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Students' Readiness for the Posthuman Workforce in a Rurally Located University in South Africa

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Abstract: The rapid advancement of digital tools, artificial intelligence, and global connectivity is reshaping workforce expectations, rendering it crucial to understand how students in rural and historically disadvantaged universities are preparing for such changes. These students often encounter compounded barriers, including inadequate digital infrastructure, outdated learning tools, limited exposure to emerging technologies, and scarce opportunities for practical collaboration, all of which impede their acquisition of the skills and competencies necessary to thrive in a posthuman environment. Guided by the Technological Acceptance Model and further interpreted through Van Dijk's Digital Divide Model and Sen's Capability Approach within a transformative paradigm employing participatory action research as a design. Semi-structured interviews were conducted with 15 fourth-year rural university students selected through convenience sampling, and the data were analysed thematically. The findings reveal that poor connectivity, limited access to modern learning tools, reduced exposure to advanced technologies, and inadequate opportunities for practical application collectively hinder students' preparedness for technology-driven work environments. Despite these challenges, students exhibit resilience, adaptability, and problem-solving potential—qualities that are valuable for the evolving workforce. The study concludes that targeted interventions to improve infrastructure, enhance access to digital tools, provide structured exposure to emerging technologies, and strengthen digital literacy programmes are essential to bridging the preparedness gap and enabling rural students to thrive in the posthuman workforce. Consequently, this article contributes to the literature by elucidating the digital readiness gaps experienced by rural students and proposes interventions to bridge infrastructural, technological, and literacy barriers to facilitate equitable participation in the workforce.

Keywords: Posthumanism, rural university students, workforce readiness, digital literacy, technological acceptance.

1. Introduction

In an era increasingly shaped by automation, artificial intelligence (AI), robotics, and pervasive connectivity, the nature of work is undergoing significant transformations across societies worldwide. These technological and social changes, commonly referred to as posthumanist shifts, challenge the traditional human-centred conception of labour by situating humans within a complex, entangled relationship with intelligent machines, algorithms, and digitally mediated environments (Snaza, 2014; Le Grange & Du Preez, 2023; Du Preez, 2023). Posthumanism necessitates a re-evaluation of human agency and capability in contexts wherein machines are not merely tools but active participants in knowledge production and work processes. In this context, the competencies requisite for the 21st-century workforce extend beyond technical expertise to encompass adaptability, critical thinking, digital fluency, ethical reasoning, and the ability to collaborate with non-human agents (Snaza, 2014; Braidotti, 2019). International research underscores the importance of preparing students for these transformations, highlighting that education systems must equip learners with both technological skills and socio-ethical awareness to thrive in a posthuman future

(Chetty, 2017; Selwyn, 2019). However, access to technology, opportunities for technology-mediated learning, and preparedness for posthuman challenges remain deeply uneven across global contexts, disproportionately disadvantaging rural and marginalised populations (Perrin, 2019; Chetty, 2017). These inequalities pose the risk of engendering a new class of digitally excluded citizens who are ill-equipped to participate fully in the evolving workforce.

The global literature consistently highlights a persistent digital divide that undermines efforts to democratise education and prepare all students equitably for future labour markets. For instance, studies conducted in the United States and parts of Europe demonstrate that while urban students benefit from access to high-speed internet, sophisticated devices, and innovative educational technologies, students in rural areas frequently lack these resources, resulting in a gap in both skills and confidence in utilising emerging technologies (Roberts & Townsend, 2016; van Dijk, 2020). The COVID-19 pandemic starkly illuminated these disparities, with rural students disproportionately excluded from online learning opportunities due to inadequate connectivity and limited digital literacy (Curtis et al., 2021; UNESCO, 2020). Moreover, digital inequality is not solely a matter of access; it also encompasses the quality of engagement with technology and the capacity to use digital tools meaningfully to advance learning and employability (van Dijk, 2020). In the absence of targeted interventions, these gaps are likely to widen as technological advancements accelerate, leaving rural students unprepared for the demands of the posthuman workforce, where hybrid human-machine collaboration will be central.

The situation in Sub-Saharan Africa magnifies these global trends. Structural challenges such as underdeveloped digital infrastructure, prohibitive costs of internet connectivity, limited electricity supply, and low levels of digital literacy continue to impede the participation of rural populations in digital learning ecosystems (Kamutuezu, Winschiers-Theophilus, & Peters, 2021; Bhorat et al., 2023). While many African governments have initiated policies to promote ICT integration in education, the implementation of these policies has been uneven, particularly in rural and underserved areas where schools and universities often lack the necessary resources (African Union, 2020). The World Bank (2019) and GSMA (2019) have documented gender- and income-related disparities in digital access, noting that rural women and economically disadvantaged students face even greater barriers in accessing digital devices and online platforms. Heeks (2021) cautions that this may result in "adverse digital incorporation," whereby limited and inequitable access to digital systems may reinforce existing inequalities rather than mitigate them. Furthermore, while some African studies have examined the general digital divide, few have investigated how this divide interacts with the specific competencies demanded by a posthuman workforce, which includes not only basic Information and Communication Technology (ICT) skills but also advanced capabilities such as AI literacy, digital collaboration, and critical engagement with technology (Boateng, 2024).

