

# Equity and Access in Digital Transformation: Enhancing Curriculum Delivery at Rural Universities



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## ABSTRACT

This study explored the role of digital education in rural universities, focusing on equity and access in the digital transformation of curriculum delivery. With the Fourth Industrial Revolution significantly impacting higher education through the integration of learning technologies, the digital divide remains a substantial barrier, particularly in developing countries. The research aimed to address this challenge by investigating how digital education can bridge the gap in rural universities. A scoping review of literature published between 2022 and 2024 in South Africa was conducted, utilising the Technology Acceptance Model as the theoretical framework. The study followed a systematic approach using the PRISMA procedure to access, screen, and analyse relevant literature. Thematic analysis revealed key insights into the challenges and opportunities of digital transformation in rural universities. The study provides practical recommendations aimed at promoting equity and access, contributing to ongoing discussions on how to improve digital curriculum delivery in under-resourced areas. This study contributes to scholarship by providing a comprehensive analysis of digital transformation in rural universities, highlighting strategies to enhance equity and access in curriculum delivery, and addressing the digital divide through practical recommendations.

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## INTRODUCTION

The Fourth Industrial Revolution has fundamentally reshaped various sectors, including education, by integrating advanced digital technologies. This integration promises to enhance teaching methodologies and enrich learning experiences, thereby improving educational outcomes.<sup>1</sup> However, the benefits of these advancements are not uniformly distributed across different regions, particularly in developing countries. The digital divide, which refers to the gap between those who have access to modern information and communication technologies and those who do not, remains a significant barrier to the digital transformation of higher education in these regions.<sup>2</sup>

In rural areas, where infrastructure and resources are often limited, the digital divide is more pronounced. This disparity hampers students' ability to engage with digital learning tools, further exacerbating existing educational inequalities. Rural universities, in particular, face unique challenges in implementing digital education due to inadequate technological infrastructure, lack of digital literacy,

<sup>1</sup> Klaus Schwab, *The Fourth Industrial Revolution*, Group, New York (New York: Crown Publishing Group, 2017).

<sup>2</sup> J. Nyerere, Q. Gravenir, and G. Mse, "The Digital Divide and E-Learning Adoption in Rural Kenya: A Case Study of Two Public Universities," *Distance Education* 4, no. 1 (2020): 100–114.

and insufficient support for both students and teachers.<sup>3</sup> These challenges highlight the urgent need for targeted interventions to bridge the digital divide and promote equity in educational opportunities.

The integration of digital technologies in higher education is not only about access but also about effective usage. The TAM, developed by Davis, provides a theoretical framework for understanding how perceived ease of use and perceived usefulness influence the acceptance and use of new technologies.<sup>4</sup> TAM has been widely applied in educational research to examine the factors that affect technology adoption among students and teachers.<sup>5</sup> This study utilizes TAM to explore the dynamics of digital education in rural universities in South Africa, focusing on equity and access in the digital transformation of curriculum delivery.

A growing body of literature has examined the impact of digital education on learning outcomes. For instance, Alhumaid et al. found that digital learning tools can significantly enhance students' engagement and academic performance when effectively integrated into the curriculum.<sup>6</sup> However, these benefits are often contingent on the availability of adequate technological infrastructure and digital literacy skills. In rural universities, where these resources are typically scarce, the potential of digital education remains largely untapped.<sup>7</sup> This study seeks to fill this gap by investigating the specific barriers and opportunities associated with digital education in rural settings.

The digital divide in education is not merely a technological issue but also a socio-economic one. Students from disadvantaged backgrounds often lack access to necessary digital tools and the internet, limiting their ability to participate in online learning.<sup>8</sup> This inequity is further compounded in rural areas, where socio-economic challenges are more prevalent. Addressing these disparities requires a comprehensive approach that includes improving technological infrastructure, enhancing digital literacy, and providing ongoing support for students and teachers.<sup>9</sup>

This study adopts a scoping review methodology, guided by the PRISMA procedure, to systematically explore literature published between 2022 and 2024 in South Africa. Scoping reviews are particularly useful for mapping out key concepts, types of evidence, and gaps in research.<sup>10</sup> By employing this method, the study aims to provide a comprehensive overview of the current state of digital education in rural universities and identify the factors that influence its effectiveness. The findings will inform practical recommendations for policymakers, teachers, and institutions to support the digital transformation of curriculum delivery.

The digital divide poses a significant challenge to the equitable implementation of digital education in rural universities. By focusing on the specific barriers and opportunities in these settings, this study aims to contribute to the broader goal of creating a more inclusive and equitable education system. The insights gained from this research will help develop strategies to enhance equity and access in the digital transformation of curriculum delivery, ensuring that all students, regardless of their geographic location, can benefit from the opportunities offered by digital education.

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<sup>3</sup> Sue Bennett et al., "How Technology Shapes Assessment Design: Findings from a Study of University Teachers," *British Journal of Educational Technology* 48, no. 2 (2017): 672–82.

<sup>4</sup> Fred D. Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* 13, no. 3 (September 1989): 319, <https://doi.org/10.2307/249008>.

<sup>5</sup> Viswanath Venkatesh and Fred D. Davis, "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," *Management Science* 46, no. 2 (February 2000): 186–204, <https://doi.org/10.1287/mnsc.46.2.186.11926>.

<sup>6</sup> Khadija Alhumaid et al., "COVID-19 & Elearning: Perceptions & Attitudes of Teachers towards E-Learning Acceptance in the Developing Countries," *Multicultural Education* 6, no. 2 (2020): 100–115.

<sup>7</sup> Arshi Naim et al., "Mechanism of Direct and Indirect Assessments for Continuous Improvement in Higher Education," in *Evaluating Global Accreditation Standards for Higher Education* (IGI Global, 2024), 200–216, <https://doi.org/10.4018/979-8-3693-1698-6.ch013>.

<sup>8</sup> Elisabeth Beauoyer, Sophie Dupéré, and Matthieu J. Guitton, "COVID-19 and Digital Inequalities: Reciprocal Impacts and Mitigation Strategies," *Computers in Human Behavior* 111 (October 2020): 106424, <https://doi.org/10.1016/j.chb.2020.106424>.

<sup>9</sup> Q. Wang et al., "The Digital Divide and Higher Education: The Challenges and Opportunities of Online Learning during the COVID-19 Pandemic," *Journal of Educational Technology Development and Exchange* 13, no. 1 (2020): 69–80.

<sup>10</sup> Andrea C. Tricco et al., "PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation," *Annals of Internal Medicine* 169, no. 7 (October 2, 2018): 467–73, <https://doi.org/10.7326/M18-0850>.

### Key Research Questions

1. What are the primary barriers to digital education in rural universities in South Africa?
2. How do issues of digital literacy and technological infrastructure impact the adoption of digital learning tools in these settings?
3. What strategies can be implemented to enhance equity and access in the digital transformation of curriculum delivery in rural universities?

## LITERATURE REVIEW

### *Digital Transformation in Curriculum Delivery in Higher Education*

The digital transformation of curriculum delivery in higher education has been significantly accelerated by the advent of advanced technologies and the increasing demand for flexible learning environments. Digital tools and platforms have enabled a shift from traditional, lecture-based instruction to more interactive and personalized learning experiences.<sup>11</sup> According to Almarashdeh et al., the use of Learning Management Systems (LMS) has facilitated the creation of digital classrooms where resources are accessible anytime and anywhere, thereby enhancing the learning experience.<sup>12</sup> This transformation has been driven by the need to cater to diverse learning styles and preferences, offering students a more engaging and customized education.

