internet connectivity, insufficient Wi-Fi coverage, and frequent power outages as impediments interfacing with online learning platforms. One participant went on to say: "Most of the time, I use my phone’s hotspot, but

when there’s no electricity, everything stops. I can’t even attend class" (Participant 3). This, however, corresponds to Aruleba and Jere's (2022) results that infrastructural instabilities in rural universities largely disrupt digital learning.

There were also cited restrictions of overcrowding in computer laboratories and being closed at odd hours: "We have computer labs, but they are always full or closed when you really need them" (Participant 11). Most especially for those on the low-end smartphones, this was highly limiting. As Participant 8 explained: "You can’t type an assignment on a small screen—it takes forever, and the app keeps crashing." There were also some student-improvised adaptions at work, such as downloading lecture slides and videos while on campus to view them offline at home later.

But, as Participant 17 explained, "Sometimes I forget to download the notes, and when I get home, I can’t do anything." This, in a way, relates to Rogers' (2003) implementation stage, the attempt to adopt or be adopted but limited by barriers within the system. Mobile data are costly, and this was named as a deterrent among others. Participant 5 added: "Data is expensive; I have to choose between buying food and buying data." Others spoke about the frustration over intermittent connectivity-"The Wi-Fi works in the morning but slows down or disappears in the afternoon" (Participant 10). It largely inhibited progressing through the DOI knowledge and implementation stages, as identified by Sahin (2006). Participant 14 concluded: "You feel like you are always behind because you can’t keep up with the online work." Altogether, these accounts corroborate Argani's (2025) assertion that infrastructural deficit still stands as a major constraint toward equitable engagement in digital learning by rural higher education.

Theme 2: Peer Influence and Informal Learning

Peer networks became crucial given the unfamiliar technological terrain to navigate through. Numerous students acknowledged having to do with friends or roommates who taught them the learning platform skills rather than going through official channels. Participant 1 stated: "Everything I learned, I learned from my roommate. She taught me how to use the portal and submit assignments. Without her, I would have failed." This aligns with Rogers' (2003) focus on interpersonal networks as being crucial during the persuasion and decision phases of adoption. The culture of sharing extended beyond one-on-one assistance.

Students described being added to peer-created WhatsApp groups for technical help or academic collaboration: "Someone shared a link to a WhatsApp group where they post tips on using the LMS. It's been a lifesaver" (Participant 4). Informal digital mentoring took many forms-from step-by-step video tutorials by peers ("A friend sent me a video showing how to upload assignments" - Participant 13) to face-to-face guidance in computer labs ("I sat next to someone who knew what they were doing, and they walked me through the process" - Participant 6).

Several indicated that witnessing peer successes encouraged technology adoption by themselves: "When I saw others doing it, I thought, maybe I can too" (Participant 16). Dooley (1999) and Medlin (2001) similarly contend that socially embedded learning furthers innovation diffusion in resource-poor contexts. The informal help interactions sometimes became learning

opportunities: "During class, when someone couldn't log in, another student would help on the spot" (Participant 19). However, others complained about the uneven help: “If you don’t know anyone who can help, you struggle” (Participant 7). This informal ecosystem created the 'community of resilience,' as Participant 15 stated: "We help each other because the university doesn't have proper training." Yet, as Ajani et al. (2025) observe, without institutional recognition and integration, these grassroots efforts risk being unsustainable.

Theme 3: Institutional Support and Pedagogical Integration

This obstacle involves lack of consistent institutional training and pedagogical support, with students expressing frustration at lecturers assuming them to be digitally literate. Participant 2 said: "Some lecturers just told us to use the LMS but never explained how. If we had problems, we were on our own." Lack of onboarding contradicts DOI persuasion and implementation stages as plasma must be learned for continued adopter as Sahin (2006) puts forth. Conflicting use of digital tools across faculties and modules was reported by students. Participant 12 said: "Some lecturers use videos and discussion forums; others just upload PDFs and never interact." This ambiguity destroyed the confidence that digital learning is worth a shot: "It's hard to take the online part seriously when some classes don't bother" (Participant 18).

