

The Impact of Digital Technologies on Higher Education in South Africa

Everjoy Chipo Makazhe

Department of Auditing, Faculty of Economics and Financial Sciences, Walter Sisulu University, Mthatha, South Africa

<https://orcid.org/0009-0000-6644-8893>

Corresponding author: emakazhe@wsu.ac.za

Abstract. Digital technologies are revolutionising higher education and reshaping institutional operations, including teaching and learning in South Africa and across the globe. In South Africa, the COVID-19 pandemic accelerated the process, forcing most Higher Education Institutions (HEIs) to adopt hybrid learning models as an alternative to traditional face-to-face approaches. Using a qualitative research paradigm, this contextual study examines the position of digital technologies as change-agents for the South African higher education system. The study utilizes content analysis to explore the benefits and limitations of employing digital technologies. Findings reveal that digital technologies have contributed immensely to teaching and learning by streamlining things, offering better access to educational materials, lowering the cost of operation, and improving education quality in general. Despite having such advantages, there are several unresolved issues, i.e., inadequate digital infrastructure, uneven deployment of dependable internet and devices, variation in digital competency among students and staff, and concerns about honesty in virtual exams. These issues are significant hurdles to realizing the benefits of digitalization in higher studies. In order to address these issues, the study recommends that HEIs emphasize digital inclusion through the growth of infrastructure, improved access to the internet, and ongoing digital literacy skills for students and employees. It also emphasizes the importance of developing efficient online examination strategies and policies for academic integrity. The study concludes that effective digital transformation in South African tertiary education calls for action from all the stakeholders involved in developing a digitally empowered ecosystem that enables all stakeholders with the necessary skills, tools, and support needed to thrive in the 21st century.

Keywords: Digital technologies, higher education, transformative, South Africa, digitalisation.

1. Introduction

Quality education is a crucial element of the United Nations' 2030 Agenda for Sustainable Development, aimed at providing equitable and inclusive educational experiences for all students. Digital technologies have emerged as essential tools to achieve this goal. According to Kumar et al (2022), information technology (IT) has become a key driver of educational reforms, facilitating the dissemination of shared knowledge. In an era dominated by technology, especially with the advent of Industry 4.0, it is vital to harness the full potential of IT (Makazhe & Maramura, 2024). Digital technologies can revolutionise higher education by offering new possibilities for enhancing teaching, learning and administrative processes (Parveen & Ramzan, 2024). The growing demand

for education and the systemic problems experienced by schools in South Africa necessitate the incorporation of widespread innovative technologies into everyday teaching methodologies (Mouton et al., 2013).

The essence of digital tools spans beyond increasing access to education but also promoting geographical, socioeconomic and resource equity. Technologies such as Learning Management Systems (LMS), virtual classrooms and artificial intelligence (AI) driven tools have redefined education by changing how students engage with content, instructors and peers. Like many other countries, South Africa is seeing and exploring the transformative impact of digital technologies on higher education. This impact presents significant opportunities to meet the country's developmental obligations and to build a dynamic and creative economy and society (Landa, Zhou & Marongwe 2021). In recent years, South Africa's higher education sector has undergone considerable transformation, with the COVID-19 epidemic accelerating the digitisation of education, leading to a widespread and revolutionary shift towards online learning (Sharlovych, Vilchynska, Danylyuk, Huba & Zadilska, 2023). This paper explores the ongoing application of digital technologies, their opportunities and challenges and the possible future direction of a digitally transformed higher education sector in South Africa. While a growing number of studies explore the uses of digital technologies in South African higher education, relatively few studies focus on the theoretical implications derived from empirical research or critically examine the relationship between technology, teaching and learning in higher education (Zongozzi, 2021). Integrating multimedia systems into the learning process is an essential aspect of the digital transformation happening in higher education, utilising digital technology to enhance the learning experience, making it more interactive, accessible and efficient (Haleem, Javaida, Qadri & Sumanc, 2022; Klave & Cane, 2024; Ghavifekr & Rosdy, 2015).

1.1 Background

The Fourth Industrial Revolution (4IR) is underway and is driven by technological advancements in artificial intelligence, robotics, the Internet of Things, 3D printing, biotechnology and nanotechnology (Nyagadza, Pashapa, Chare, Mazuruse & Hove, 2022). These innovations hold the potential to address some of the most compelling socio-economic challenges and offer countries exceptional opportunities to progress. Recent advancements in computer technologies have significantly transformed how education is delivered worldwide and how institutions adapt to these changes for students. In the academic context, digital technologies encompass e-learning tools and systems such as Learning Management Systems (LMS), virtual classrooms, digital libraries and mobile learning applications (Mhlanga, 2020). These innovations have shifted education from a static, in-person format to dynamic and diverse learning modalities, enabling individuals to acquire knowledge anytime and anywhere. Veldhoven and Vanthienen (2022) note that digital technologies change how people work, create, share information, and socialise. In the 4IR era, the nature and speed of this transformation are particularly pronounced. According to Parveen and Ramzan (2024), digital technologies have become integral to daily life and offer different ways of transforming all sectors, including higher education. The use of technology in education worldwide has been influenced by progress in information and communication technologies (ICT), the expansion of the internet reach, and the increasing need for student-focused teaching and learning methods (Haleem et al., 2022; Kalyani, 2015). Beyond delivering content, digital tools enhance learning opportunities, provide personalised feedback, and help students develop the essential digital skills required in today's job market (Chanda, Sain, Shogbesan, Phiri & Akpan, 2024).