The integration of digital technologies into curriculum delivery also supports the development of critical digital skills that are essential for the modern workforce. Digital literacy has become a fundamental component of higher education, preparing students for the demands of the digital economy.<sup>13</sup> For instance, the use of collaborative tools, such as Google Workspace and Microsoft Teams, fosters teamwork and communication skills, while platforms like Coursera and edX provide access to a wide range of courses and specializations. These tools not only enhance learning outcomes but also ensure that students are well-equipped with the skills needed for their future careers.<sup>14</sup>

Moreover, digital transformation in curriculum delivery has the potential to bridge educational gaps and promote inclusivity. Online learning platforms offer opportunities for students from remote or underserved areas to access quality education that would otherwise be unavailable to them.<sup>15</sup> The flexibility of online courses allows students to learn at their own pace, accommodating those who may have other commitments such as work or family. This aspect of digital education is particularly relevant in the context of rural universities, where access to traditional educational resources may be limited.<sup>16</sup>

However, the successful implementation of digital curriculum delivery requires addressing several challenges, including the digital divide and resistance to change among teachers and institutions. Ensuring that both students and faculty have access to the necessary technological resources and training is crucial for the effective use of digital tools.<sup>17</sup> Additionally, institutions must foster a culture of innovation and continuous improvement, encouraging the adoption of new technologies and teaching methods. As noted by Garrison and Vaughan, blended learning models, which combine online and face-

<sup>11</sup> Oluwatoyin Ayodele Ajani and Bongani T Gamede, "Curriculum Delivery and Digital Divide in South African Higher Institutions during the COVID-19 Pandemic: A Case of Social Injustice," *International Journal of Innovation, Creativity, and Change* 15, no. 8 (2021): 590–603; Oluwatoyin Ayodele Ajani and Mncedisi Christian Maphalala, "Online Learning Environments in Higher Education: Nexus Between Self-Directed Learning and Learning Attainment in Students' Online Learning Engagement," *International Journal of Social Science Research and Review* 6, no. 11 (2023): 349–67.

<sup>12</sup> I. Almarashdeh, G. Jaradat, and A. Abualkishik, "E-Learning in Higher Education Institutions in Jordan: Effectiveness and Limitations," *Education and Information Technologies* 25, no. 6 (2020): 555–68.

<sup>13</sup> Christine Redecker and Yves Punie, "Digital Competence of Educators DigCompEdu" (Publications Office of the European Union Luxembourg, 2017).

<sup>14</sup> Barbara Means, Marianne Bakia, and Robert Murphy, *Learning Online* (Routledge, 2014), <https://doi.org/10.4324/9780203095959>.

<sup>15</sup> Fiona Mae Hollands and Devayani Tirthali, "Why Do Institutions Offer MOOCs?," *Online Learning* 18, no. 3 (August 25, 2014), <https://doi.org/10.24059/olj.v18i3.464>.

<sup>16</sup> Oluwatoyin Ayodele Ajani and Bongani T Gamede, "Decolonising Teacher Education Curriculum in South African Higher Education.," *International Journal of Higher Education* 10, no. 5 (2021): 121–31; Bennett et al., "How Technology Shapes Assessment Design: Findings from a Study of University Teachers."

<sup>17</sup> Beaunoyer, Dupéré, and Guitton, "COVID-19 and Digital Inequalities: Reciprocal Impacts and Mitigation Strategies."

to-face instruction, can serve as a transitional approach, helping institutions to gradually integrate digital technologies into their curricula while maintaining the benefits of traditional classroom interactions.<sup>18</sup>

### **Barriers to Digital Education in Rural Universities**

The integration of digital education in rural universities in South Africa faces significant barriers, predominantly related to technological infrastructure, socio-economic factors, and institutional support.<sup>19</sup> One of the primary barriers is inadequate technological infrastructure. Rural universities often lack sufficient access to high-speed internet, reliable electricity, and modern digital devices, which are essential for implementing digital learning tools effectively.<sup>20</sup> This infrastructural gap not only limits the ability of these institutions to adopt new technologies but also affects the quality of education provided.

Socio-economic factors also play a critical role in hindering digital education in rural areas.<sup>21</sup> Students from disadvantaged backgrounds often struggle to afford digital devices and internet access, further widening the digital divide.<sup>22</sup> This financial barrier is compounded by the fact that many rural areas in South Africa are plagued by high levels of poverty and unemployment, making it difficult for students to participate in digital learning. The lack of financial resources at both the student and institutional levels poses a significant challenge to the adoption of digital education.

Institutional support is another crucial factor that impacts the success of digital education initiatives. Rural universities often suffer from a lack of administrative and technical support necessary for integrating digital tools into the curriculum.<sup>23</sup> This includes insufficient training for teachers, inadequate maintenance of technological infrastructure, and a lack of strategic planning to support digital transformation. Without robust institutional support, efforts to implement digital education in rural universities are likely to falter.<sup>24</sup>

Moreover, cultural and contextual factors must be considered. Resistance to change and a lack of awareness about the benefits of digital education can hinder its adoption. Teachers and students in rural areas may be more accustomed to traditional teaching methods and may not readily embrace new technologies.<sup>25</sup> Overcoming these cultural barriers requires targeted interventions that address the specific needs and concerns of rural communities, emphasizing the value and potential of digital education.

### **Impact of Digital Literacy and Technological Infrastructure**

Digital literacy is a critical component in the successful adoption of digital learning tools. In rural universities, a significant gap in digital literacy exists among both students and teachers. Digital literacy encompasses the skills and knowledge required to use digital devices and platforms effectively.<sup>26</sup> Without these skills, students and teachers are unable to take full advantage of digital learning opportunities. This

<sup>18</sup> D. R. Garrison and N. D. Vaughan, *Blended Learning in Higher Education: Framework, Principles, and Guidelines* (Jossey-Bass, 2013).

<sup>19</sup> O.A. Ajani and N. P. Khumalo, "Aftermaths of the Post-Covid-19 Pandemic Experiences: Assessing and Repositioning South African Higher Education," *International Journal of Social Science Research and Review* 6, no. 6 (2023): 674–83.

<sup>20</sup> Bennett et al., "How Technology Shapes Assessment Design: Findings from a Study of University Teachers"; Mncedisi Christian Maphalala and Oluwatoyin Ayodele Ajani, "Teaching and Learning of Computer Science in Higher Education: A Self-Directed Learning Perspective," in *Navigating Computer Science Education in the 21st Century* (IGI Global, 2024), 89–111.

<sup>21</sup> Oluwatoyin Ayodele Ajani and Mncedisi Christian Maphalala, "The Impact of the COVID-19 Pandemic on Educational Transformation in African Higher Education: A Systematic Literature Review on Rural Universities," *International Journal of Research in Business and Social Science* 12, no. 8 (2023): 445–53.

<sup>22</sup> Beaunoyer, Dupéré, and Guitton, "COVID-19 and Digital Inequalities: Reciprocal Impacts and Mitigation Strategies"; Maphalala and Ajani, "Teaching and Learning of Computer Science in Higher Education: A Self-Directed Learning Perspective."