South Africa exemplifies these challenges within its complex socio-historical context. The legacy of apartheid has left rural and historically disadvantaged communities with insufficient educational infrastructure and restricted access to digital technologies (Chisango, Marongwe, Mtsi, & Matyedi, 2020). Although internet penetration has improved in urban centres, rural communities continue to lag behind, with connectivity rates significantly lower than the national average (van Dijk, 2006). Prior to the COVID-19 pandemic, only approximately 22% of South Africans had reliable internet access, with rural areas experiencing the most pronounced shortages (Chisango et al., 2020). The pandemic further exposed the vulnerabilities of students from rural backgrounds, many of whom lacked the devices, data, or connectivity necessary to participate in online classes (Ajani, 2025). Empirical studies conducted at South African universities have demonstrated that rural students often enter higher education with low computer self-efficacy, minimal exposure to emerging technologies, and limited opportunities to develop digital competencies essential for future employment (Zwane & Mudau, 2023; Omodan, 2023). Although policy documents, such as the White Paper on e-Education, outline ambitious plans to integrate ICT into education, the reality is that many

rural universities lack the funding, infrastructure, and staff development required to implement these policies effectively (Department of Telecommunications, 2013).

The challenges are even more pronounced in provinces such as the Eastern Cape, where universities are frequently situated in deep rural and previously disadvantaged areas. Studies focusing on this region have reported significant infrastructural deficits, including unreliable electricity, poor internet connectivity, and inadequate access to modern learning facilities (Aruleba & Jere, 2022; Lukose & Agbeyangi, 2024). Students often rely on outdated computers, shared devices, and expensive mobile data to complete assignments, attend online lectures, or access digital learning resources (Chisango et al., 2020). Some students commute long distances or attend classes from remote villages where network coverage is erratic, resulting in disrupted learning experiences and diminished engagement with digital tools. This lack of exposure not only hampers their academic performance but also undermines their confidence and preparedness to engage with the advanced technologies that dominate the contemporary job market (Zongozzi, 2025). Furthermore, institutional support in these contexts is frequently minimal, with limited workshops, training programmes, or internships available to enhance students' digital literacy and employability. This situation highlights the compounded disadvantage faced by rural students in historically marginalised provinces.

Although a substantial body of research has investigated the digital divide in education, a notable gap remains in studies that explicitly connect infrastructural and socio-economic barriers to the development of posthuman workforce competencies among rural university students. Most existing scholarship tends to focus either on access to technology or on the acquisition of digital skills in isolation, without exploring how these factors intersect to influence students' preparedness for future work environments that demand hybrid human-machine collaboration and continuous learning. Furthermore, there is a scarcity of research that captures the lived experiences of rural students who strive to engage with digital learning while residing in deeply rural locales characterised by acute resource scarcity and systemic exclusion. Addressing this gap is critical for developing targeted interventions that not only improve access to technology but also enhance students' capabilities to use technology meaningfully in ways that align with the demands of a posthuman workforce.

In light of these gaps, the study that informs this paper aimed to investigate the specific barriers faced by rural students in accessing educational resources essential for posthuman workforce preparation, as well as the impact of these limitations on their acquisition of relevant competencies. By focusing on the lived experiences of students in a rural and historically disadvantaged context, the study provides a nuanced understanding of the interplay between digital exclusion and workforce readiness in a posthuman era. The Technological Acceptance Model (TAM) serves as the theoretical framework that enables the analysis of students' perceptions of technology and their readiness to engage with it.

1.1 Research Questions

Building on the preceding discussion, which underscores the significant impact of digital inequality on rural students' preparedness to engage in a posthuman workforce, this paper addresses the critical gaps identified in the existing literature regarding the ways in which infrastructural, socio-economic, and pedagogical barriers influence the acquisition of essential future-oriented competencies. Consequently, to investigate these issues comprehensively and generate empirical insights that can inform policy and practice, the study was guided by the following two research questions:

- What specific barriers do rural university students face in accessing the educational resources necessary for developing skills relevant to the posthuman workforce?
- How do limitations in access to educational opportunities influence rural students' acquisition of the competencies required to thrive in a posthuman work environment?

2. Theoretical Framework

The study is grounded in the Technological Acceptance Model (TAM), a framework developed by Davis (1989) to elucidate how users come to accept and utilise technology. TAM posits that two primary factors—perceived usefulness and perceived ease of use—shape individuals' attitudes towards technology adoption, which in turn influence their behavioural intentions and actual technology use (Venkatesh & Davis, 2000). This model has been extensively applied in educational contexts to comprehend how students engage with digital tools and learning platforms (Teo, 2011; Šumak, Heričko & Pušnik, 2011). In the context of rural university students, TAM provides a lens through which to examine how their perceptions of technology, shaped by limited infrastructure, inadequate training, and socio-economic constraints, impact their readiness to adopt and effectively use emerging technologies required in posthuman work environments. Moreover, TAM enables the study to capture the interplay between subjective attitudes towards technology and the external barriers that may inhibit adoption, such as connectivity challenges or lack of institutional support (Scherer, Siddiq & Tondeur, 2019).