Institutions of higher learning must address infrastructure gaps, improve digital skills, and create a welcoming environment that nurtures students and educators to maximise digital technologies (Kanyane, 2023). While digital technologies offer tremendous opportunities for higher education, their adoption is largely mettlesome and fragmented. In South Africa,

the higher education system is included in the discussion of the 4IR, focusing on the impact of building digital technologies on the learning environment (Carrim, 2022). However, the potential for change in these digital technologies has not yet been utilized to tackle the associated challenges effectively. A comprehensive approach incorporating digital and non-digital strategies is essential to address these complex issues (Mhlanga, 2020). According to Christie (2020) South Africa has one of the most underperforming education systems in the world, with persistent inequalities based on race, gender, language, and class that continue to fragment society and impair the country's full social and economic development. Research indicates that while the 4IR has been adopted by South Africa's top higher education institutions, this progress is limited to a small fraction of the nation's 26 public universities (Lubinga, Maramura & Masiyaa, 2023). The higher education sector is key in preparing individuals for a meaningful and constructive life while driving research and innovation to advance the country. However, the higher education system faces significant challenges such as decreasing levels of public funding, rising enrolments, high drop-out rates, low throughput rates, and poor performance in terms of equity and quality (Schalkwyk, 2021). In addition, the emerging digital era opens new opportunities and pressures the higher education sector to adapt and transform. Therefore, this study aimed to explore the transformative impact of digital technologies on South African higher education, offering a unique and important contribution to the existing body of knowledge on digital technology transformation in higher education in this sector.

1.2. Digital technologies in higher education

Digital technologies are reformulating higher education worldwide, creating the opportunity to amend many facets, such as teaching, research, and administration (McCarthy, McConney, Maor & Cavanaugh, 2023). As technological advancements quicken, institutions increasingly adopt innovative solutions and frameworks to meet changing educational demands, enhance access to quality education, and equip students with the skills needed in a digital-first economy (Moloi & Salawu, 2020). The term "digital technologies" can be defined in several ways. Tulinayo, Ssentume, and Najjuma (2018) define digital technologies as a broad spectrum of tools, services, applications, and hardware/software combinations that enable the electronic creation, storage, processing, transmission, and display of information services or activities. Aldhafeeri and Male (2020) define it as multipurpose equipment or gadgets connected to the internet, especially to portable, hand-held devices like smartphones and tablets. This concept includes various digital tools and resources, such as online, virtual, and e-learning platforms (Haleema et al., 2022). It also encompasses digital devices, programs, and tools that radically change how higher education institutions facilitate teaching and learning. Activities that institutions undertake to provide learning opportunities, such as curriculum design, student admissions, support services, teaching, assessment, student experience, governance, and administration, are integral to higher education teaching and learning (Tien, Ngoc, Trang, Duc & Mai, 2022). Nikou and Aavakare (2021) suggest that while digital technologies can potentially transform higher education radically, the exact form of this new educational paradigm is unclear. Undeniably, foreseeing the future form of higher education is intricate. It is increasingly evident that higher education will not only change but will likely be disruptive in nature and will impact the structure and operations of existing institutions. HEIs face increasing social, political, and economic pressure to change (Chaka, 2022). Digital technologies offer a means to innovate and provide a new direction for changing higher education for the public good. As such, digital technologies are increasingly being seen as enablers of change for higher education (Alenezi, 2023). This paper focuses on digital technology-enabled change or innovation in higher education.

1.3 Statement of the problem

Despite the recognised potential of digital technologies to transform higher education, South African universities face significant challenges in fully integrating these

technologies into their educational systems (Manda & Dhaou, 2019). Lufungulo, Mulubale, Mambwe, and Mwila (2023) state that these challenges range from infrastructure limitations and digital skills gaps among educators and students to issues of equitable access and effective pedagogical integration. There is an urgent need to understand how technology can be strategically used to improve learning outcomes, enhance access, and meet the diverse needs of students in South Africa. This requires an inclusive examination of the current situation, impacts, and potential strategies for digital transformation in the higher education sector (Mtshali, Maistry, & Govender, 2020). Moreover, the rapid pace of technological advancement necessitates incessant adaptation and innovation in educational practices, presenting challenges for universities aiming to remain relevant and competitive in the global education landscape (Rodríguez-Abitia & Bribiesca-Correa, 2021). This study examines the current state, transformative effects, and implementation strategies of digital technologies in South African higher education, eventually seeking to inform more inclusive and sustainable efforts for digital transformation.

1.4 Objectives

- To examine how digital technologies have transformed teaching, learning, and institutional operations in South African Higher Education Institutions (HEIs).
- To identify the key challenges associated with adopting digital technologies in South African HEIs, focusing on digital access, digital literacy, and assessment integrity.
- To explore the opportunities and benefits brought about by the integration of digital technologies in higher education, including improvements in accessibility, efficiency, and educational quality.

2. Theoretical keystones: Connectivism theory

Theories have influenced educators' perspectives on the learning process, shaping their teaching approaches. These learning theories reflect diverse views on the nature of knowledge and the learning processes. Prominent learning theories, such as behaviourism, cognitivism, constructivism, constructionism, and connectivism, influence contemporary discussions about technology integration. This study adopts connectivism as its guiding framework due to its relevance to digital technologies. George Siemens introduced connectivism in 2004, characterising it as a new theory of learning significantly impacted by technology (Mhlanga, Denhere & Moloji, 2022). According to Abad-Segura, Gonzalez-Zamar, Infante-Moro, and Garcia (2020), connectivism theory offers a novel perspective on supporting online learning in an ever-changing digital environment. The theory highlights how internet technologies open new avenues for teaching and learning and facilitate information exchange on the global web.

