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Smart Universities: A Concept Overview of Adoption Challenges for Historically Black Universities in South Africa

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Abstract

Universities today are experimenting with AI and big data to enhance the student experience on campus; however, from a South African perspective, the question is: can historically black universities adapt to this rapidly evolving higher education environment? This paper employed a qualitative research method to answer these questions, and secondary data were sourced from a review of current literature. The paper found that infrastructure challenges, a lack of skills and development, and limited resources were major factors hindering historically black universities from adopting the concept of a smart university. Historically black universities offered minimal, if any, tech-focused courses, which prevented them from acclimating themselves to the elements of the 4IR. The implications have been that historically black universities will struggle to catch up to previously white universities in transitioning their campuses from the traditional model of higher education to the concept of a smart campus.

Keywords: *Higher education, Competitiveness, Development, Technology, Smart campus*

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1. INTRODUCTION

The revolution in higher education is currently underway, and at its core, it represents a significant shift in the role of technology within the university setting. An integral component of this change is the establishment of "Smart Campuses," which involves integrating advanced technological solutions to enhance the quality of education, communication, security, and overall campus life (Hartman Advisors, 2023). The emergence of smart campus technology promotes a highly interconnected, interactive, and intelligent educational setting. The system leverages cutting-edge technologies, including artificial intelligence (AI), Internet of Things (IoT), Chat GPT, big data, and machine learning, to deliver personalized educational experiences, facilitate real-time communication, and streamline administrative processes.

This technological transition enables higher education institutions to respond effectively to evolving student requirements and expectations (Hartman Advisors, 2023). The process of digitizing learning methods, utilizing virtual reality (VR) classrooms, and implementing AI-powered, tailored learning aids is

no longer considered a futuristic idea. Smart campus technology has the potential to completely transform the way institutions operate and provide education, resulting in a more interactive, productive, and inclusive atmosphere.

The apartheid government in South Africa established historically black universities (HBCUs) to cater to black students who were prohibited from attending racially segregated white-only universities (Iilorah, 2006). These institutions received inadequate funding compared to the universities that exclusively serve white students. The insufficient funding had a detrimental impact on their output, namely in research and postgraduate development. Following the abolition of apartheid and segregation at universities, Historically Black Universities (HBUs) face additional challenges alongside the enduring effects of the apartheid era. They continue to get insufficient funding, and the student body primarily consists of individuals from economically disadvantaged and rural backgrounds (Iilorah, 2006). However, with the changing landscape of higher education and the introduction of technology in teaching and learning, debates and arguments have emerged in the higher education domain in South Africa. Central to the argument is whether historically black universities (HBUs) can integrate this technological revolution into their teaching and learning, considering the many structural challenges they face. The advancement of technology has been progressing swiftly over the past few decades, particularly in the realm of information and communication technology (ICT). Information and Communication Technology (ICT) has significantly transformed several areas of society, including business, healthcare, entertainment, and education (Sharma, 2023).

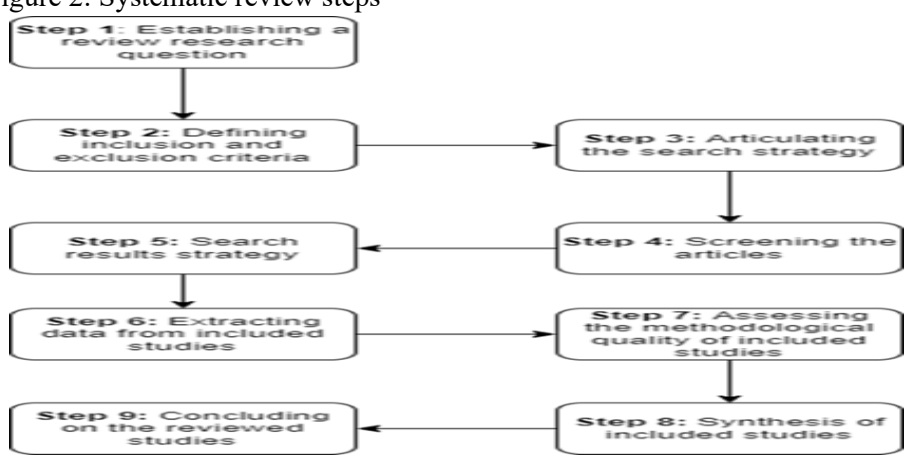
Technology has become a crucial component of higher education in the twenty-first century. According to Sharma (2023), it has revolutionized the methods of student learning, teaching practices, and operational procedures of educational institutions. Technology has created novel opportunities for accessibility, excellence, and ingenuity in higher education. Therefore, this paper examines the concept of a smart university, its components, and the challenges that historically black universities in South Africa face in integrating the components of a smart university into their teaching and learning. The following question guides this paper: What are the benefits of a smart university, and what adaptation challenges can historically black universities in South Africa face in the quest to integrate this concept into their daily operations?