While TAM provides a robust structure for analysing technology acceptance, its explanatory power can be enhanced by integrating insights from Van Dijk's Digital Divide Model and Sen's Capability Approach. Van Dijk (2020) emphasises that digital exclusion is not only about access to devices or the internet, but also about disparities in digital skills, usage, and outcomes. His model identifies four successive barriers—motivational, material, skills, and usage—that determine whether individuals can fully participate in digital societies (van Dijk, 2006). These dimensions are particularly relevant for rural students who may possess devices but lack the motivation, training, or contextual opportunities to exploit them effectively. Similarly, Sen's Capability Approach (Sen, 1999) highlights that access to resources alone does not guarantee meaningful development; what matters is the ability of individuals to convert resources into capabilities that enable them to lead lives they value. Applying this approach to digital education underscores that rural students' mere exposure to technology is insufficient unless they can develop the competencies necessary to transform that exposure into opportunities for learning and workforce participation (Robeyns, 2005; Zheng & Walsham, 2008).

The relevance of these theoretical perspectives to the study resides in their capacity to provide a multi-layered understanding of the factors influencing rural students' readiness for the posthuman workforce. TAM facilitates the exploration of students' attitudes towards technology and their willingness to adopt it. In contrast, the frameworks proposed by Van Dijk and Sen enable the analysis to extend beyond mere attitudes to encompass the structural and contextual conditions that shape technology use and skill acquisition. Collectively, these theories offer a comprehensive analytical lens through which to interpret how infrastructural deficiencies, socio-economic barriers, and pedagogical limitations converge to affect digital adoption and competence development. This integrated theoretical approach ensures that the findings are not solely descriptive but also explanatory, elucidating how access, perceptions, and capabilities interact to either empower or hinder rural students in their preparation for the evolving demands of the posthuman world. By applying these frameworks, the study aims to generate insights that inform both institutional strategies and policy interventions designed to bridge the rural digital divide and enhance workforce readiness.

3. Methodology

The study is situated within a transformative research paradigm, which emphasises the necessity to address power imbalances, promote social justice, and incorporate marginalised voices in the production of knowledge. The transformative paradigm is predicated on the belief that research should not only generate knowledge but also contribute to positive social change (Mertens, 2019). It challenges conventional positivist approaches by recognising that realities are socially constructed

and shaped by cultural, political, and historical contexts (Creswell & Poth, 2018). This paradigm is particularly suited to research involving rural university students, who frequently encounter systemic exclusion in accessing educational resources and workforce opportunities. Therefore, situating the study within a transformative paradigm ensures that the experiences of these students are not only documented but also analysed in ways that can inform interventions aimed at bridging digital and competency gaps in a posthuman context.

Consistent with this paradigm, the study adopts a qualitative research approach, which seeks to understand phenomena through the meanings individuals ascribe to their experiences. Qualitative research is particularly appropriate for exploring complex social issues in which context, perceptions, and lived experiences are central to understanding (Denzin & Lincoln, 2018). Through this approach, the study captures the nuanced ways in which rural students perceive barriers to technology use, access to educational resources, and competency development for the posthuman workforce. Unlike quantitative methods, which prioritise numerical data, the qualitative approach facilitates a deeper exploration of subjective realities, enabling the researcher to interpret participants' voices within their socio-cultural and institutional environments (Creswell & Poth, 2018). This approach supports the generation of rich, contextually grounded insights that align with the study's goal of informing equitable educational practices.

In accordance with its paradigm and approach, the study employs a participatory action research (PAR) design. PAR is an inclusive methodology that actively involves participants in the research process, emphasising collaboration and the co-creation of knowledge (Kemmis, McTaggart, & Nixon, 2014). This design is particularly valuable in studies involving marginalised populations, as it empowers participants to share their experiences and contribute to solutions that affect their communities (Reason & Bradbury, 2008). In this study, PAR facilitates engagement with rural students not merely as subjects but as co-researchers whose insights guide the analysis and recommendations. Through iterative cycles of reflection and action, the design ensures that the research outcomes are both contextually relevant and applicable in addressing barriers to digital inclusion and workforce readiness.

3.1 Other methods

The study utilised semi-structured interviews as the primary data collection method. Semi-structured interviews are widely employed in qualitative research because they balance structure with flexibility, allowing researchers to explore predetermined questions while also probing deeper into participants' responses (Kvale & Brinkmann, 2015). This method was selected to enable students to share detailed accounts of their experiences with digital technologies, access to educational resources, and perceptions of their readiness for a posthuman workforce. The flexibility of semi-structured interviews provided opportunities to capture rich narratives and uncover themes that may not have been anticipated at the outset. Interviews were conducted face-to-face on campus and virtually when students were attending from deep rural areas with connectivity challenges, thereby ensuring inclusivity and representation of diverse student circumstances.

The study involved fifteen fourth-year students enrolled at a rural university located in a historically disadvantaged area of South Africa. Participants were selected through convenience sampling, a non-probability technique that involves recruiting individuals who are readily available and willing to participate (Etikan, Musa, & Alkassim, 2016). This sampling strategy was appropriate given the study's focus on capturing the lived experiences of a specific student group within the constraints of time and resources. Fourth-year students were purposively targeted because, as final-year undergraduates, they had accumulated substantial academic and digital learning experiences within the institution. Their insights were therefore critical in reflecting both the challenges they had faced over time and their readiness to transition into the workforce. Additionally, this group was more

likely to provide reflective and informed perspectives on how access to technology—or the lack thereof—had shaped their skills development.