The absence of an intelligible institutional strategy was strongly felt. Participant 9 acknowledged: "There's no standard way of using the LMS. Every lecturer does it differently." In the argument by Ajani & Dlomo (2025), without coherent policy, the technology integration becomes fragmented and inequitable. Some lecturers provide wonder online experiences; one participant said, "One lecturer used quizzes and gave feedback quickly—it made me want to participate more" (Participant 20).

These were exceptions though. More frequently, participants cited the lack of timely feedback: "You submit work and hear nothing for weeks" (Participant 5), or staff incompetence on technical matters: "Sometimes the lecturer doesn't even know how to fix the problem" (Participant 14). Overall, this theme reflects a pedagogical gap: while the technology existed, its instructional use was inconsistent and often unprofessional; just as Animashaun et al. (2024) have noted, technology without pedagogical change will never improve learning outcomes.

Theme 4: Perceptions of Technological Usefulness

Technology use intention was highly affected by student perceptions of usefulness. Relative Advantage concept by Rogers (2003) had implication here. Those with prior experiences tended to feel more positively, stating that it saves time and is most convenient: "It saves me time. I can access everything in one place, even when I am not on campus" (Participant 8). Others said that being able to use online resources for revision at their own convenience was great: "I like that I can go back and watch the lecture again" (Participant 1). Some wanted to make sure all materials were kept in one place: "Before we used to lose handouts; now it’s all there" (Participant 12).

For the few who still had limited access or with low quality of telecommunication connectivity, technology was considered more a bane than an actual boon: "I spend more time

trying to log in than actually learning" argued Participant 16. Participant 7 added: "If the system is down, you just miss out—there's no backup plan." Students complained about a lack of contextual adaptation: "They bring in systems made for people with fibre and laptops. We don't have that here" (Participant 19), which corresponds with the call by Ajani and Ngema (2024) for context-appropriate digital strategies in rural education.

Such views would be worsened by technical failings ("The site crashes when everyone logs in" - Participant 5) and poor optimization for mobiles ("It doesn't work well on my phone, and that's all I have"-Participant 3). Hence, it appears that students were more concerned about evaluations of usefulness as to whether these qualities would really fit within their realities, which confirms Sahin's (2006) assertion that adoption can only occur if perceived value exists in context.

Theme 5: Compatibility with Learning Contexts

This theme explored the compatibility, which is the degree to which an innovation aligns with the users' values, needs, and experiences (Rogers, 2003). Findings revealed that compatibility was the other determining factor. Students reported the fact that many digital tools are designed without considering linguistic, cultural, or learning style diversity. Participant 11 stated, "It's all in English, fast paced, and assumes you know tech. That's not our reality." For some, the format itself was alienating because of all the reading: "I understand better when I watch something. But most modules just give us PDFs to read" (Participant 6). Multimedia resources were of great help for visual and auditory learners; however, their availability was sparse.

Several participants stated feelings of exclusion caused by the lack of multilingual support: "It would help if some of the instructions were in isiZulu" (Participant 17). Others attributed incompatibility to their rural schooling background: "We didn't use computers in high school, so everything here feels too advanced" (Participant 4). Some considered learning style mismatches to be discouraging: "Some people are shy to speak in forums, but that's the only option" (Participant 2). Technological interfaces were sometimes inappropriate for mobile usage: "You have to scroll too much on the phone, and it's confusing" (Participant 10). These experiences all support Dooley's (1999) argument, that innovations are likely to be adopted when they are culturally and contextually relevant. Participant 13 summarised this belief: "It's not just about having the technology—it has to work for us and how we learn."