The connectivism theory posits that learning happens through networking as people in online or virtual learning environments share their interests, knowledge, viewpoints, expertise, and opinions (Kropf, 2013). This thinking underscores the role of technology in modern education, illustrating how digital platforms enable students to access, exchange, and co-create knowledge in unprecedented ways. The theory emphasizes the interconnectedness of information and the role of digital networks in learning. The theory was explicitly used to determine the most key challenges of applying digital technologies in South African HEIs across digital access, digital literacy, and examination integrity. In addition, the theory was used to analyze the potential and benefits generated by the convergence of digital technologies in higher education, including improvements in accessibility, efficiency, and quality of education. This, therefore, makes it an ideal framework for examining the transformative impact of digital technologies on higher education in South Africa. Specifically, this theory is used to determine the key challenges associated with adopting digital technologies in South African HEIs.

3. Methodology

This study adopted an interpretive approach and employed a qualitative methodology. As noted by Pathak, Jena & Kalra, (2013), qualitative research involves collecting and analysing non-numerical data such as text, audio, or video, to gain insights into various ideas, perspectives, and experiences. The study relied on documentary and conceptual analyses of credible sources as secondary evidence to explain and contextualise the impact of digital technologies in HEIs.

3.1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

This study adopted an interpretive paradigm and used a qualitative research methodology, focusing on conducting a systematic literature review guided by the PRISMA framework. According to Trifu, Smîdu, Badea, Bulboacă, & Haralambie (2021), PRISMA facilitates the reporting of techniques and results in systematic reviews with adequate detail, enabling users to evaluate the reliability and relevance of the findings (Figure 1). The interpretivist approach was appropriate for exploring the complex, context-specific experiences and meanings associated with digital transformation in South African HEIs. Peer-reviewed journal articles, government and institutional reports, policy briefs, and academic books published between 2015 and 2024 were used. The inclusion criteria were keywords: relevance to digital transformation in HEIs, focus on the South African context (or comparable African/global contexts where appropriate) and publication in reputable academic or institutional platforms. Databases such as Google Scholar, Scopus, EBSCOhost and ScienceDirect were used to retrieve relevant materials. Search terms included: ‘digital transformation in higher education’, ‘South Africa’, ‘online learning’, ‘hybrid learning’, ‘digital inclusion’, ‘e-learning’ and ‘educational technology’. The study was contextual, aiming to synthesise existing literature findings to understand better the transformative role of digital technologies in teaching, learning and institutional management. The PRISMA flow diagram was used to document the literature identification, screening, eligibility, and inclusion processes to ensure transparency and methodological rigour. The final set of sources, 20 journals, was subjected to thematic analysis, focusing on recurring concepts, challenges, and strategies related to digital transformation. This approach consolidated diverse perspectives and provided a comprehensive overview of the state and impact of digital technology in South African HEIs.

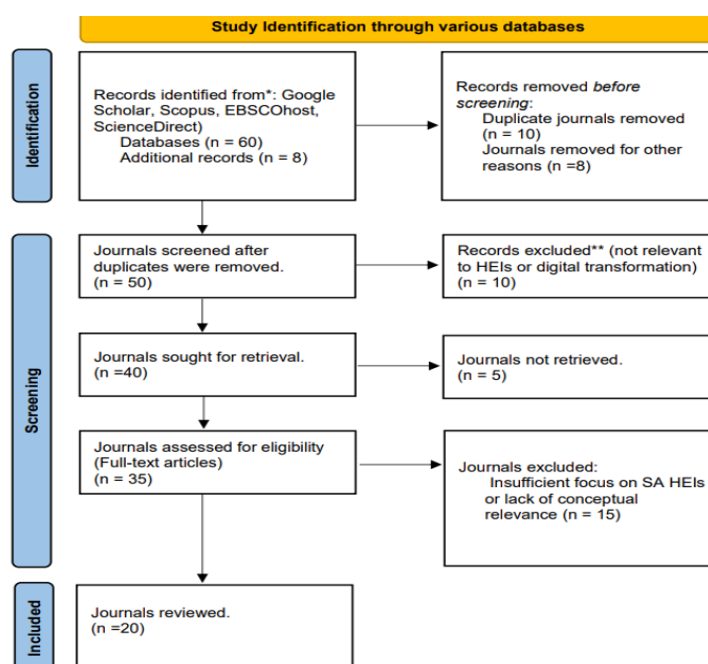


Figure 1: PRISMA 2020 flow diagram for new systematic reviews

4. Findings

4.1 Transformation of Higher Education Institutions by Digital Technologies

The integration of digital technologies has started a profound transformation within South African Higher Education Institutions, affecting pedagogical approaches, learning methodologies, and the very operational fabric of these institutions (Mhlanga et al., 2022). Adopting online learning platforms signifies a remarkable shift, enabling institutions to extend their reach to students beyond geographical constraints (Blaschke, 2015). According to Alenezi (2023), the digital revolution in higher education has initiated a wealth of resources beyond traditional textbooks, as students can now access interactive simulations, multimedia content, and international databases at their fingertips. Learning management systems (LMS), data analytics, and artificial intelligence reshape pedagogy, student experience, educator roles, and institutional learning (Qolamani & Mohammed, 2023). The shift towards digital technologies has altered teaching and learning and greatly impacted the operational aspects of South African HEIs. Administrative tasks such as admissions, registration, and financial aid are now streamlined through online portals, reducing paperwork and improving productivity. Data analytics tools provide valuable insights into student performance, enabling institutions to identify at-risk students and provide targeted support (Ngcamu, 2019). These transformations provide significant benefits in access, efficiency, and educational quality. However, they also emphasise the need for ongoing investment in digital infrastructure, capacity building for staff and students, and inclusive policies to ensure equitable access across various institutional contexts.