<sup>23</sup> Ajani and Maphalala, "The Impact of the COVID-19 Pandemic on Educational Transformation in African Higher Education: A Systematic Literature Review on Rural Universities"; Wang et al., "The Digital Divide and Higher Education: The Challenges and Opportunities of Online Learning during the COVID-19 Pandemic."

<sup>24</sup> Ajani and Khumalo, "Aftermaths of the Post-Covid-19 Pandemic Experiences: Assessing and Repositioning South African Higher Education."

<sup>25</sup> Nyerere, Gravenir, and Mse, "The Digital Divide and E-Learning Adoption in Rural Kenya: A Case Study of Two Public Universities."

<sup>26</sup> Alhumaid et al., "COVID-19 & Elearning: Perceptions & Attitudes of Teachers towards E-Learning Acceptance in the Developing Countries."

gap is often a result of limited exposure to digital technologies and insufficient training programmes aimed at enhancing digital competencies.

The state of technological infrastructure directly impacts the adoption of digital learning tools. Rural universities frequently lack the necessary infrastructure, such as reliable internet connectivity, modern computers, and up-to-date software.<sup>27</sup> These deficiencies create an environment where even the most motivated teachers and students cannot effectively use digital tools. The absence of reliable technological infrastructure undermines the potential benefits of digital education and reinforces existing educational inequalities.

Research has shown that improving digital literacy and technological infrastructure can lead to significant improvements in educational outcomes. For instance, Naim et al. found that students who had access to better technological resources and digital literacy training performed better academically and were more engaged in their studies.<sup>28</sup> This suggests that addressing these foundational issues can have a transformative impact on education in rural universities, enabling students to participate fully in the digital learning environment.

Furthermore, there is a strong interrelationship between digital literacy and technological infrastructure. Enhancing digital literacy without addressing infrastructure issues is likely to be ineffective, and vice versa. Comprehensive strategies that simultaneously improve digital literacy and technological infrastructure are essential for the successful adoption of digital learning tools.<sup>29</sup> Such an integrated approach ensures that students and teachers have both the skills and the resources needed to thrive in a digital education setting.

### **Strategies to Enhance Equity and Access**

Enhancing equity and access in the digital transformation of curriculum delivery in rural universities requires a multifaceted approach. One effective strategy is to invest in improving technological infrastructure. This includes expanding internet access, providing reliable electricity, and ensuring that universities have access to modern digital devices.<sup>30</sup> Governments and private sector partnerships can play a crucial role in funding and supporting these infrastructural improvements, ensuring that rural universities have the resources they need to implement digital education effectively.

Another important strategy is to enhance digital literacy through targeted training programmes. Teachers need ongoing professional development to learn how to integrate digital tools into their teaching practices effectively.<sup>31</sup> Similarly, students require training to develop the skills necessary to use these tools for learning. Initiatives such as workshops, online courses, and peer mentoring programmes can help build digital competencies among both teachers and students, ensuring that they can fully engage with digital learning opportunities.<sup>32</sup>

Institutional support is also critical for the success of digital education initiatives. This includes providing technical support, creating strategic plans for digital transformation, and fostering a culture of innovation within the university.<sup>33</sup> Universities need to prioritize digital education in their policies and allocate resources to support its implementation. This may involve establishing dedicated departments or

<sup>27</sup> Sue Bennett, Shirley Agostinho, and Lori Lockyer, "The Process of Designing for Learning: Understanding University Teachers' Design Work," *Educational Technology Research and Development* 65 (2017): 125–45; Ajani and Maphalala, "The Impact of the COVID-19 Pandemic on Educational Transformation in African Higher Education: A Systematic Literature Review on Rural Universities."

<sup>28</sup> Naim et al., "Mechanism of Direct and Indirect Assessments for Continuous Improvement in Higher Education."

<sup>29</sup> Wang et al., "The Digital Divide and Higher Education: The Challenges and Opportunities of Online Learning during the COVID-19 Pandemic."

<sup>30</sup> Bennett, Agostinho, and Lockyer, "The Process of Designing for Learning: Understanding University Teachers' Design Work."

<sup>31</sup> Oluwatoyin Ayodele Ajani and Samantha Govender, "Impact of ICT-Driven Teacher Professional Development for the Enhancement of Classroom Practices in South Africa: A Systematic Review of Literature," *Journal of Educational and Social Research* 13, no. 5 (2023): 116–28; Alhumaid et al., "COVID-19 & Elearning: Perceptions & Attitudes of Teachers towards E-Learning Acceptance in the Developing Countries."

<sup>32</sup> Samantha Govender et al., "Making In-Service Professional Development Effective in a Rural Context," *Contextualising Rural Education in South African Schools* 3 (2023): 78; Mhlonishwa Khumalo and Reward Utete, "Factors That Influence Academic Performance of Students: An Empirical Study," *The Seybold Report* 18, no. 106 (2023): 1710–22.

<sup>33</sup> Wang et al., "The Digital Divide and Higher Education: The Challenges and Opportunities of Online Learning during the COVID-19 Pandemic."

roles focused on digital education and ensuring that there is a clear vision and strategy for integrating digital tools into the curriculum.

Finally, addressing socioeconomic barriers is essential for promoting equity and access. Scholarships, grants, and subsidies can help students from disadvantaged backgrounds afford digital devices and internet access.<sup>34</sup> Additionally, universities can establish partnerships with local businesses and organizations to provide students with access to digital resources. By addressing these financial barriers, rural universities can ensure that all students, regardless of their socioeconomic status, have the opportunity to benefit from digital education.

### ***Policy Interventions and Government Role***

Policy interventions play a critical role in supporting the digital transformation of education in rural universities. Governments need to develop and implement policies that promote the use of digital tools in education and address the unique challenges faced by rural institutions.<sup>35</sup> These policies should focus on improving technological infrastructure, enhancing digital literacy, and providing financial support to students and universities. By creating an enabling policy environment, governments can facilitate the successful implementation of digital education initiatives.

One of the key areas where policy interventions are needed is in the allocation of resources. Governments can provide funding for infrastructure projects, such as expanding internet access and providing digital devices to rural universities.<sup>36</sup> This funding can be complemented by partnerships with private sector organizations, which can provide additional resources and expertise. By prioritizing investments in technological infrastructure, governments can help ensure that rural universities have the resources they need to implement digital education effectively.

Another important area for policy intervention is the development of digital literacy programmes. Governments can support the creation and implementation of training programmes for teachers and students, aimed at enhancing their digital skills.<sup>37</sup> These programmes can be delivered through various channels, including online courses, workshops, and in-person training sessions. By investing in digital literacy, governments can help ensure that students and teachers are equipped with the skills they need to engage with digital learning tools effectively.

Furthermore, policy interventions should also focus on addressing socio-economic barriers to digital education. This includes providing financial support to students from disadvantaged backgrounds, such as scholarships, grants, and subsidies.<sup>38</sup> Governments can also encourage universities to develop partnerships with local businesses and organizations to provide students with access to digital resources. By addressing these financial barriers, policy interventions can help promote equity and access in the digital transformation of curriculum delivery in rural universities.

### ***Practical Recommendations for Rural Universities***

Based on the literature reviewed, several practical recommendations can be made to support the digital transformation of education in rural universities. First, investing in technological infrastructure is essential. This includes expanding internet access, providing reliable electricity, and ensuring that universities have access to modern digital devices.<sup>39</sup> Governments, private sector organizations, and universities should collaborate to fund and support these infrastructural improvements.