The study was conducted at a rural university situated in the Eastern Cape of South Africa, a province characterised by high poverty rates, limited infrastructure, and historical educational disadvantages. The university's location made it an ideal setting to explore issues of digital exclusion and workforce readiness within a posthuman context. Students in this environment often experience compounded barriers, including unreliable internet connectivity, electricity instability, and limited exposure to advanced technologies. These contextual factors provided a rich backdrop for understanding how environmental and institutional conditions intersect with students' experiences of technology adoption and skills acquisition. Data collected from the semi-structured interviews were analysed using thematic analysis, a method that involves identifying, analysing, and reporting patterns within qualitative data. Thematic analysis allowed the researcher to generate themes that aligned with the research questions and objectives, thereby providing meaningful insights into the barriers and competencies shaping rural students' preparation for the posthuman workforce (Braun & Clarke, 2006).

3.2 Ethical considerations

Ethical considerations were meticulously observed throughout the study to safeguard the protection, dignity, and rights of the participants. Prior to data collection, ethical clearance was secured from the University (name withheld for anonymity purposes) Research Ethics Committee, under approval number FEDREC15-06-23-3, thereby authorising the study to proceed in accordance with institutional and national guidelines. Informed consent was obtained from all participants, who were provided with comprehensive information regarding the purpose of the research, the voluntary nature of their participation, and their right to withdraw at any stage without penalty. Confidentiality and anonymity were strictly maintained by assigning pseudonyms (ST1 to ST15) to replace participants' actual names in all transcripts, analyses, and publications. Data were securely stored in password-protected files accessible solely to the researcher, and no identifying information was disclosed in any publications. Furthermore, the study adhered to the principles of beneficence and non-maleficence, ensuring that participants were not subjected to any harm or undue stress during the interviews. The research also respected cultural sensitivity, particularly in light of the rural and historically disadvantaged context of the participants, and ensured that findings would be disseminated in ways that could potentially enhance their educational experiences. In this study, informed consent was obtained in writing from all participants following the provision of detailed information concerning the purpose, procedures, and voluntary nature of the research. Participants were also assured of their right to withdraw at any time without penalty. Written consent was preferred over verbal consent to ensure clear documentation of participants' agreement and compliance with institutional ethical standards.

4. Presentation of Results

The results of this study are presented in a manner that directly correlates with the research questions and the themes that emerged from the thematic analysis of participants' responses. The analysis captures the perspectives of the students through illustrative quotations, thereby providing rich insights into their experiences and perceptions. Themes were generated to reflect the principal patterns identified in the data, with each theme offering an understanding of the barriers rural students encounter in accessing educational resources and how these limitations influence their acquisition of the competencies required for the posthuman workforce. The table below summarises the correspondence between the identified themes and the research questions, serving as a framework for the detailed analysis that follows.

Table 1: *Research questions and corresponding themes*

Research Questions	Themes identified
• What specific barriers do rural university students face in accessing educational resources necessary for developing skills relevant to the posthuman workforce?	i. Limited Digital Infrastructure and Internet Connectivity ii. Insufficient Access to Modern Learning Tools
• How do limitations in access to educational opportunities influence rural students' acquisition of the competencies required to thrive in a posthuman work environment?	i. Reduced Exposure to Emerging Technologies ii. Limited Opportunities for Practical Application and Collaboration

Table 1 presents a summary of the research questions alongside the corresponding themes that emerged from the data analysis. This table functions as a framework that connects the study's objectives to the thematic findings, thereby ensuring a clear alignment between the research questions and the results presented.

4.1 Question 1, theme 1: Limited digital infrastructure and internet connectivity

The initial theme elucidates the extent to which infrastructural deficiencies, particularly inadequate connectivity and erratic electricity supply, significantly constrain rural students' access to educational resources. The narratives provided by participants reveal a pattern of recurrent frustrations arising from unreliable Wi-Fi access on campus, the prohibitive cost of mobile data, suboptimal network coverage at home, and frequent power outages that impede the learning process. Collectively, these factors contribute to an environment characterised by inconsistent and stressful digital engagement, thereby exacerbating the disparity between rural and urban learners.

> *ST1: "Most of the time, our campus Wi-Fi is too slow to download study materials. At home, I rely on my phone's data, which is expensive and sometimes doesn't work due to poor network coverage."*
>
> *ST4: "When assignments require online research, I struggle because I cannot always access reliable internet. It feels as though we are left behind compared to students in urban areas like East London, Port Elizabeth, and Johannesburg."*

The comments from ST1 and ST4 collectively emphasise both the institutional and personal struggles associated with poor connectivity. While campus Wi-Fi fails to meet the basic needs for academic work, personal mobile data—an alternative many students resort to—proves to be costly and unreliable. This dual limitation not only interrupts academic routines but also reinforces the perception that rural students are disadvantaged compared to their urban peers, as highlighted by ST4's feeling of being "left behind."

> *ST8: "Even during online lectures, I often get disconnected. It makes it hard to stay engaged or understand new technologies."*
>
> *ST12: "I live in a remote area, and there is no stable network. Sometimes, I climb a hill just to catch a signal for uploading assignments."*

The narratives of ST8 and ST12 illustrate the significant consequences of inadequate connectivity during critical learning moments. In the case of ST8, recurrent disconnections during online classes result in the omission of essential content and subsequent disengagement, thereby undermining the comprehension of technology-driven materials. ST12's account of physically ascending a hill to obtain a signal underscores the extraordinary measures that rural students must undertake to meet

academic requirements, thereby highlighting their resilience in the face of systemic infrastructural deficiencies.