2. MATERIALS AND METHODS

This paper employed a qualitative research approach, utilizing a semi-systematic review method. The growing debate and arguments about the concept of Smart universities in South Africa's higher education landscape have begun to take centre stage in higher education policy debates. While the authors would have preferred an empirical study, time and financial constraints necessitated a semi-systematic literature review, with the aim of carefully synthesizing the literature to draw meaningful conclusions. With the above, the methodology used for this paper, including how articles were found, included, and excluded, is described in this section. In this paper, a systematic literature review research strategy was chosen. According to Davis et al. (2014), referenced in Snyder (2019), conducting reviews transparently and reproducibly is what the systematic literature review as a research method aims to achieve.

Above all, it enables the selection of articles to incorporate or omit from this paper (Snyder, 2019). Unlike the other review strategies, this research strategy enabled the critical evaluation of the information gathered from the included articles. During the process, reliable conclusions can be reached (Moher et al., 2009), as cited in (Snyder, 2019). Furthermore, Gough's (2007b) nine phases of systematic review, as cited in Bearman et al. (2012), were employed in implementing this research strategy. These phases include the following: formulating a review question, specifying inclusion and exclusion criteria, formulating a search strategy, screening articles, disclosing the search strategy's outcomes, extracting pertinent data from included studies, evaluating the methodological quality of included studies, synthesizing included studies, and formulating conclusions from a critical review of the included studies.

Figure 2: Systematic review steps



Source: David Gough (2007b) cited in (Bearman et al., 2012)

The above diagram illustrates how relevant data for this paper were collected. It describes the steps the author undertook to look for the data, link it to the theme of this paper, assess its usability, determine how data was included and excluded, and finally, determine how the collected data was synthesized to consolidate the argument. This paper adhered to the following criteria because the systematic literature review process necessitates knowledgeable and strict inclusion and exclusion criteria of studies in its undertaking:

2.1. Inclusion criteria

1. The databases Scopus, JSTOR, Science Direct, Ebscohost, Elsevier, and Web of Science were searched, and articles were chosen. – Their databases were found to have many articles published on the concept of smart universities in South Africa, hence their usage
2. We chose papers published in peer-reviewed journals between September 2023 and the year 2000. -The debates around smart universities in a 41R era in South Africa's higher education sector began to gain prominence around the year 2000 and have grown considerably over the last three decades, hence the use of these years
3. We only included research articles that were written in English and published; articles written in other languages were not included. Translation from another language other than English would have been time-consuming, hence the authors felt English articles were better suited in this context.
4. We used the following search terms in the aforementioned databases to find articles to include (phase 3)."Smart Universities, The 4IR, Higher education in South Africa, Historically white (Urban) Universities and Historically Black (Rural) Universities, and Technology in Higher education in South Africa. The words were key in helping navigate the plethora of literature available.
5. Nevertheless, the authors also used reliable online news websites to obtain information because there is a dearth of scholarly research on the debates around smart universities in a 41R era in South Africa's higher education sector.