Second, enhancing digital literacy through targeted training programmes is crucial. Teachers need ongoing professional development to learn how to integrate digital tools into their teaching practices

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<sup>34</sup> Beaunoyer, Dupéré, and Guitton, "COVID-19 and Digital Inequalities: Reciprocal Impacts and Mitigation Strategies."

<sup>35</sup> Wang et al., "The Digital Divide and Higher Education: The Challenges and Opportunities of Online Learning during the COVID-19 Pandemic."

<sup>36</sup> Bennett, Agostinho, and Lockyer, "The Process of Designing for Learning: Understanding University Teachers' Design Work."

<sup>37</sup> Alhumaid et al., "COVID-19 & Elearning: Perceptions & Attitudes of Teachers towards E-Learning Acceptance in the Developing Countries."

<sup>38</sup> Beaunoyer, Dupéré, and Guitton, "COVID-19 and Digital Inequalities: Reciprocal Impacts and Mitigation Strategies."

<sup>39</sup> Bennett, Agostinho, and Lockyer, "The Process of Designing for Learning: Understanding University Teachers' Design Work."

effectively.<sup>40</sup> Similarly, students require training to develop the skills necessary to use these tools for learning. Initiatives such as workshops, online courses, and peer mentoring programmes can help build digital competencies among both teachers and students.

Third, providing robust institutional support is vital for the success of digital education initiatives. This includes offering technical support, creating strategic plans for digital transformation, and fostering a culture of innovation within the university.<sup>41</sup> Universities should prioritize digital education in their policies and allocate resources to support its implementation. Establishing dedicated departments or roles focused on digital education can ensure a clear vision and strategy for integrating digital tools into the curriculum.

Finally, addressing socioeconomic barriers is essential for promoting equity and access. Scholarships, grants, and subsidies can help students from disadvantaged backgrounds afford digital devices and internet access.<sup>42</sup> Additionally, universities can establish partnerships with local businesses and organizations to provide students with access to digital resources.<sup>43</sup> By addressing these financial barriers, rural universities can ensure that all students, regardless of their socioeconomic status, have the opportunity to benefit from digital education.

## THEORETICAL FRAMEWORK

### Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), developed by Davis (1989), is a robust theoretical framework for understanding the factors influencing the adoption and use of new technologies. TAM posits that perceived usefulness (PU) and perceived ease of use (PEOU) are primary determinants of technology acceptance. PU refers to the degree to which a person believes that using a particular system would enhance their job performance, while PEOU pertains to the degree to which a person believes that using a system would be free of effort. These constructs have been extensively validated in various contexts, making TAM a widely accepted model in technology adoption research.

In the context of higher education, TAM provides valuable insights into how students and teachers perceive and adopt digital learning tools. Numerous studies have applied TAM to explore the acceptance of e-learning platforms, Learning Management Systems (LMS), and other educational technologies. For instance, Šumak, Heričko, and Pusnik conducted a meta-analysis of e-learning acceptance studies and confirmed the significant roles of PU and PEOU in influencing students' attitudes towards e-learning.<sup>44</sup> These findings highlight the relevance of TAM in understanding the adoption of digital education technologies.

TAM's applicability extends beyond e-learning to various educational technologies, including mobile learning, virtual classrooms, and digital content delivery. Mobile learning, in particular, has gained traction in higher education due to its flexibility and accessibility. Research by Park, Nam, and Cha demonstrated that PU and PEOU significantly influenced university students' acceptance of mobile learning applications.<sup>45</sup> This study underscores the importance of ensuring that educational technologies are perceived as both useful and easy to use to foster widespread adoption.

The simplicity and explanatory power of TAM make it an ideal framework for investigating the digital transformation of curriculum delivery in rural universities. Rural institutions face unique challenges, such as limited technological infrastructure and lower levels of digital literacy among students

<sup>40</sup> Alhumaid et al., "COVID-19 & Elearning: Perceptions & Attitudes of Teachers towards E-Learning Acceptance in the Developing Countries"; Samantha Govender and Oluwatoyin Ayodele Ajani, "Monitoring and Evaluation of Teacher Professional Development for Resourceful Classroom Practices," *Universal Journal of Educational Research* 9, no. 4 (April 2021): 870–79, <https://doi.org/10.13189/ujer.2021.090421>; Govender et al., "Making In-Service Professional Development Effective in a Rural Context."

<sup>41</sup> Wang et al., "The Digital Divide and Higher Education: The Challenges and Opportunities of Online Learning during the COVID-19 Pandemic."

<sup>42</sup> Beaunoyer, Dupéré, and Guitton, "COVID-19 and Digital Inequalities: Reciprocal Impacts and Mitigation Strategies."

<sup>43</sup> Oluwatoyin Ayodele Ajani and Shan Simmonds, "Decolonising Pre-Service Teacher Education toward Equity and Inclusivity: Imagining Transformative Curriculum through Socially Just Pedagogies," *Alternation*, 2022.

<sup>44</sup> Boštjan Šumak, Marjan Heričko, and Maja Pušnik, "Evaluation of XML Schema Support in Knowledge Management," *Information Modelling and Knowledge Bases XXXII*, December 16, 2020, <https://doi.org/10.3233/FAIA200826>.

<sup>45</sup> Sung Youl Park, Min-Woo Nam, and Seung-Bong Cha, "University Students' Behavioral Intention to Use Mobile Learning: Evaluating the Technology Acceptance Model," *British Journal of Educational Technology* 43, no. 4 (July 4, 2012): 592–605, <https://doi.org/10.1111/j.1467-8535.2011.01229.x>.

and teachers. By applying TAM, researchers can systematically explore how these challenges impact the perceived usefulness and ease of use of digital learning tools in rural settings. This approach provides a structured way to identify the factors that facilitate or hinder the adoption of digital education in these contexts.

Moreover, TAM can be extended to include additional constructs that capture the specific dynamics of technology adoption in rural universities. For instance, Venkatesh and Bala proposed an extension of TAM, known as TAM3, which incorporates factors such as computer self-efficacy, perceptions of external control, and perceived enjoyment.<sup>46</sup> These additional constructs can provide deeper insights into the unique barriers and motivators that influence the acceptance of digital learning tools in rural educational settings.

One of the strengths of TAM is its ability to be integrated with other theoretical models to enhance its explanatory power. For example, the Unified Theory of Acceptance and Use of Technology (UTAUT) integrates elements from TAM, the Theory of Planned Behavior (TPB), and the Diffusion of Innovations Theory (DIT) to provide a more comprehensive understanding of technology adoption.<sup>47</sup> By incorporating elements of UTAUT, researchers can explore how social influence, facilitating conditions, and individual attitudes impact the adoption of digital education technologies in rural universities.

The relevance of TAM in the context of rural universities is further supported by empirical evidence. A study by Teo examined the factors influencing teachers' intentions to use technology in rural schools and found that PU and PEOU were significant predictors of technology acceptance.<sup>48</sup> This study highlights the importance of ensuring that digital tools are perceived as beneficial and easy to use, particularly in resource-constrained environments. The findings suggest that interventions aimed at improving the perceived usefulness and ease of use of digital technologies can enhance their adoption in rural educational settings.