4.2. Challenges of implementing digital technologies in South Africa

Educators face significant pressure to implement e-learning strategies, yet these efforts are usually insufficiently supported. Many institutions have inadequate structures to provide the necessary support for staff and students integrating digital technologies into teaching and learning (Johnson, Jacovina, Russell, & Soto, 2016). According to Gaigher, le Roux, and Bothma (2016), some entrenched traditional practices in academia, like expensive commercial textbook publishing services, mitigate against the practical implementation of meaningful digital technologies. These hindrances underscore the need to transform South African higher education institutions for the digital age in what has been termed knowledge leadership (Lumadi, 2024). Research within South African higher education institutions has identified a few challenges that institutions are currently experiencing when implementing digital technologies in learning and teaching approaches (Preez & Grange, 2020).

There seems to be a disregard for the inequality and unfairness existing in our country regarding the digital divide, as evidenced by the sluggish attempts of educational institutions to deploy computer systems aimed at addressing low levels of computer literacy among students (Mercade & Gairin, 2020). Johnson et. al. (2016) state that the progress of integrating digital technologies in teaching and learning is thwarted by limited access to fundamental resources. In South Africa, access to technology and reliable internet connectivity remains unbalanced, with many communities, particularly schools in remote areas, struggling with limited internet access and occasional electricity shortages. As a result, these groups are at risk of being barred from the educational sector's digital revolution (Mkhonto & Mubangizi, 2024). According to Ndebele, Muhuro & Nkonki (2016), the effects of apartheid are still evident decades after the attainment of democracy, as students at historically black universities, which are primarily found in rural areas, experience isolation, neglect and inadequate resource allocation. Many educators and students struggle to acquire the fundamental digital literacy skills needed to use digital tools efficiently (Parveen & Ramzan, 2024). South African universities located in rural areas, particularly those designated as historically disadvantaged institutions, face significant challenges due to their high enrolment of students from low-income families. These institutions, including the University of Venda, University of Fort Hare, University

of Limpopo, Walter Sisulu University, and North-West University, are often reluctant to embrace technology because it is too expensive to enhance teaching and learning (Kanyane, 2023).

Educators must close the digital skills gap to optimise the advantages of digital tools in the classroom. A significant obstacle to the digital revolution of education is the inadequate application of digital policies. Although prioritising students is essential for success in this rapidly changing environment, progress is hampered by the ineffective application and enforcement of university regulations regarding digital platforms (Budiyanto, Latifah, Saputro & Prananto, 2024). This shows that the promise of improved compatibility and smooth integration of digital technology remains elusive without strong plans and regulations to remove obstacles and guarantee compliance. One of the challenges with digital technologies at South African universities is their limited capacity to safeguard student data, raising concerns about information security.

Parveen and Ramzan (2024) state that as technology becomes increasingly integrated into education, safeguarding student privacy and securing data takes precedence. Educational institutions must implement strong security measures to protect private student information and maintain moral principles for gathering, storing and using data. It is important to balance technology's advantages and privacy issues to build trust and preserve a safe learning environment. Despite the global embrace of digital technologies in the education sector, many academic staff members in South Africa still struggle to engage effectively with online teaching and learning platforms (Kanyane, 2023). They often lack the necessary skills, knowledge, and competencies, and unfortunately, there is no specific curriculum or program to help them improve their proficiency with these digital tools. This discourages them from eagerly using digital tools for teaching and learning. A study by Kanyane (2023) highlighted that most academic staff members at a historically disadvantaged higher education institution in Limpopo province were graduates from rural institutions. These staff members are often stereotyped as resistant to change, leading to a reluctance to adopt digital technologies.

4.3. Linking the challenges to connectivism theory.

The challenges encountered in implementing digital technologies in higher education can be linked to connectivism theory. Introduced by George Siemens in 2004, connectivism posits that knowledge is distributed across networks and that meaningful learning connections are formed by individuals who engage with diverse types of information (Hendricks, 2019). In South Africa, many students rely on phones to study due to limited access to other resources, which contradicts the foundational principles of connectivism. The unequal distribution of digital tools hinders the development of learning networks for students to connect with various sources of information and knowledge (Woldegiorgis, 2022).

A significant challenge lies in the lack of digital infrastructure, especially in rural areas. Universities serving underprivileged populations face intermittent internet access, insufficient digital devices, and a shortage of tech support. Universities in remote regions, like Walter Sisulu University (WSU), struggle with poor internet connectivity and low bandwidth (Songca, Ndebele & Mbodila 2021). These disparities make it difficult for students to relate, which is a fundamental aspect of connectivism, emphasising the importance of connecting people, ideas, and resources in networked learning environments. Lack of regular access to technology can lead to lost opportunities related to collaborative learning, discovery, and connecting with global knowledge networks. Digital technology usage in higher education in South Africa requires addressing structural and attitudinal barriers (Naidoo & Singh-Pillay, 2024). Addressing these challenges could move institutions of higher learning closer to a connectivism model of collaborative and networked learning. Such a teaching method could also be the key to reducing educational inequity in an all-connected and information-rich world and making one realise his or her full potential.

Connectivism theory emphasises the importance of developing skills to explore and utilise networks effectively to enhance one's understanding and knowledge (Kropf, 2013). This is particularly important in the South African educational system, where many students and teachers struggle with basic digital literacy skills. These deficiencies hinder meaningful engagement with online resources, negatively impacting personal learning journeys and knowledge sharing within educational communities and ultimately affecting overall productivity. Connectivism suggests that learners interact with networks to gain diverse perspectives and access knowledge sources, where individuals interact with diverse perspectives and sources by sharing interests, knowledge, viewpoints, ideas, and expertise in online or virtual learning environments. This suggests that learning today occurs through network connections (Dunaway, 2011). However, educational institutions in South Africa, particularly those in rural areas, face significant challenges, such as costly technology and strict regulations. These barriers limit their participation in learning networks, resulting in fewer opportunities for collaboration, innovation, and access to information.