To enhance the literature search, the author went to each of the databases listed above and typed in the keywords used in this paper. This displayed the available publications that related to the keywords. The authors then looked at the abstract to scan for critical arguments in line with the paper's aim. If the abstract presented an argument related to the paper's aim, the author would download the articles and look for similar arguments and debates. Therefore, if

the abstract did not present an argument concerning the debates around smart universities in a 41R era in South Africa's higher education sector, it was not considered. The data collected was thematically analysed.

The authors looked at the keywords of each article concerning the theme and main research question of this paper. After that, similar arguments were grouped together and further analysed through a narrative literature approach. For example, articles that talked about smart universities in South Africa's higher education sector were grouped together. After this, the arguments of these articles were compared to the argument of the paper, thus allowing the authors to identify gaps. Subsequently, this process enabled the paper to draw meaningful conclusions based on the shortcomings of existing published literature.

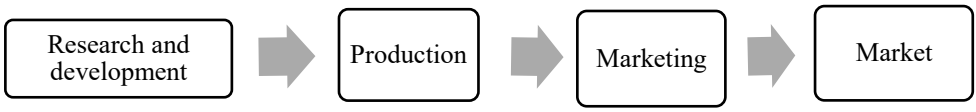
2.2. Exclusion criteria

The sources that did not discuss the debates surrounding smart universities in South Africa's higher education sector were excluded. Sources published prior to 1998 were omitted. The article acknowledges the limitations of the above research method. Firstly, the search was limited to five databases; hence, perhaps, a more comprehensive search of different databases would have yielded more information to help better consolidate the argument of this paper. Secondly, an empirical study employing questionnaires or interviews may have yielded firsthand knowledge, thus consolidating innovativeness and reality in the paper's argument. However, the author analysed the data effectively to ensure innovativeness and uniqueness despite these limitations.

3. THEORETICAL FRAMEWORK

This paper will apply the Technology push theory to further delve into the current debates around smart universities in South Africa's higher education sector. The technology push is a theory that suggests technological advancements drive innovation and growth, with innovation in turn driving market growth and technology driving innovation. This approach pushes technology innovation to the market through production and marketing (Nuñez-Jimenez, Knoeri, Hoppmann, & Hoffmann, 2019). According to Hötte (2023), a Technology Push arises when technological breakthroughs enable the development and commercialization of novelties. The technology push is a term used to describe an approach in which technology innovation is pushed to the market, from internal development through production to marketing (Isoherranen & Kess, 2011).

Figure 1: Technology push technology transfer model

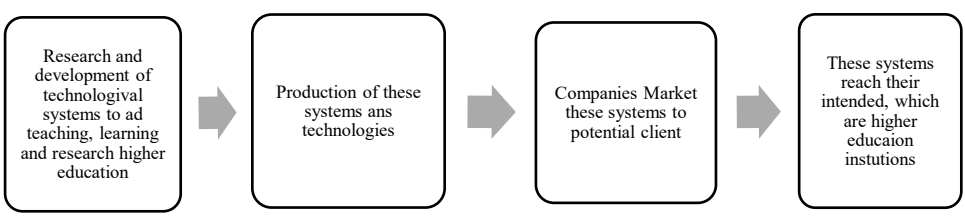


Source: Momcilovic et al. (2013)

Applying the technology push theory within the above context, Momcilovic et al. (2013) explain that the Technology push is a technology-driven approach where an emerging technology or a new combination of existing technologies provides the driving force for an innovative product and/or solution to a problem in the market. The sequence of phases in the technology push strategy is presented in Fig. 1. This strategy is initiated by a discovery or an idea that originates from basic research when the researchers realize the advantages of the new technology. The research and development phase involves designing a new product and creating prototypes for further testing.