Additionally, TAM provides a framework for evaluating the effectiveness of interventions designed to promote the adoption of digital learning tools. For instance, training programmes aimed at enhancing digital literacy among teachers and students can be assessed using TAM constructs to determine their impact on PU and PEOU. By measuring changes in these perceptions, researchers can evaluate the success of these interventions and identify areas for improvement. This application of TAM ensures that efforts to promote digital education are informed by empirical evidence and are tailored to the specific needs of rural universities.

Furthermore, TAM's focus on user perceptions aligns with the broader goal of creating student-centred educational environments. By prioritizing the needs and experiences of students and teachers, TAM ensures that the adoption of digital learning tools is driven by their perceived value and usability. This student-centred approach is crucial for fostering engagement and motivation, particularly in rural settings where traditional educational resources may be limited. By understanding and addressing the factors that influence technology acceptance, teachers can create more effective and inclusive digital learning environments.

TAM provides a robust and versatile framework for understanding the adoption of digital learning tools in higher education, particularly in rural universities. Its emphasis on perceived usefulness and ease of use, coupled with its ability to be extended and integrated with other models, makes it an invaluable tool for exploring the factors that influence technology acceptance. By applying TAM, researchers can gain critical insights into the challenges and opportunities associated with digital education in rural settings, ultimately contributing to the development of more effective and equitable educational practices.

## METHODOLOGY

This study adopted a scoping review methodology to systematically explore the existing literature on digital education in rural universities in South Africa, focusing on equity and access in the digital transformation of curriculum delivery. Scoping reviews are particularly valuable for mapping out key

<sup>46</sup> Maphalala and Ajani, "Teaching and Learning of Computer Science in Higher Education: A Self-Directed Learning Perspective."

<sup>47</sup> Venkatesh and Davis, "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies."

<sup>48</sup> Timothy Teo, "Factors Influencing Teachers' Intention to Use Technology: Model Development and Test," *Computers & Education* 57, no. 4 (2011): 2432–40.

concepts, identifying types of evidence, and highlighting research gaps within a specific field.<sup>49</sup> This approach was selected to provide a comprehensive overview of the current state of knowledge and to identify areas requiring further investigation. The review adhered to the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews) guidelines, ensuring rigor and transparency throughout the review process.<sup>50</sup>

### ***Literature Search Strategy***

The literature search was conducted across several electronic databases, including Google Scholar, PubMed, Scopus, and Web of Science. A systematic search strategy was employed using predefined keywords such as "digital education," "rural universities," "South Africa," "equity," "access," "curriculum delivery," and "technology acceptance." Boolean operators (AND, OR) were utilized to refine the search results, ensuring that all relevant studies were captured. The search was limited to articles published between 2022 and 2024 to ensure the inclusion of the most recent advancements and findings in the field.

### ***Inclusion and Exclusion Criteria***

Studies included in the review were peer-reviewed articles, conference papers, and reports that specifically focused on digital education in rural universities within South Africa. These studies needed to address issues related to equity, access, or the digital transformation of curriculum delivery. Articles not written in English, studies conducted outside the specified geographic region, and research focusing on primary or secondary education were excluded to maintain the relevance and focus of the review.

### ***Data Extraction and Analysis***

Data extraction was carried out using a standardized form to collect critical information from each study, including objectives, methods, key findings, and conclusions. Thematic analysis was then employed to identify and synthesize common themes and patterns across the studies.<sup>51</sup> This analysis provided a deeper understanding of the barriers and facilitators of digital education in rural universities, informing the development of practical recommendations.

### ***Quality Appraisal***

To ensure the quality and reliability of the included studies, a critical appraisal was conducted using the Mixed Methods Appraisal Tool (MMAT).<sup>52</sup> This tool evaluates the methodological quality of qualitative, quantitative, and mixed-methods studies. Each study was assessed based on criteria such as the clarity of the research question, the appropriateness of the methodology, and the robustness of data collection and analysis. Studies failing to meet the minimum quality standards were excluded from the final synthesis.

### ***Ethical Considerations***

As a review of existing literature, this study did not involve direct data collection from human participants, minimizing ethical concerns. Ethical guidelines were followed to accurately represent the findings of the included studies, with appropriate citations ensuring the integrity and credibility of the review.<sup>53</sup>

<sup>49</sup> Hilary Arksey and Lisa O'Malley, "Scoping Studies: Towards a Methodological Framework," *International Journal of Social Research Methodology* 8, no. 1 (February 2005): 19–32, <https://doi.org/10.1080/1364557032000119616>.

<sup>50</sup> Tricco et al., "PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation."

<sup>51</sup> Virginia Braun and Victoria Clarke, "Using Thematic Analysis in Psychology," *Qualitative Research in Psychology* 3, no. 2 (2006): 77–101.

<sup>52</sup> Quan Nha Hong et al., "Mixed Methods Appraisal Tool (MMAT), Version 2018," *Registration of Copyright* 1148552, no. 10 (2018): 1–7.

<sup>53</sup> David Gough, Sandy Oliver, and James Thomas, "An Introduction to Systematic Reviews (2nd Edition)," *Psychology Teaching Review* 23, no. 2 (2017): 95–96, <https://doi.org/10.53841/bpsptr.2017.23.2.95>.

### Flow Diagram of the Systematic Search Process

The systematic search process is summarized in Figure 1, which outlines the identification, screening, eligibility, and inclusion phases. This flow diagram provides a visual representation of the rigorous and transparent approach employed throughout the review.