> *ST14: "We also have electricity problems. Power cuts happen frequently, so even if you have data, you cannot charge your devices to continue learning. At the end, one is not proficient in the use of the internet, even."*

Finally, ST14 introduces an additional layer of electrical instability, which interacts with network issues to create compounded barriers. Even when internet access is theoretically available, power outages render devices unusable, illustrating how multiple infrastructural failures intersect to further obstruct digital learning. Collectively, these accounts demonstrate that limited infrastructure is not a singular problem but rather a web of interrelated challenges that continuously hinder rural students' educational engagement and skill development.

4.2 Question 1, theme 2: Insufficient access to modern learning tools

The second theme indicates that, even when connectivity is somewhat managed, rural students face another significant barrier: limited access to contemporary learning tools. The participants consistently describe outdated equipment, a lack of licensed software, insufficient personal devices, and restricted access to institutional resources as substantial obstacles that impede their ability to acquire practical experience with the technologies necessary for a posthuman workforce.

> *ST3: "We still use outdated computers in the lab, and many of them don't support the software we are supposed to learn."*
>
> *ST6: "Some courses require advanced applications, but we don't have licenses or proper devices to practice. I end up just reading about them instead of using them."*

The accounts from ST3 and ST6 underscore a direct discrepancy between curriculum expectations and the resources available to students. Outdated laboratory equipment and a lack of software licences impede students' capacity to engage in experiential learning, thereby confining them to a passive, theoretical approach to mastering technological tools. This situation obstructs the development of confidence and competence, which are essential for workplace readiness.

> *ST10: "I feel disadvantaged because I don't own a laptop. Using only a smartphone limits how much I can learn or experiment with digital tools."*
>
> *ST13: "When COVID-19 started, I realised how far behind we were. While other universities quickly moved online, we struggled because students like me didn't have devices or proper connectivity."*

The responses from ST10 and ST13 highlight how personal device ownership—or the lack thereof—affects the degree of students' participation in digital learning. ST10's reliance on a smartphone for complex academic tasks exemplifies the limitations of mobile devices in facilitating effective digital engagement. Furthermore, ST13's reflection on the pandemic period reveals that rural students were disproportionately affected when learning transitioned online, exposing systemic vulnerabilities that extend beyond individual responsibility.

> *ST15: "Even the campus labs close early, and because I live far away, I miss the chance to use the computers there. At home, I don't have any alternative."*

Lastly, ST15 underscores how institutional policies, such as early laboratory closures, inadvertently exacerbate access barriers for students residing at a considerable distance from campus. For these students, the absence of alternative learning environments at home results in a cessation of their educational progress once laboratories close. This scenario illustrates the intersection of geographical factors with institutional limitations, thereby restricting opportunities for the acquisition of essential digital skills.

The analysis indicates that the deficiency in modern learning tools is not merely a consequence of outdated technology but represents a multifaceted challenge encompassing insufficient resources, inadequate institutional support, and personal economic constraints. In conjunction with infrastructural deficiencies, these barriers significantly limit rural students' opportunities to cultivate the practical competencies necessary for success in an increasingly technology-driven, posthuman workforce.

4.3 Question 2, theme 1: Reduced exposure to emerging technologies

The initial theme emerging from this research question suggests that rural students face limited exposure to advanced technologies, which directly hinders their acquisition of competencies essential for a rapidly evolving, posthuman workforce. The participants consistently articulated that their learning environments are misaligned with the technological trends shaping contemporary industries. This deficiency in exposure not only constrains their technical skills but also undermines their confidence when confronting future employment situations.

> *ST2: "I have never worked with AI-based tools in class. And the employers expect us to be familiar with them, right? It makes me nervous because I have only read about them, not used them."*
>
> *ST5: "We don't have enough workshops or training sessions on new technologies. Sometimes I feel that my learning is not future-oriented."*

Together, ST2 and ST5 highlight how the lack of practical interaction with emerging technologies leaves students feeling unprepared for industry expectations. Engaging with AI-based tools or other advanced digital resources solely through reading, without firsthand experience, creates a skills gap that theoretical knowledge alone cannot bridge. Furthermore, the absence of training programmes or workshops deprives students of opportunities to enhance their knowledge in alignment with global trends.

> *ST9: "By the time we hear about new digital trends, students in other places are already ahead, which makes me feel unprepared for the real world."*
>
> *ST7: "Because our university is in a disadvantaged setting, or you can call it a rural area, we hardly get invited to major tech events or career expos where we can learn about future technologies."*

These narratives from ST9 and ST7 illustrate how geographic isolation contributes to delayed access to additional information and fewer opportunities for exposure to emerging technologies. The sense of lagging behind peers in better-resourced contexts generates anxiety about future competitiveness and reinforces the perception of rural students as disadvantaged in technology-driven job markets.