After the successful testing, different manufacturing methods are analysed, and the most efficient one is adopted for the final product. Finally, the product is promoted to the market in the marketing phase. In short, technology-push product development is based on the belief that the producer recognizes a market need even before the market does and practically educates the customer. A primary characteristic of this approach is the increasing importance of science in the innovation process and the strong correlations between R&D and innovative output. The diagram below illustrates how the Technology Push Theory can be applied to higher education.

Figure 2: Applying the Technology push theory in higher education



In the context of higher education, several events have disrupted its offerings over the past three decades. Most recently, the novel Coronavirus forced higher education institutions to seek new innovative ways to deliver higher education. The pandemic forced many higher education institutions to close and transition to remote learning. However, it is vital to note that in some countries, especially in the developing world, home learning has never been the focus of institutions of higher learning. Rather, institutions of higher learning have

focused on the traditional way of teaching and learning, which involves face-to-face classes. However, the pandemic forced online learning, which was technologically driven; applications such as Zoom, Microsoft Teams, Moodle, and Blackboard became vital in the push to ensure continuity in the higher education sector in the face of an unrelenting COVID-19 pandemic.

Barakabitze et al. (2019) argue that many universities globally are already embracing 4IR technologies, but most universities in Africa, including South Africa, have not kept pace with this trend, especially HBUs.

3.1. Brief history of higher education in South Africa

During the apartheid era, the system of higher education in the Republic of South Africa was intentionally structured to maintain the dominance and advantages of the white minority in power (Bunting, 2006). The Bantu Education Act of 1952, for instance, guaranteed that black South Africans would receive an education designed to restrict their educational opportunities and, hence, confine them to the labouring class. Case, Marshall, McKenna, and Mogashana (2018) express their dissatisfaction with the development of a two-tier higher education system in the country because of apartheid. The first tier was reserved for the privileged and affluent individuals who had the opportunity to study in institutions that were given priority by the apartheid system from a developmental standpoint. These institutions were characterized by their infrastructure and skilled workforce, and were primarily located in urban areas. The second tier was designed to accommodate the historically marginalized groups, primarily the African population (black South Africans), Indians, and coloureds. They were situated outside the city, faced structural difficulties, and were not seen from the same perspective as their white counterparts (Case et al., 2018). South Africa is home to 11 historically black universities that have significantly contributed to the growth and progress of the country's higher education system. The universities included in this list are: The University of Bophuthatswana, which has recently been renamed the North-West University (NWU); the University of Durban-Westville (UDW); the University of Fort Hare; the Medical University of South Africa (MEDUNSA); the main branch of the University of the North-Turfloop; the University of the North-Qwaqwa; the University of Transkei; the University of Venda (UNIVEN); Vista University; the University of the Western Cape (UWC); and the University of Zululand (UNIZULU) (Badat, Barron, Fisher, Pillay & Wolpe, 1994 in Subotzky, 1997). After the abolition of apartheid in 1994, there were a total of 36 higher education institutions in the country. Out of this total, ten were universities with a history of being disadvantaged, and seven were Technikons with a history of being disadvantaged. These institutions

were specifically intended for the education of black South Africans. On the other hand, ten universities and seven Technikons had a history of being advantaged, and they were designated for the exclusive development of white South Africans. Two remote learning institutions provided education to individuals of various racial backgrounds.