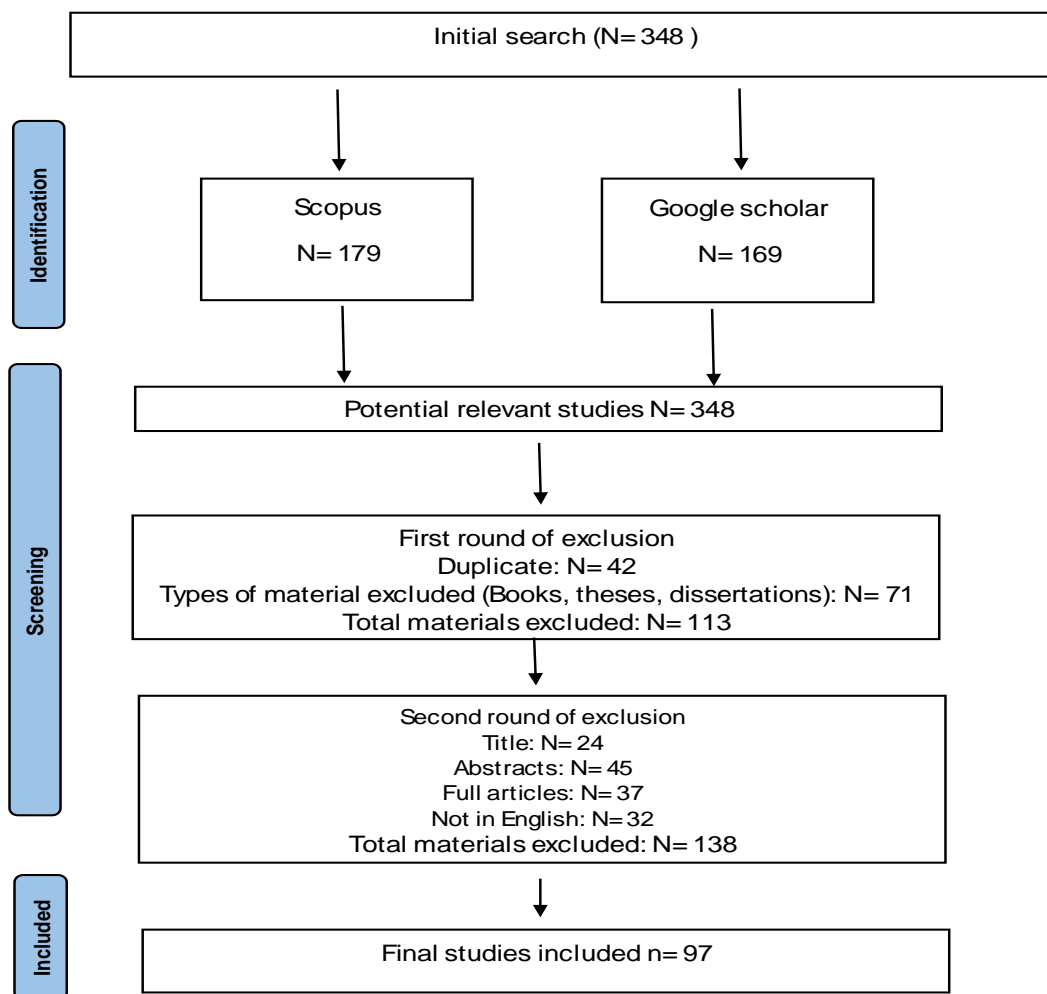


Figure 1: Flow diagram of the systematic search process

By following this structured methodology, the study provides a comprehensive understanding of the digital education landscape in rural South African universities, with a particular focus on equity and access, and identifies gaps that warrant further research.

### PRESENTATION OF RESULTS /FINDINGS

In table 1 below, the study presents a summary of key findings from some of the literature sources, using the PRISMA flow:

Table 1: Summary of Key Findings

Themes	Key Findings	Methods	Authors and Year
<b>Technological Infrastructure and Access</b>	The digital divide limits the adoption of digital education due to inadequate infrastructure in rural universities.	Systematic literature review, Case study	Ajani, 2023; Ajani & Khumalo, 2023; Nyerere et al., 2020; Adeoye et al., 2020; Mukama, 2020

Themes	Key Findings	Methods	Authors and Year
<b>Socio-Economic Barriers and Digital Literacy</b>	Socio-economic barriers and digital literacy gaps hinder digital education, impacting access to online learning.	Mixed methods, Case study, Survey	Ajani & Gamede, 2021; Ajani, 2021; Beaunoyer et al., 2020; Brown, 2020; Asare, 2021; Mtebe & Raphael, 2018; Chitanana, 2021
<b>Digital Literacy and Skills Development</b>	Digital literacy training enhances engagement and learning outcomes; necessary for effective digital education.	Survey, Literature review	Ajani, 2022; Ajani & Maphalala, 2023; Alhumaid et al., 2020; Chitanana, 2021
<b>Teacher Support and Digital Readiness</b>	ICT-driven professional development enhances classroom practices; digital tool adoption relies on perceived ease of use and training.	Systematic literature review, Survey	Ajani & Govender, 2023; Ajani, 2021; Teo, 2011
<b>Institutional Support and Government Role</b>	Institutional support is essential for effective digital education; government policies promote access and infrastructure development.	Thematic analysis, Survey, Policy review	Ajani, 2024; Ajani & Simmonds, 2022; Bennett et al., 2020; Wang et al., 2020; Van Deursen & Van Dijk, 2020
<b>Digital Access Initiatives</b>	Government programs enhance access to digital resources, but infrastructure challenges remain in rural settings.	Case study	Ajani, 2023; Urama & Acheampong, 2021; Nyerere et al., 2020
<b>Technology Acceptance Model (TAM)</b>	Perceived usefulness and ease of use are key to technology adoption in educational settings.	Longitudinal field studies, Theoretical model development	Ajani, 2023; Venkatesh & Davis, 2000; Davis, 1989
<b>Methodological Approaches</b>	Scoping reviews effectively map research areas, revealing gaps in digital transformation research.	Scoping review methodology	Ajani, 2024; Tricco et al., 2018
<b>Collaborative Efforts and Continuous Evaluation</b>	Partnerships and continuous evaluations are crucial for successful digital education implementation.	Mixed methods, Case study	Ajani, 2023; Bennett et al., 2020; Fasae & Adegbilero-Iwari, 2015; Asare, 2021; Ouma et al., 2013

### Theme 1: Technological Infrastructure and Access

Inadequate technological infrastructure is a significant barrier to the adoption of digital education in rural universities in South Africa, as well as in other developing African countries. For instance, in Kenya, many rural educational institutions struggle with unreliable internet connectivity and frequent power outages, which significantly impede the effective use of digital learning tools.<sup>54</sup> Similarly, in Nigeria, the lack of access to modern computers and essential software limits the ability of universities to deliver

<sup>54</sup> Nyerere, Gravenir, and Mse, "The Digital Divide and E-Learning Adoption in Rural Kenya: A Case Study of Two Public Universities."

high-quality digital education.<sup>55</sup> These infrastructural deficiencies underscore the urgent need for substantial investments in technology to enable the benefits of digital learning to be realized in rural settings.

Moreover, the disparity in technological infrastructure between urban and rural areas exacerbates educational inequalities. In Uganda, urban universities are often better equipped with advanced technological facilities compared to their rural counterparts, creating a digital divide that hinders equal access to education.<sup>56</sup> Addressing this imbalance requires targeted efforts to enhance the technological infrastructure in rural universities, ensuring that all students, regardless of their geographic location, have access to the necessary tools for digital learning.

## **Theme 2: Socio-Economic Barriers and Digital Literacy Gaps**

Socio-economic factors and digital literacy gaps are intertwined barriers that significantly hinder digital education in rural African universities. In South Africa, many students from rural areas come from low-income families and cannot afford personal digital devices or internet subscriptions, further widening the digital divide.<sup>57</sup> This economic disadvantage is also prevalent in countries like Ghana, where the high cost of internet data remains a major obstacle for students attempting to engage in online learning.<sup>58</sup> These financial barriers highlight the need for policies and initiatives that provide financial support and affordable internet access to students from disadvantaged backgrounds.

Significant gaps in digital literacy among both students and teachers compound these socio-economic barriers. In Tanzania, a study found that many teachers lacked the training and confidence to integrate digital tools into their teaching practices effectively, limiting the potential benefits of digital education.<sup>59</sup> Efforts to improve digital literacy have shown promising results in countries like Zimbabwe, where teacher training programmes have been implemented to enhance teachers' digital competencies.<sup>60</sup> By equipping teachers with the necessary skills and knowledge, these programmes help build a foundation for integrating digital tools into the curriculum.

## **Theme 3: Institutional and Government Support**

Institutional and government support play crucial roles in the successful implementation of digital education in rural universities. The findings indicated that many rural institutions lack the administrative and technical support needed to sustain digital learning initiatives.<sup>61</sup> This includes inadequate training programmes for teachers, insufficient technical assistance for students, and a lack of strategic planning for digital transformation. Strong institutional support structures are necessary to overcome these challenges and ensure the effective integration of digital tools into the curriculum.