DISCUSSION

It is crucial that the results of study help understand how rural university students adopt new technologies for curriculum delivery. On Rogers' Diffusion of Innovation theory, we look at student experiences that could be placed at different levels of the innovation-decision process and at times undermine their free flow at persuasion or decision phase by system constraints. Conditions of infrastructure that were put forward by participants resonate with the enduring digital divide that informs rural educational settings in South Africa (Ajani, 2025; Aruleba & Jere,

2022; Maphalala & Ajani, 2025). The inclination of the students towards the use of mobile devices and the unstable Internet connection emphasizes an urgent need for investment in digital infrastructure. In the absence of accessible and reliable technology, it is impossible for the students to make any meaningful integration or confirmation of new tools, indicating that Sahin (2006) agrees with this finding as well.

Peer learning was found to be very essential for students in coping with their situation. Rogers (2003) stresses that adoption is greatly facilitated through interpersonal networks, with informal mentoring from peers being essential in skills transfer from early adopters to laggards. This complements the findings of Medlin (2001) and Sherry and Gibson (2002), who reported that peer mentoring remains pivotal for digital skills acquisition in resource-poor contexts. Nonetheless, these beneficial social dynamics are undermined by the absence of formal digital literacy support, which jeopardizes the sustainability and scalability of peer-led initiatives. While students willingly form WhatsApp study groups to exchange content tutorials, such initiatives have an unsteadily reactive nature and have not yet infiltrated institutional strategy. Institutions would have to formalize and support peer-learning ecosystems to ensure integration with wider curricular goals (Ajani et al., 2025).

In the most basic sense, lack of proper institutional support, critical among them being poor onboarding procedures and pedagogical designs, limits students' ability to integrate technology into their learning routines. Students do not interact with their teachers beyond using PDF uploads. Such a pedagogical trend resonates perfectly with the Ajani and Dlomo (2025) findings on weak digital integration in rural school administration. Students' perceptions of technology had, in fact, very much to do with their prior exposures and the realities of the context in which they found themselves. Much of the positive attitudes toward digital tools came from frequent use, while frustration or an atmosphere of inaccessibility, resulting from bandwidth and device limitations, characterized most others. This matches well with Rogers' construct of performance expectancy, whose perceptions of use are directly related to the levels of adoption.

Imported technologies are often mismatched with local environments of learning; hence, contextual fit is of importance. Urban fibre-optic networks and optimized platforms failing to cater to mobile-dependent, rural settings are a recipe for disaster. As Ajani and Ngema (2024) reaffirm, that makes perfect sense because successful technology integration lies in its localized conditions and readiness from the children who will be consuming the product. Add to that the compatibility in terms of socio-cultural as well as cognitive learning preferences. Students were alienated from these platforms that were text-heavy and dominated by English as they did not factor in multilingual visual learning needs. That misfit corroborates findings by Dooley (1999), who emphasized the cultural specificity necessary of innovations for success.

Another emotional perspective that student voices lent to digital exclusion described its emotional consequences. Frustration, anxiety, and loss of confidence often characterize the feelings when technologies feel imposed, rather than introduced through scaffolded support.

This component further deepens Rogers' model, suggesting that what psych readiness should also be incorporated would be technical infrastructure. Indeed, the study argues that the process of adoption of innovation is cyclic rather than linear. However, progress was reversed for some students who reached the stage of implementation when they experienced problems with the platform or were neglected by the institution. This movement is cyclic, therefore challenging deterministic views on innovation and supporting Sahin's (2006) claim that adoption requires continuous reinforcement.

While the study had its main thrust in the adoption of emerging technologies, alternate interpretations of the data suggest that resistance to the adoption and the pre-university schooling experiences majorly influenced student engagement. Some participants felt uneasy or hesitant when it came to using digital platforms, and rather than just infrastructural constraints, this unease was deeply rooted in their pre-tertiary educational experience. Most of these students had attended rural schools where exposure to computers or any form of online learning was almost nil; this gave rise to some form of intimidation and reluctance when presented with digital tools in the university setting (Maphalala & Ajani, 2025; Berger, 2020). Resistance was not a calm and passive phenomenon; instead, it actively manifested itself in avoidance behaviours, for example, putting off engagement with LMS or relying solely on peer support. Again, the lack of digital literacy at their prior schooling had created a psychosocial barrier that enhanced technical challenges. The results recall Sahin's (2006) observation that adoption depends not only on perceived usefulness but on users' readiness and prior experiences. Recognizing alternative interpretations is crucial to develop interventions that look at more than just infrastructural deficits but also focus on the socio-emotional and educational histories of rural students.