4.4. Opportunities of digital technologies in teaching and learning

The implementation of digital technologies and the evolving conceptual approaches are expanding the scope and accessibility of university education. Currently, university study is no longer limited to young individuals with the time, resources, and academic ability to undertake a full-time campus-based study (Khoza & Mpungose, 2020). Lourens, Newaskar, Sathyamurthy, and Timijerselwan (2022) posit that e-learning enables part-time learning, flexible learning times and repurposed study spaces, an important consideration in South Africa with its mediocre pass rates, extended periods of study, and limited economic opportunities post-matric. It also encourages remedial instruction, access to resources, enhancing access to cutting-edge developments outside the university, and transition or second-chance outreach programs on university campuses. One can provide educational resources through various methods, including digital learning. Digital platforms like Google Classroom increase student access to education and learning engagement. By using these tools, students become active learners and offer insightful feedback based on the knowledge and abilities they acquire (Nurtayeva et al., 2024). According to Lubinga et al. (2023) Dr Maths' project by the Council for Scientific and Industrial Research provides South African students with personalised, real-time human teaching support in mathematics, automated topic recognition, and language clarification. This initiative is one of the key benefits of digitalisation.

Several higher education institutions in South Africa have embraced automation to enhance the quality, speed, and agility of their services. For example, at the University of Pretoria, customers can now apply for data services, update passwords, and order services across different portfolios, including business systems (UP, 2019). Furthermore, the university offers systems for collaboration and communication through email and mobile devices, as well as support infrastructure systems, such as off-site laptop assistance. Additionally, they provide teaching and learning management systems that facilitate automated marking and classroom technology (UP, 2019). Moreover, institutions actively promote and integrate activities related to the 4IR. For example, in 2021, the University of Johannesburg acquired an intelligent and agile mobile robot called SPOT. This groundbreaking acquisition marked a significant milestone as it was the first for academic institutions in South Africa and Africa. SPOT is capable of navigating challenging terrain at impressive speeds, even when carrying heavy loads (UJ, 2021).

Digitalisation offers more flexible learning schedules, making accommodating family, work, and social commitments easier. Additionally, the need for punctual arrival and departure for exams, commitment to in-person lectures, and reliance on often hectic public transportation are some drawbacks of traditional face-to-face education that are also diminishing (Pillay et al., 2021). HEIs in South Africa are grappling with challenges, complicating their core teaching and learning functions, research, and community

engagement (Valverde-Berrocoso, Ferná'ndez-Sa'nchez, Dominguez & Sosa-Dí'az , 2021). Integrating digital technologies into teaching and learning is widely viewed as a potential solution in our increasingly digital society. According to (Valverde-Berrocoso et al., 2021), despite the expansion of e-learning and various innovations, the extent to which digital technology has transformed teaching and learning in higher education remains limited.

5. Discussion

South African higher education lags behind in the incorporation of digital technologies. Most HEIs experience erratic and poor internet connectivity, especially in rural areas, undermining effective online learning (Makoe & Olcott, 2021). In addition, the cost of digital devices and data is unaffordable to most students, reinforcing social inequalities (Lusigi, 2019). Student and teacher digital literacy remains an urgent concern, since mastery of technology is more than mere access; it is a profound knowledge of digital tools and resources (Wet, 2015). Additionally, entrenched teaching methods are inherently conservative, making it challenging to integrate new technologies into the curriculum. Recognizing the need to teach many students who are not necessarily near campuses, higher education institutions are beginning to incorporate online learning, which is making significant strides in South African higher education (Blaschke, 2012). Most institutions are using digital tools to offer online courses, but internet connectivity, digital literacy, and the best ways to teach online remain challenging (Lembani, Gunter, Breines, & Dalu, 2019). First-year disadvantaged students often find it challenging because they have had less experience with technology-enhanced learning during their secondary education years. This suggests intervention in offering an even playing ground (Serathi & Zogli, 2021). When universities implement digital transformation, consideration of ethical challenges such as data privacy and security is needed to ensure accountability and equitable utilization of technology for educational purposes.

6. Conclusion

The South African higher education sector's digital revolution creates tremendous opportunities and presents immediate challenges. While digital technologies reshape the pedagogic approaches, the administrative tasks, and the broader student experience, they also guarantee greater access, enhanced efficiency, and more responsive, flexible learning environments (Kalyani, 2024). Tools such as e-learning platforms, learning management systems, and data analytics software promise to revolutionize the educational landscape (Rafiq, Iqbal & Afzal, 2024).. However, this transformation is occurring in a climate of harsh imbalances. Past injustices, infrastructural deficits, and illiteracy about digital intelligence persist to limit advancement, particularly among rural and historically disadvantaged institutions. These structural limitations, policy vulnerabilities, and resistance to change hinder the full integration of digital technologies in pedagogy and pedagogic practices (Mabidi, 2024). Also, data protection problems, access imbalances, and staff preparedness are grounds to give precedence to more targeted and participatory interventions. In the framework of connectivism, it becomes clear that accessing digital networks and communicating effectively within them is critical to learning in the modern era. Nevertheless, educators and learners cannot fully engage with these active networks of knowledge without routine access to digital technology and the skill to effectively utilize it (Haleem et al., 2022).

In the years to come, the successful digitalisation of higher education in South Africa will be a complex challenge: one that will invest in infrastructure, develop digital capacities, construct inclusive policies, and create equity-based innovation. By dismantling the systemic obstacles and unlocking the power of digitalisation, institutions can open a road towards a more networked, resilient, and inclusive higher education system.