Government policies were found to be instrumental in supporting digital education. Policies that provided funding for technological infrastructure, digital literacy programmes, and financial assistance for students significantly improved access to and adoption of digital learning tools.<sup>62</sup> In Kenya, the government's National ICT Policy has facilitated the expansion of internet connectivity and provided

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<sup>55</sup> I A Adeoye, A F Adanikin, and Ariyo Adanikin, "COVID-19 and E-Learning: Nigeria Tertiary Education System Experience," 2020; Oluwatoyin Ayodele Ajani, "Curriculum Delivery Through Learning Technologies in Online Classrooms: Challenges and Prospects in Higher Education," *Journal of Curriculum and Teaching* 12, no. 4 (August 13, 2023): 83, <https://doi.org/10.5430/jct.v12n4p83>.

<sup>56</sup> Evode Mukama, "From Policies to Implementation of Open Distance Learning in Rwanda: A Genealogical and Governmentality Analysis," *Journal of Learning for Development* 5, no. 1 (March 17, 2018), <https://doi.org/10.56059/jl4d.v5i1.237>.

<sup>57</sup> Sally Brown, *Learning, Teaching and Assessment in Higher Education* (London: Bloomsbury Publishing, 2020).

<sup>58</sup> S. Asare, "The Role of Digital Learning in Promoting Equity and Access in Ghanaian Rural Schools," *Journal of Educational Technology Systems* 50, no. 1 (2021): 27–44.

<sup>59</sup> Joel S Mtebe and Christina Raphael, "A Critical Review of Elearning Research Trends in Tanzania," in *2018 IST-Africa Week Conference (IST-Africa)* (IEEE, 2018), Page-1.

<sup>60</sup> L. Chitanana, "Teacher Training and Digital Literacy in Zimbabwe: A Case Study of ICT Integration," *African Journal of Teacher Education* 10, no. 2 (2021): 23–38.

<sup>61</sup> Ester van Laar et al., "Measuring the Levels of 21st-Century Digital Skills among Professionals Working within the Creative Industries: A Performance-Based Approach," *Poetics* 81 (August 2020): 101434, <https://doi.org/10.1016/J.POETIC.2020.101434>.

<sup>62</sup> Wang et al., "The Digital Divide and Higher Education: The Challenges and Opportunities of Online Learning during the COVID-19 Pandemic."

resources for ICT integration in education.<sup>63</sup> Effective policy interventions can bridge the digital divide and promote equity in education. Additionally, initiatives like the One Laptop per Child programme in Rwanda and teacher training programmes in Zimbabwe provide valuable examples of how targeted efforts can enhance digital education in rural settings.<sup>64</sup>

#### **Theme 4: Perceived Usefulness and Ease of Use**

The TAM highlights that perceived usefulness (PU) and perceived ease of use (PEOU) are critical factors influencing technology adoption. The results showed that when digital tools were perceived as beneficial for enhancing learning outcomes, students and teachers were more likely to adopt them.<sup>65</sup> For instance, in Kenya, a study found that students who perceived digital learning platforms as useful for their studies showed higher levels of engagement and satisfaction.<sup>66</sup> Similarly, in Nigeria, perceived usefulness positively impacted the adoption of mobile learning among university students.<sup>67</sup>

Perceived ease of use also plays a crucial role. The study found that complex and user-unfriendly digital tools deterred students and teachers from using them.<sup>68</sup> In Ghana, research indicated that the ease of use of mobile learning platforms significantly affected students' willingness to use these technologies.<sup>69</sup> Efforts to improve ease of use have been implemented in countries like Uganda, where user-centred design approaches have been adopted to develop digital education platforms.<sup>70</sup>

#### **Theme 5: Collaborative Efforts and Continuous Evaluation**

Collaborative efforts between universities, government bodies, and private sector organizations are essential for overcoming the challenges of digital education in rural areas. Partnerships can provide the necessary resources, expertise, and support to enhance digital education.<sup>71</sup> In Nigeria, collaborations between universities and tech companies have facilitated the provision of digital devices and training programmes for students and teachers.<sup>72</sup> In Ghana, the collaboration between the government and the private sector through initiatives like the Ghana-India Kofi Annan Centre of Excellence in ICT has provided critical support for digital education.<sup>73</sup>

Continuous evaluation and feedback mechanisms are essential for the successful implementation of digital tools. Regular assessments of digital learning platforms help identify issues and areas for improvement, ensuring that the tools remain effective and user-friendly.<sup>74</sup> In Kenya, ongoing evaluations of e-learning platforms have been conducted to ensure their relevance and effectiveness in meeting educational needs.<sup>75</sup> By implementing robust evaluation mechanisms, rural universities can ensure that their digital education initiatives are responsive to the needs of students and teachers and are continually refined to enhance their effectiveness.

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<sup>63</sup> Nyerere, Gravenir, and Mse, "The Digital Divide and E-Learning Adoption in Rural Kenya: A Case Study of Two Public Universities."

<sup>64</sup> Chitanana, "Teacher Training and Digital Literacy in Zimbabwe: A Case Study of ICT Integration."

<sup>65</sup> Fred D Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly*, 1989, 319–40.

<sup>66</sup> Gordon O Ouma, Fredrick M Awuor, and Benjamin Kyambo, "E-Learning Readiness in Public Secondary Schools in Kenya.," *European Journal of Open, Distance and E-Learning* 16, no. 2 (2013): 97–110.

<sup>67</sup> Joseph Kehinde Fasae and Idowu Adegbilero-Iwari, "Mobile Devices for Academic Practices by Students of College of Sciences in Selected Nigerian Private Universities," *The Electronic Library* 33, no. 4 (August 3, 2015): 749–59, <https://doi.org/10.1108/EL-03-2014-0045>.

<sup>68</sup> Venkatesh and Davis, "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies."

<sup>69</sup> Richard Boateng et al., "Determinants of E-Learning Adoption among Students of Developing Countries," *The International Journal of Information and Learning Technology* 33, no. 4 (August 1, 2016): 248–62, <https://doi.org/10.1108/IJILT-02-2016-0008>.

<sup>70</sup> D. Mulumba and T. Waema, "User-Centred Design Approach to e-Learning Platform Development in Uganda," *Journal of Educational Computing Research* 57, no. 4 (2019): 874–94.

<sup>71</sup> Bennett, Agostinho, and Lockyer, "The Process of Designing for Learning: Understanding University Teachers' Design Work."

<sup>72</sup> Fasae and Adegbilero-Iwari, "Mobile Devices for Academic Practices by Students of College of Sciences in Selected Nigerian Private Universities."

<sup>73</sup> Asare, "The Role of Digital Learning in Promoting Equity and Access in Ghanaian Rural Schools."

<sup>74</sup> Naim et al., "Mechanism of Direct and Indirect Assessments for Continuous Improvement in Higher Education."

<sup>75</sup> Ouma, Awuor, and Kyambo, "E-Learning Readiness in Public Secondary Schools in Kenya."

## DISCUSSION

The findings of this study underscore the critical importance of technological infrastructure in the adoption of digital education in rural universities. The inadequate infrastructure in many rural areas, as evidenced by the experiences in South Africa, Kenya, and Nigeria, significantly impedes the effective use of digital learning tools.<sup>76</sup> The TAM suggests that perceived ease of use (PEOU) is a crucial determinant of technology adoption.<sup>77</sup> When infrastructure is lacking, even the most user-friendly digital tools become difficult to use, thus reducing their perceived ease of use. Therefore, addressing infrastructural deficiencies through targeted investments and strategic planning is essential to enhance the perceived ease of use and overall adoption of digital education tools.