> *ST11: "Most of our lecturers also struggle with some of the latest digital tools, so we don't get the full exposure we need to be competitive."*
>
> *ST14: "I only learned about cloud computing and AI through YouTube, not in class. This shows that we rely on ourselves to bridge the gap."*

ST11's comment indicates that even educators face challenges with newer technologies, which limits students' learning experiences. When instructors are not fully confident with advanced tools, they may not integrate them into their teaching, depriving students of crucial exposure. ST14's experience further illustrates how students resort to self-learning through online platforms, reflecting a lack of institutional support in preparing them for the digital demands of the workforce. This reliance on self-initiative highlights the structural deficiencies in their formal education. Hence, the combined transcripts under this theme reveal that the reduced exposure to emerging technologies stems from multiple factors: a lack of institutional resources, an absence of training opportunities, limited access to professional tech events, and gaps in lecturers' digital expertise. These barriers leave students

underprepared for industries increasingly shaped by AI, cloud computing, and other posthuman technologies.

4.4 Question 2, theme 2: Limited opportunities for practical application and collaboration

The second theme illustrates that, in addition to their exposure to technology, students face considerable constraints in their ability to apply their learning in practical contexts and collaborate through contemporary digital platforms. Their experiences indicate that the educational environment predominantly adheres to theoretical frameworks, offering limited opportunities for the practical application of advanced tools or for participation in technology-based teamwork. This deficiency in practical engagement diminishes their confidence and restricts their capacity to cultivate skills that are increasingly regarded as essential in the posthuman workforce.

> *ST7: "Group projects are often done without digital collaboration tools because many of us can't access them. This limits our exposure to teamwork in tech-based environments."*
>
> *ST11: "Most of our learning is theoretical. Without practical sessions using advanced technologies, I doubt if I am confident enough, Yhooo."*

The accounts from ST7 and ST11 illustrate how the lack of digital collaboration tools hinders students from gaining experience in virtual teamwork—an essential skill in contemporary workplaces. Furthermore, the dominance of theory over practice leaves students uncertain about their ability to operate in technologically advanced work environments.

> *ST13: "Internships in tech-driven companies are rare here, so we miss the chance to practice what we learn in class in real-life settings."*
>
> *ST15: "When we have practical work such as teaching practices, it is often simulated using outdated methods. It doesn't prepare us for how things are done in real workplaces."*

ST13 and ST15 highlight the scarcity of practical learning opportunities, such as internships or realistic training sessions. The lack of exposure to actual industry practices, coupled with reliance on outdated methods, results in students graduating without the applied experience that employers often require.

> *ST6: "Even collaboration with students from other universities is rare, maybe because of our poor digital infrastructure. We miss out on global networking experiences."*
>
> *ST1: "Some of my peers have never used platforms like Zoom or Teams properly because they only join classes via voice due to poor connections. You think this will not affect how prepared you are for work in digital environments?"*

The comments from ST6 and ST1 emphasise how infrastructural limitations restrict opportunities for broader collaboration, such as networking with peers from other institutions or achieving fluency in platforms commonly utilised in professional contexts. This deficiency in exposure to digital environments further undermines their preparedness to integrate into remote or technology-enhanced workplaces. Consequently, the analysis of these transcripts indicates that the limited opportunities for practical application and collaboration represent significant barriers to students' skill development. Their inability to practise with advanced tools, engage in digital teamwork, and participate in internships or global networking results in a learning experience that is disconnected from the demands of a posthuman workforce. This theme accentuates the urgent necessity for interventions that bridge the gap between theoretical learning and real-world technological engagement.

5. Discussion of Findings

This section discusses the study's findings by integrating them with existing literature and theoretical perspectives. The discussion not only confirms how the barriers identified in the data align with or deviate from previous studies but also demonstrates how the Technology Acceptance Model (TAM), Van Dijk's Digital Divide Model, and Sen's Capability Approach elucidate the implications of these findings.

The study identified that limited digital infrastructure and unstable internet connectivity significantly hinder rural students' access to educational resources essential for the development of skills required in a posthuman workforce. The participants' accounts of inadequate Wi-Fi, high mobile data costs, and electricity outages reveal structural barriers that consistently disrupt their engagement with digital learning. Similar findings have been reported by Chisango et al. (2020), who noted that rural South African universities encounter persistent infrastructural inadequacies that impede students' opportunities for digital learning. Globally, Perrin (2019) and UNESCO (2020) observed that rural learners often experience the digital divide more acutely, resulting in inequitable learning outcomes compared to their urban counterparts. These infrastructural constraints, as elucidated by Van Dijk (2006, 2020), represent "material access" and "usage" barriers within the digital divide model, as they restrict both the availability and practical application of technology. From the perspective of TAM, when technology use is constrained by unreliable connectivity, students' perceptions of its usefulness diminish, subsequently affecting their acceptance and engagement with it (Venkatesh & Davis, 2000). Additionally, Sen's Capability Approach (1999) posits that even when students exhibit motivation, the absence of supportive conditions limits their capacity to convert available resources into meaningful learning outcomes. Consequently, this finding demonstrates how infrastructural deficits systematically disadvantage rural students by diminishing their agency and preparedness to participate in the posthuman workforce.