7. Recommendations

Based on the challenges and opportunities within, as well as the information in the literature reviewed, the following are suggested to guide the digitalisation of South African higher education in a practical, inclusive, and sustainable way:

- Access and inclusion through digital, particularly for township and rural students.
- Explicit guidelines on online assessment conduct, academic integrity, and moderation.
- Enhance Support Systems for Students and Staff

References

- Abad-Segura, E., González-Zamar, M.D., Infante-Moro, J.C. & García, G.R. (2020). Sustainable Management Of Digital Transformation in Higher Education: Global Research Trends. *Sustainability*, 12, 1-24. <https://doi.org/10.3390/su12052107>.
- Aldhafeeri, F. & Male, T. (2020). Digital Technologies In Higher Education: Learning Challenges. *Encyclopedia of Education and Information Technologies*, 1-8.
- Alenezi, M. (2023). Digital Learning and Digital Institution in Higher Education. *Education Sciences*, 13(88). <https://doi.org/10.3390/educsci13010088>.
- Budiyanto, C., Latifah, R., Saputro, H. & Prananto, A. (2024). The Barriers And Readiness To Deal With Digital Transformation In Higher Education. *TEM Journal*, 13(1), 334-348, <https://dx.doi.org/10.18421/TEM131-35>.
- Carrim N. (2022) 4IR In South Africa And Some Of Its Educational Implications. *Journal of Education*, 86. <https://dx.doi.org/10.17159/2520-9868/i86a01>.
- Chaka, C. (2022). Is Education 4.0 A Sufficient Innovative, And Disruptive Educational Trend To Promote Sustainable Open Education For Higher Education Institutions? A Review Of Literature Trends. *Frontiers In Education*, 7.
- Chanda, T., Zohaib Hassan Sain, Z., Shogbesan, Y., Phiri, E. & Akpan, W. (2024). Digital Literacy In Education: Preparing Students For The Future Workforce. *International Journal of Research*, (8). <https://doi.org/10.5281/zenodo.13347718>.
- Christie, P. (2020). *Decolonising Schools In South Africa: The Impossible Dream?* In T. A. Francis (Ed.). Routledge.
- Dunaway, M.K. (2011). *Connectivism: Learning Theory and Pedagogical Practice for Networked Information Landscapes*. Sage, 675-685. <https://dx.doi.org/10.1108/00907321111186686>.
- Gaigher, S., Le Roux, E., & Bothma, T. (2016). The Effect Of Digital Publishing On The Traditional Publishing Environment. *Essays Innovate*, 8.
- Ghavifekr, S. & Rosdy, W.A.W. (2015). Teaching And Learning With Technology: Effectiveness Of ICT Integration In Schools. *International Journal of Research In Education and Science*, 1(2), 175-191.
- Haleem, A., Javaid, M., Qadri, M.A. & Suman, R. (2022). Understanding The Role Of Digital Technologies In Education: A Review. *Sustainable Operations And Computer*, 3, 275–285.
- Hendricks, G.P. (2019). Connectivism as a Learning Theory and its Relation to Open Distance Education. *Progressio*, 41, 13. <https://doi.org/10.25159/2663-5895/4773>
- Johnson, A.M., Jacovina, M. E., Russell, D. E., & Soto, C. M. (2016). Challenges And Solutions When Using Technologies In The Classroom. In S. A. Crossley & D. S. McNamara (Eds.) *Adaptive Educational Technologies For Literacy Instruction* (Pp. 13-29). New York: Taylor & Francis.
- Kalyani, K.L., (2024).The Role Of Technology In Education: Enhancing Learning Outcomes And 21st Century Skills. *International Journal of Scientific Research Modern Science and Technology*, 3(4), 5-10.
- Kanyane, M. (2023). *Digital Work – Transforming The Higher Education Landscape In South Africa*. Springer, 150-158. <https://doi.org/10.1007/978-3-031-26490-09>.