In summary, it confirms that rural higher education will have to digitalize contextually, equity-centred, and pedagogy-grounded. Beyond access, institutions such as the selected rural university will need to consider socio-cultural, infrastructural, and pedagogical conditions shaping technology adoption. The diffusion of innovation is anything but a technological process-its deep human roots transverse lived realities, peer trust, and the right to inclusive, empowering education.

CONCLUSION AND RECOMMENDATIONS

In the past year, several applications of the Diffusion of Innovation Theory have been used to investigate the experiences and adoption of emerging technologies for the curriculum delivery system within rural higher education by first-year undergraduate students at the selected rural university. It is concluded from the research that students appreciate the role of digital tools to some extent in improving learning; however, barriers that include infrastructural deficits, socio-economic constraints, and pedagogical misalignments hinder their adoption journey. Access to devices, reliable connectivity, and relevant training remain limited; thus, students often find their way around such constraints using informal peer networks. Without formal institutional

support and culturally relevant pedagogical support, these grassroots efforts are likely to remain informal. The study therefore suggests that there is a pressing need to view technology adoption not so much in terms of access but in terms of equity, context, and human-centred engagement. The study suggests the following recommendations:

1. Invest in Infrastructure. Policy makers and university management should concentrate on investment in stable access to the Internet, campus-wide Wi-Fi, and mobile-friendly platforms that propose solutions to the unique realities imposed by rurality on students.
2. Digital Orientation that is Contextualised. Compulsory, multilingual digital literacy and LMS orientation for first-year students must be developed and presented to deal with both technical knowledge and emotional preparedness.
3. Structure Peer Learning. Formalisation of student-driven peer mentoring will complement institutional support in a way that builds sustainable, community-based digital-learning culture.
4. Learning for Lectures. Targeted training for academic staff in designing pedagogically rich, interactive, and inclusive digital learning experiences relevant for rural learning environments should be provided.
5. Adopt Human-Centred Innovation. Design future digital initiatives using a participatory design-based approach in which students and staff will contribute to shaping technology policies and platforms that reflect local needs and constraints.

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APPENDIX

Table 1.

Summary of Findings

Key Theme	Key Findings
Infrastructural Inequality	Students reported unreliable internet, limited Wi-Fi, and outdated devices, hindering access to LMS and digital learning tools. Lack of functional computer labs and poor maintenance of existing infrastructure further restricted access. The digital divide was especially visible in off-campus areas where connectivity was inconsistent or non-existent.
Socio-Economic Constraints	Students struggled to afford data or devices, with many using low-end smartphones and sharing devices with family. Financial limitations limited participation in online learning and contributed to academic inequality. Students expressed that socio-economic disparities compounded the challenges of digital learning in rural environments.
Digital Literacy Gaps	Participants lacked familiarity with LMS features such as online submissions and discussion forums. Many had no prior exposure to digital platforms, making adaptation difficult and stressful. There was a strong demand for structured digital training and orientation sessions.
Peer-led Support and Informal Learning Networks	In the absence of formal training, students relied on peers to navigate digital platforms and solve problems. Peer mentoring emerged as a significant driver of technology use and confidence among less experienced students. However, reliance on informal networks risked leaving behind students without strong peer support.

Perceptions of Innovation and Institutional Readiness	Students recognised the potential of digital tools but were concerned about inconsistent usage by lecturers across faculties. The lack of standardised LMS integration and unclear institutional strategy undermined confidence in digital learning. Students called for stronger institutional commitment, support structures, and inclusive digital policies.