The study revealed that insufficient access to modern learning tools restricts students' ability to develop digital literacy and practical competencies essential for future employment. The data highlighted outdated computer laboratories, the absence of licensed software, the lack of personal laptops, and institutional constraints as barriers preventing students from gaining direct experience with contemporary technologies. These findings resonate with the work of Ajani (2025) and Scherer et al. (2019), who demonstrated that access to updated learning technologies is a critical determinant of students' confidence and proficiency in using digital tools. Similar observations by Teo (2011) suggest that students' adoption of technology is heavily influenced by the availability and functionality of devices, as posited in the Technology Acceptance Model (TAM). Furthermore, Van Dijk's model reinforces this finding by linking the lack of modern tools to a "skills gap," whereby students are unable to acquire the competencies necessary for advanced digital use (van Dijk, 2006). Sen's Capability Approach also supports this interpretation, as students' ability to transform educational resources into actual capabilities is severely constrained by inadequate technological infrastructure (Robeyns, 2005; Zheng & Walsham, 2008). Thus, the lack of access to modern tools not only limits the acquisition of digital skills but also perpetuates structural inequalities that hinder students' future employability in technologically advanced industries.

It was discovered that reduced exposure to emerging technologies significantly limits rural students' preparedness to thrive in a posthuman work environment. The findings indicate that students rarely interact with advanced tools such as AI-based applications and cloud computing, often resorting to self-directed learning through informal means, such as YouTube. This lack of structured exposure to technological trends aligns with studies by Boateng (2024) and Chetty (2017), which highlight how the absence of engagement with cutting-edge tools leads to skill deficits and anxiety regarding workplace demands. Furthermore, the participants' experiences of being excluded from technology events and career expos reflect geographic isolation, a barrier widely noted in studies of African

higher education (Kamutuezu et al., 2021). From a theoretical perspective, the Technology Acceptance Model (TAM) underscores that limited exposure diminishes perceived ease of use and perceived usefulness, both of which are crucial for technology adoption (Venkatesh & Davis, 2000). Van Dijk's model further frames this as a "usage gap," wherein, even when devices are available, the lack of opportunities to use emerging tools restricts advanced digital engagement (van Dijk, 2020). Sen's Capability Approach reinforces this argument by illustrating that without exposure, students lack the "capabilities" to translate their learning into competitive skills (Sen, 1999). Therefore, this finding confirms that exposure to emerging technologies is critical for preparing rural students for future labour markets where digital fluency and adaptability are highly valued.

The study further elucidated that limited opportunities for practical application and digital collaboration undermine students' competence and confidence in technology-driven environments. Participants indicated that the majority of their learning was theoretical, characterised by outdated methods, minimal internships, and restricted use of digital collaboration tools. These findings align with Kolb's (2015) observation that practical engagement is essential for deep learning, and with Aruleba and Jere (2022), who noted that rural students' employability suffers when practical training is scarce. Moreover, the experiences of participants ST7 and ST1 regarding limited exposure to platforms such as Zoom or Teams resonate with the findings of Scherer et al. (2019), who reported that familiarity with digital collaborative tools significantly influences students' readiness for remote work environments. Theoretically, the Technology Acceptance Model (TAM) elucidates that without frequent practical interaction, students may perceive digital tools as difficult to use, which may discourage their adoption (Teo, 2011). Van Dijk's digital divide framework situates this issue as both a "skills" and "usage" barrier, indicating that without practice, rural students are unable to progress beyond basic technology use to advanced, productive engagement. Sen's Capability Approach (1999) also reinforces this perspective, as the absence of practical experiences diminishes students' ability to convert educational opportunities into valuable real-world skills. Consequently, this finding underscores that bridging the rural-urban divide in digital collaboration and practical training is crucial for empowering students to function effectively in the posthuman workforce.

6. Inductive and Deductive Conclusion

From the analysis of participants' narratives, the study inductively concludes that rural university students encounter a convergence of infrastructural, institutional, and socio-economic barriers that significantly restrict their access to digital resources and limit their preparedness for the posthuman workforce. The findings reveal that poor internet connectivity, unstable electricity supply, outdated learning tools, and limited exposure to emerging technologies collectively undermine students' confidence and capability to engage with technologically advanced learning environments. These challenges are not merely technical but also experiential, as students are deprived of practical engagement with digital tools and collaborative platforms essential for developing crucial competencies. Consequently, rural students remain at a disadvantage when competing in a labour market increasingly characterised by automation, artificial intelligence, and global connectivity.

Drawing on the Technological Acceptance Model, Van Dijk's Digital Divide Model, and Sen's Capability Approach, the study deductively confirms that students' preparedness for the posthuman workforce is determined by the interplay between access, perceptions, and capabilities. The Technological Acceptance Model elucidates how infrastructural deficits and limited exposure adversely influence students' perceived ease of use and usefulness of digital tools, thereby reducing adoption and engagement. Van Dijk's framework situates these barriers within multiple layers of the digital divide—material, skills, and usage—while Sen's Capability Approach highlights that even when resources are available, contextual limitations restrict students' ability to transform them into meaningful learning achievements. These theoretical perspectives collectively demonstrate that addressing preparedness for the posthuman workforce necessitates interventions that extend beyond

the mere provision of technology to also include the enhancement of skills, perceptions, and contextual support systems.

6.1 Recommendations

Based on the findings, this paper recommends that higher education institutions catering to rural students prioritise investments in digital infrastructure, including reliable campus Wi-Fi, alternative power solutions, and expanded computer laboratory facilities. Institutions should also implement structured programmes to expose students to emerging technologies through workshops, technology-driven internships, and partnerships with industry stakeholders. Furthermore, integrating advanced digital collaboration tools into teaching practices and providing ongoing digital training for lecturers will ensure that both educators and students are better equipped for a technology-driven environment. Policymakers should consider targeted funding and policy frameworks that specifically address the unique challenges faced by rural universities, thereby ensuring equitable access to resources and opportunities. Finally, students should be supported through initiatives that build their confidence and capabilities, enabling them to navigate and thrive in the evolving workforce.