- Khoza, S.B. & Mpungose, C.B. (2020). Digitalised Curriculum To The Rescue Of A Higher Education Institution. *African Identities*, 23. <https://doi.org/10.1080/14725843.2020.1815517>.
- Klave, E., & Cane, R. (2024). Digital Transformation Of Higher Education: Integrating Multimedia Systems Into The Study Process. *Environment. Technology. Resources. Proceedings of the International Scientific and Practical Conference*, 2, 168-174. <https://doi.org/10.17770/etr2024vol2.8017>.
- Kropf, D.C. (2013). Connectivism: 21st Century's New Learning Theory. *European Journal of Open, Distance and e-Learning* 16(2), 11.
- Kumar, A., Agrawal, R., Wankhede, V.A., Sharma, M. & Mulat-Weldemeskel, E. (2022). A Framework For Assessing Social Acceptability Of Industry 4.0 Technologies For The Development Of Digital Manufacturing. *ScienceDirect*, 174. <https://doi.org/10.1016/j.techfore.2021.121217>.
- Landa, N., Zhou, S. & Marongwe, N. (2021). Education In Emergencies: Lessons From COVID-19 In South Africa. *Springer*, 67, 167-183. <https://doi.org/10.1007/s11159-021-09903-z>.
- Lembani, R., Gunter, A., Breines, M. R., & Dalu, M. T. B. (2019). The Same Course, Different Access: The Digital Divide Between Urban and Rural Distance Education Students in South Africa. *Journal of Geography in Higher Education*, 44(1), 70. <https://doi.org/10.1080/03098265.2019.1694876>.
- Lourens, M.E. Et Al. 2022. Inclination Of Higher Education Students Towards Medical And Healthcare Start-Ups: An Empirical Study In The Post Covid Scenario. *Neuroquantology: An Interdisciplinary Journal of Neuroscience and Quantum Physics*. 20(7), 2590-2598. <https://doi.org/10.14704/Nq.2022.20.7.NQ33334>
- Lubinga, S., Maramura, T.C. & Masiyaa, T. (2023). Adoption Of Fourth Industrial Revolution: Challenges In South African Higher Education Institutions. *Journal of Culture and Values in Education*, 6(17). <https://doi.org/10.46303/jcve.2023.5>.
- Lufungulo, E. S., Jia, J., Mulubale, S., Mambwe, E., & Mwila, K. (2023). Innovations And Strategies During Online Teaching In An Edtech Low-Resourced University. *Computer Science*, 4(4). <https://doi.org/10.1007/s42979-023-01729-w>.
- Lumadi, R.I. (2024). The Influence And Effects Of Digital Revolution On Africa's Higher Education Systems. *South African Journal Of Higher Education*, 38. <https://dx.doi.org/10.20853/38-3-6370>.
- Lusigi, A. (2019). Higher Education, Technology, and Equity in Africa. *New Review of Information Networking*, 24(1), 1. <https://doi.org/10.1080/13614576.2019.1608576>.
- Mabidi, N. (2024). A Systematic Review Of The Transformative Impact Of The Digital Revolution On Higher Education in South Africa. *South African Journal of Higher Education*, 38. <https://dx.doi.org/10.20853/38-3-6366>
- Makazhe, E.C. & Maramura, T.C. (2024). The Role Of Fourth Industrial Revolution (4IR) Technologies In Achieving Sustainable Development Goals. In *Policies, Methodologies, and Insights in Organizational Management. EEEU 2023. Springer Proceedings in Business and Economics* (pp. 985-998). Springer. <https://doi.org/10.1007/978-981-97-0996-058>.
- Makoe, M., & Olcott, D. (2021). Leadership For Development: Re-Shaping Higher Education Futures and Sustainability in Africa. *Journal of Learning for Development*, 8(3), 487. <https://doi.org/10.56059/jl4d.v8i3.569>
- Manda, M. I., & Dhaou, S. B. (2019). Responding to the Challenges and Opportunities in the 4th Industrial Revolution in Developing Countries. <https://doi.org/10.1145/3326365.3326398>
- Mccarthy, A. M., Maor, D., Mconney, A., & Cavanaugh, C. (2023). Digital Transformation In Education: Critical Components For Leaders Of System Change. *Social Sciences & Humanities Open*, 8(1), 100479.

- Mercade, C. & Gairín, J. (2020). University Teachers' Perception Of Barriers To The Use Of Digital Technologies: The Importance Of The Academic Discipline. *International Journal of Educational Technology in Higher Education*, 17(4), 14. <https://doi.org/10.1186/s41239-020-0182-x>
- Mhlanga, D. (2020). Industry 4.0: The Challenges Associated With The Digital Transformation Of Education in South Africa. *Springer*, 12-24.
- Mhlanga, D., Denhere, V. & Moloi, T. (2022). COVID-19 And The Key Digital Transformation Lessons For Higher Education Institutions In South Africa. *Education Sciences*, 12, 1-12. <https://doi.org/10.3390/>
- Mkhonto, B., Mubangizi, B., (2024). Digital Divide Or Digital Bridge? Evaluating The Impact Of ICT Integration In South Africa's Rural Schools. *International Journal of Social Science Research and Review*. 7(7). <http://dx.doi.org/10.47814/ijssrr.v7i7.2142>.
- Moloi, T., & Salawu, M. (2020). Institutionalizing Technologies In South African Universities: The Imperatives In The Fourth Industrial Revolution Era.
- Mouton, N., Louw, G. P., & Strydom, G. (2013). Critical Challenges Of The South African School System. *International Business & Economics Research Journal*, 12, 14.
- Mtshali, M. A., Maistry, S. M., & Govender, D. W. (2020). Online Discussion Forum: A Tool To Support Learning In Business Management Education. *South African Journal of Education*, 40(2), 1. <https://doi.org/10.15700/saje.v40n2a1803>.
- Naidoo, J., & Singh-Pillay, A. (2024). Social Justice Implications Of Digital Science, Technology, Engineering And Mathematics Pedagogy: Exploring A South African Blended Higher Education Context. *Springer*, 1-27. <https://doi.org/10.1007/s10639-024-12813-w>
- Ngcamu, B. S. (2019). Digitalizing South African Universities: Exploring Benefits, Barriers And Risks. In Intechopen Ebooks. *Intechopen*. <https://doi.org/10.5772/intechopen.86693>
- Ndebele, C., Muhuro, P. & Nkonki, V. (2016). Rurality And The Professional Development Of University Teachers. *South African Journal Of Higher Education*, 30(19). <https://dx.doi.org/10.20853/30-6-728>
- Nikou, S. & Aavakare, M. (2021). An Assessment Of The Interplay Between Literacy And Digital Technology In Higher Education. *Education and Information Technologies*, 26, 3893–3915. <https://doi.org/10.1007/s10639-021-10451-0>.
- Nurtayeva, D., Kredina, A., Kireyeva, A., Satybalidin, A. & Ainakul, N. (2024). The Role Of Digital Technologies In Higher Education Institutions: The Case Of Kazakhstan. *Problems and Perspectives in Management*, 22(1), 562-577. [http://dx.doi.org/10.21511/ppm.22\(1\).2024.45](http://dx.doi.org/10.21511/ppm.22(1).2024.45).
- Nyagadza, B., Pashapa, R., Chare, A., Mazuruse, G. & Hove, P.K. (2022). Digital Technologies, Fourth Industrial Revolution (4IR) & Global Value Chains (Gvcs) Nexus With Emerging Economies' Future Industrial Innovation Dynamics. *Cogent Economics & Finance* 10, 1-14. <https://doi.org/10.1080/23322039.2021.2014654>
- Parveen, S. & Ramzan, S.I. (2024). The Role Of Digital Technologies In Education: Benefits and Challenges. *International Research Journal on Advanced Engineering and Management*, 2(9). <https://doi.org/10.47392/irjaem.2024.0299>.
- Pathak, V., Jena, B. & Kalra, S. (2013). Qualitative Research. *Perspectives In Clinical Research*, 3. <https://doi.org/10.4103/2229-3485.115389>.
- Pillay, A., Khosa, M., Sheik, A., Campbell, B., Mthembu, B. & Nyika, N. (2021). How Home Contexts Of South African University Students Shape Their Experiences Of Emergency Remote Teaching And Learning *Student Success*, 12. <https://doi.org/10.5204/ssj.1779>.