Socioeconomic barriers and gaps in digital literacy significantly hinder the adoption of digital education. This study found that many students from low-income families cannot afford digital devices or internet access, which is a common issue in South Africa and Ghana.<sup>78</sup> According to TAM, perceived usefulness (PU) plays a pivotal role in technology adoption.<sup>79</sup> However, without basic access to technology, students and teachers cannot experience or appreciate the usefulness of digital tools. Initiatives like Rwanda's One Laptop per Child programme and Zimbabwe's teacher training programmes are effective examples of how improving digital literacy and providing access to digital tools can enhance the perceived usefulness and ease of use, thereby fostering greater adoption.<sup>80</sup>

The role of institutional and government support in facilitating digital education cannot be overstated. The study highlighted the lack of administrative and technical support in many rural universities, which hampers the sustainability of digital learning initiatives.<sup>81</sup> TAM posits that external factors, such as facilitating conditions, significantly influence the perceived ease of use and perceived usefulness of technology.<sup>82</sup> Government policies in Kenya and South Africa that provide funding and infrastructure improvements have shown positive impacts on the adoption of digital education.<sup>83</sup> Effective policies and strong institutional support structures are essential to create an enabling environment that promotes the successful integration of digital learning tools.

The perceived usefulness and ease of use of digital tools are crucial for their adoption, as highlighted by TAM.<sup>84</sup> This study found that when students and teachers in Kenya and Nigeria perceived digital learning platforms as beneficial and easy to use, their engagement and satisfaction levels increased.<sup>85</sup> Simplifying digital interfaces and involving users in the design process, as seen in Uganda, can significantly improve the perceived ease of use.<sup>86</sup> By demonstrating the tangible benefits of digital tools and ensuring they are user-friendly, educational institutions can enhance the perceived usefulness and ease of use, thereby encouraging broader adoption among students and teachers.

The importance of collaborative efforts and continuous evaluation in the successful implementation of digital education initiatives was evident in this study. Partnerships between universities, government bodies, and private sector organizations provide essential resources and support,

<sup>76</sup> Nyerere, Gravenir, and Mse, "The Digital Divide and E-Learning Adoption in Rural Kenya: A Case Study of Two Public Universities"; Adeoye, Adanikin, and Adanikin, "COVID-19 and E-Learning: Nigeria Tertiary Education System Experience."

<sup>77</sup> Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," September 1989.

<sup>78</sup> Asare, "The Role of Digital Learning in Promoting Equity and Access in Ghanaian Rural Schools."

<sup>79</sup> Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," 1989; Naim et al., "Mechanism of Direct and Indirect Assessments for Continuous Improvement in Higher Education."

<sup>80</sup> K. C. Urama and E. Acheampong, "Digital Education in Africa: Policy Frameworks and Institutional Innovations," *International Journal of Educational Development* 82 (2021): 102366; Chitanana, "Teacher Training and Digital Literacy in Zimbabwe: A Case Study of ICT Integration."

<sup>81</sup> Alexander van Deursen and Jan van Dijk, "Internet Skills and the Digital Divide," *New Media & Society* 13, no. 6 (September 6, 2011): 893–911, <https://doi.org/10.1177/1461444810386774>.

<sup>82</sup> Venkatesh and Davis, "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies."

<sup>83</sup> Nyerere, Gravenir, and Mse, "The Digital Divide and E-Learning Adoption in Rural Kenya: A Case Study of Two Public Universities"; Department of Basic Education. DBE Director-general's meeting with Limpopo Department of education provincial and district officials. Presentation by curriculum management and delivery branch on 31 January 2019.

<sup>84</sup> Davis, "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," September 1989.

<sup>85</sup> Ouma, Awuor, and Kyambo, "E-Learning Readiness in Public Secondary Schools in Kenya."; Fasae and Adegbilero-Iwari, "Mobile Devices for Academic Practices by Students of College of Sciences in Selected Nigerian Private Universities."

<sup>86</sup> Mulumba and Waema, "User-Centred Design Approach to e-Learning Platform Development in Uganda."

as demonstrated in Nigeria and Ghana.<sup>87</sup> TAM suggests that perceived ease of use and perceived usefulness are influenced by external variables such as social influence and facilitating conditions.<sup>88</sup> Continuous evaluation and feedback mechanisms, like those implemented in Kenya, help identify and address issues, ensuring that digital tools remain effective and user-friendly.<sup>89</sup> Such collaborative and evaluative approaches are critical for refining digital education strategies and enhancing their overall effectiveness and acceptance.

## RECOMMENDATIONS

One of the primary implications of this study is the urgent need to strengthen technological infrastructure in rural universities across developing countries. The lack of reliable internet connectivity, modern computers, and essential software significantly hampers the potential of digital education. For key stakeholders, including government bodies, educational institutions, and private sector partners, the recommendation is to prioritize investments in technological infrastructure. This includes expanding internet access, ensuring stable electricity supplies, and providing up-to-date digital devices. By addressing these foundational issues, stakeholders can create an environment conducive to effective digital learning and reduce the technological disparities between urban and rural educational institutions.

The study highlights significant socio-economic barriers and digital literacy gaps that impede the adoption of digital education. Many students in rural areas cannot afford digital devices or internet access, and both students and teachers often lack the necessary digital skills. Stakeholders should implement policies and initiatives to provide financial support and affordable internet access to disadvantaged students. Programmes similar to Rwanda's One Laptop per Child and digital literacy workshops in Zimbabwe can serve as models for other regions. These initiatives not only make technology accessible but also ensure that students and teachers are equipped with the skills to utilize digital tools effectively.

The critical role of institutional and government support in the successful implementation of digital education is evident from this study. Many rural universities lack the administrative and technical backing needed to sustain digital learning initiatives. Therefore, it is recommended that governments develop comprehensive policies that provide funding for technological infrastructure, digital literacy programmes, and financial assistance for students. Educational institutions should establish dedicated support centres to offer technical assistance and continuous professional development for teachers. Such support structures are essential to foster a sustainable and effective digital education ecosystem.

The study underscores the importance of collaborative efforts and continuous evaluation in enhancing digital education. Partnerships between universities, government bodies, and private sector organizations can pool resources, expertise, and support, thus overcoming the challenges faced by rural educational institutions. Stakeholders should encourage and facilitate these collaborations to promote knowledge sharing and innovation. Furthermore, continuous evaluation and feedback mechanisms are crucial for ensuring that digital tools remain effective and user-friendly. Regular assessments and adjustments based on user feedback can help refine digital education strategies, ensuring they meet the evolving needs of students and teachers.

## CONCLUSION

This study has highlighted the critical barriers and necessary interventions for the successful adoption of digital education in rural universities in developing countries. The findings emphasize the importance of robust technological infrastructure, addressing socio-economic barriers, enhancing digital literacy, and providing strong institutional and government support. Additionally, fostering collaborative efforts and implementing continuous evaluation mechanisms are essential for ensuring the effectiveness and sustainability of digital education initiatives. By addressing these key areas, stakeholders can promote equitable access to quality education, thereby bridging the digital divide and enhancing learning outcomes in rural settings.

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<sup>87</sup> Asare, "The Role of Digital Learning in Promoting Equity and Access in Ghanaian Rural Schools."

<sup>88</sup> Venkatesh and Davis, "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies."

<sup>89</sup> Ouma, Awuor, and Kyambo, "E-Learning Readiness in Public Secondary Schools in Kenya."

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