7. Declarations

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References

Bhorat, H., Signé, L., Asmal, Z., Monnakgotla, J., & Rooney, C. (2023, May). Digitalisation and digital skills gaps in Africa. *Brookings Institution.* https://www.brookings.edu/articles/digitalization-and-digital-skills-gaps-in-africa-an-empirical-profile/

Braidotti, R. (2019). *Posthuman knowledge*. Polity Press.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in* Psychology, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Chetty, K. (2017). *Bridging the digital divide: Skills for the new age*. Global Solutions Initiative.

Chisango, G., Marongwe, N., Mtsi, N., & Matyedi, T. E. (2020). Teachers' perceptions of adopting information and communication technologies in teaching and learning at rural secondary schools in Eastern Cape, South Africa. *Africa Education* Review, *17*(2), 1–19. https://doi.org/10.1080/18146627.2018.1491317

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications.

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

Denzin, N. K., & Lincoln, Y. S. (2018). *The Sage handbook of qualitative research* (5th ed.). Sage Publications.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied* Statistics, *5*(1), 1–4. https://doi.org/10.11648/j.ajtas.20160501.11

Heeks, R. (2021). From digital divide to digital justice in the Global South: Conceptualising adverse digital incorporation. *arXiv Preprint* arXiv:2108.09783.

Kamutuezu, E. U., Winschiers-Theophilus, H., & Peters, A. (2021). An exploration of factors influencing the adoption of ICT enabled entrepreneurship applications in Namibian rural communities. *arXiv Preprint* arXiv:2108.09789.

Kemmis, S., McTaggart, R., & Nixon, R. (2014). *The action research planner: Doing critical participatory action research*. Springer.

Kolb, D. A. (2015). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Boateng, G. (2024). Leveraging AI to advance science and computing education across Africa: Challenges, progress, and opportunities. In *Artificial intelligence in education: The intersection of technology and pedagogy* (pp. 205–222). Cham: Springer Nature Switzerland.

Kvale, S., & Brinkmann, S. (2015). *InterViews: Learning the craft of qualitative research interviewing* (3rd ed.). Sage Publications.

Le Grange, L., & Du Preez, P. (2023). Curriculum studies in the posthuman condition/posthuman curriculum (studies). *South African Journal of Higher* Education, *37*(5), 60–77. https://doi.org/10.20853/37-5-5985

Lukose, J., & Agbeyangi, A. (2024). Enhancing ICT literacy and sustainable practices in the hospitality industry: Insights from Mnquma Municipality. *arXiv preprint arXiv:2410.02781*.

Mertens, D. M. (2019). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. Sage Publications.

Aruleba, K., & Jere, N. (2022). Exploring digital transformation challenges in rural areas of South Africa through a systematic review of empirical studies. *Scientific* African, *16*, e01190. https://doi.org/10.1016/j.sciaf.2022.e01190

Omodan, B. I. (2023). Analysis of connectivism as a tool for posthuman university classrooms. *Journal of Curriculum Studies Research, 5*(1), 1–12. https://doi.org/10.46303/jcsr.2023.2

Reason, P., & Bradbury, H. (2008). *The Sage handbook of action research: Participative inquiry and practice* (2nd ed.). Sage Publications.

Robeyns, I. (2005). The capability approach: A theoretical survey. *Journal of Human Development, 6*(1), 93–114. https://doi.org/10.1080/146498805200034266

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

Sen, A. (1999). *Development as freedom*. Oxford University Press.

Snaza, N., Appelbaum, P., Bayne, S., Carlson, D., Morris, M., Rotas, N., ... & Weaver, J. A. (2014). Toward a posthuman education. *Journal of Curriculum* Theorising, *30*(2), 39.

Du Preez, P., Maistry, S., & Simmonds, S. (2023). Posthumanist curriculum studies and post-schooling: Contemplations from the South. *South African Journal of Higher* Education, *37*(5), 1-3. https://dx.doi.org/10.20853/37-5-6129

Šumak, B., Heričko, M., & Pušnik, M. (2011). A meta-analysis of e-learning technology acceptance: The role of user types and e-learning technology types. *Computers in Human* Behaviour, *27*(6), 2067-2077. https://doi.org/10.1016/j.chb.2011.08.005

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers &* Education, *57*(4), 2432–2440. https://doi.org/10.1016/j.compedu.2011.06.008

Van Dijk, J. A. (2006). Digital divide research, achievements, and shortcomings. Poetics, *34*(4-5), 221-235. https://doi.org/10.1016/j.poetic.2006.05.004

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management* Science, *46*(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Zheng, Y., & Walsham, G. (2008). Inequality of what? Social exclusion in the e-society as capability deprivation. *Information Technology & People, 21*(3), 222–243. https://doi.org/10.1108/09593840810896000

Zwane, S. A., & Mudau, P. K. (2023). Student teachers' experiences of open distance e-learning support in a posthuman era: A learner engagement perspective. *Journal of Curriculum Studies* Research, *5*(1), 13-33. https://doi.org/10.46303/jcsr.2023.3