- Preez, P.D. & Grange, L.L. (2020). The COVID-19 Pandemic, Online Teaching / Learning, The Digital Divide, and Epistemological Access. *Researchgate*, 18. <https://doi.org/10.29086/978-0-9869936-1-9/2020/aasbs01>
- Qolamani, K. I. B., & Mohammed, M. M. (2023). The Digital Revolution In Higher Education: Transforming Teaching And Learning. *QALAMUNA Jurnal Pendidikan Sosial Dan Agama*, 15(2), 837. <https://doi.org/10.37680/qalamuna.v15i2.3905>.
- Rafiq, S., Iqbal, S., & Afza, A., (2024). The Impact Of Digital Tools And Online Learning Platforms On Higher Education Learning Outcomes. *Al-Mahdi Research Journal (MRJ)*, 5. <https://ojs.mrj.com.pk/index.php/mrj/issue/view/14>.
- Rodríguez-Abitia, G., & Bribiesca-Correa, G. (2021). Assessing Digital Transformation In Universities. *Future Internet*, 13(2), 52. <https://doi.org/10.3390/fi13020052>
- Schalkwyk, F.V. (2021). Reflections On The Public University Sector And The Covid-19 Pandemic In South Africa. *Studies In Higher Education*, 46(1), 44-58. <https://doi.org/10.1080/03075079.2020.1859682>.
- Serathi, M. R. M., & Zogli, L.-K. J. (2021). Perceptions Of First-Year Students From Disadvantaged Backgrounds on e-learning at a South African University of Technology. <https://doi.org/10.25159/unisarxiv/000024.v1>.
- Sharlovyeh, Z., Vilchynska, L., Danylyuk, S., Huba, B. & Zadilska, H. (2023). Digital Technologies As A Means Of Improving The Efficiency Of Higher Education *International Journal Of Information And Education Technology*, 13, 1214-1221. <https://doi.org/doi:10.18178/ijiet.2023.13.8.1923>.
- Songca, R.N., Ndebele, C. & Mbodilai, M. (2021). Mitigating The Implications Of Covid-19 On The Academic Project At Walter Sisulu University In South Africa: A Proposed Framework For Emergency Remote Teaching And Learning. *Journal Of Student Affairs in Africa*, 9(14). <https://doi.org/10.24085/jsaa.v9i1.14277>.
- Tien, N.H., Ngoc, N.M., Trang, T.T.T., Duc, L.D.M. & Mai, N.P. (2022). Sustainable Development Of Higher Education Institutions In Developing Countries: Comparative Analysis Of Poland And Vietnam. *Contemporary Economic*, 16(2), 195-210.
- Trifu, A., Smîdu, E., Badea, O.D., Bulboacă, E., & Haralambie, V., (2021). Applying The PRISMA Method For Obtaining Systematic Reviews Of Occupational Safety Issues In *Literature Search. MATEC Web of Conferences*, 354. <https://doi.org/10.1051/Matconf/202235400052>.
- Tulinayo, F.P., Ssentume, P. & Najjuma, R. (2018). Digital Technologies In Resource Constrained Higher Institutions Of Learning: A Study On Students' Acceptance And Usability. *International Journal Of Educational Technology in Higher Education*, 15, 1-19. <https://doi.org/10.1186/s41239-018-0117-Y>.
- University Of Pretoria. (2019). *UP libraries steps into future as it 'employs' robot to help students*. https://www.up.ac.za/news/post_2814363-up-libraries-steps-into-future-as-it-employs-robot-to-help-students/
- University of Johannesburg. (2021). *UJ The First University In South Africa To Secure AI Robot 'Dog' – SPOT*. <https://news.uj.ac.za/news/uj-the-first-university-in-south-africa-to-secure-ai-robot-dog-spot-2/>
- Valverde-Berrocoso, J.S., Ferná'Ndez-Sa'Nchez, M.A.R., Dominguez, F.I.R. & Sosa-Di'Az, M.A.J. (2021). The Educational Integration Of Digital Technologies Pre Covid-19: Lessons For Teacher Education. *Plos One*, 16(22). <https://doi.org/10.1371/journal.pone.0256283>.
- Veldhoven, Z.V. & Vanthienen, J. (2022). Digital Transformation As An Interaction-driven Perspective Between Business, Society, And Technology. *Springer*, 32, 629-644. <https://dx.doi.org/10.1007/S12525-021-00464-5>.

- Wet, C. D. (2014). Trends In Digital Pedagogies: Implications For South African Universities Expanding Through Hybrid Online Education. *Mediterranean Journal of Social Sciences*. <https://doi.org/10.5901/Mjss.2014.V5n23p859>
- Woldegiorgis, E.T. (2022). Mitigating The Digital Divide In The South African Higher Education System In The Face Of The COVID-19 Pandemic. *Perspectives in Education*, 40(3), 197-211. <https://dx.doi.org/10.18820/2519593X/Pie.V40.I3.13>
- Zongozzi, J. N. (2021). A Concept Analysis Of Theory In South African Open Distance And E-Learning Research. *Open Learning: Journal of Open, Distance and e-Learning*, 36, 149-163. <https://doi.org/10.1080/02680513.2020.1743172>.