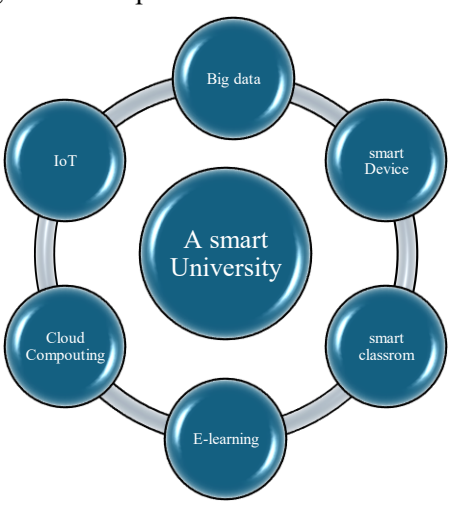
Despite 30 years since the end of apartheid and the establishment of multiparty politics in South Africa, Carolissen and Bozalek (2017:346) argue that the higher education sector, along with other levels of education, remains profoundly influenced by its apartheid history. South Africa boasts 26 state universities, which accommodate a student population of approximately one million. Additionally, over 50 higher education training schools, sometimes referred to as TVET colleges (Technical and Vocational Education and Training), enroll approximately 700,000 students. Various private colleges accommodate an extra 90,000 pupils (Tjønneland, 2017). The founding of the South African College in Cape Town in 1829, catering specifically to those of European origin, marked the initiation of higher education in South Africa. Raju (2006) argues that the apartheid administration effectively established a higher education system that was both intricate and biased. In the 1990s, the higher education system consisted of 21 universities, 15 Technikons, and various colleges, including teacher training colleges, agricultural colleges, and colleges of nursing. During the apartheid era, African students were constitutionally barred from attending the 19 white higher education institutions. Instead, they were only allowed to enrol in six schools that were explicitly designated for their use (Bunting, 2006, pp. 38-40).

Essentially, this policy dictated that black individuals would only be able to pursue higher education in their respective homelands. The colleges in these homelands were specifically designated for each major ethnic group, such as Zulus attending classes with Zulus and Xhosas with Xhosas. Furthermore, a Historically Black University (HBU) was more inclined to provide nursing programs rather than medicine, public administration, or political philosophy. During the apartheid period, research was organized to prioritize the interests of the white population and their desire for security in a continent experiencing numerous wars for independence (Bawa & Mouton, 2001). This segmentation created a dual education system characterized by inequality and injustice. Building on the previous statement, Carolissen and Bozalek (2017:347) contend that the notion of dualism, as exemplified by Plumwood (1993), emerges when two contrasting elements are subsequently ranked hierarchically.

3.2. Smart universities and massification of higher education in South Africa

A Smart University is an educational institution incorporating advanced technology, such as the Internet of Things (IoT) and smart devices, to accomplish its strategic objectives (Mbombo & Cavus, 2021). Technological innovation in computer technology and data systems is the prerequisite for becoming a leading-edge Smart University. E-learning is effective and cost-efficient at all levels, including administrators and executives. Compared to traditional universities, it reduces labour costs. Therefore, smart universities integrate new technology that enables students, teachers, and administrative staff to utilize automated systems and tools (Pornphol & Tongkeo, 2018). A smart university is an educational institution that offers innovative methods of working, studying, and teaching in environments that effectively integrate cutting-edge hardware and software platforms, utilizing large amounts of data, sensors, social media, and machine learning (Barn, 2020). Harris (2022) contends that higher education unites a varied student population under impressive and modern architectural structures. Presently, the expenses associated with obtaining a university degree have reached unprecedented levels. Consequently, students now have higher expectations in terms of both top-notch facilities and exceptional intellectual resources when selecting their educational institution. Given that university campuses function as self-contained micro-societies, serving as places of work, residence, and recreation, there is significant potential for educational institutions to implement smart city-like changes on a smaller scale within their campuses.

Figure 3: Components of a Smart University



Source: Mbombo & Cavus (2021)

The use of technology in higher education has undoubtedly gained ground. This revolution in higher education has promoted higher education institutions to understand how technology works and how it can aid in delivering quality content in the classroom. Globally, there has been a push to transform how higher education content is delivered. This push has been driven by recent observations on how higher education was disrupted because of the COVID-19 pandemic, which exposed the flaws in the traditional way of delivering higher education content (face-to-face classrooms). However, while the changing higher education environment has necessitated the push, one needs to consider resource availability, especially in South Africa, where some universities are more equal than others. Therefore, while the state funds South African universities, there is a need for clear and consistent policies to address the differences and divisions within the South African higher education system, namely between historically white and historically Black universities (Hlatshwayo, 2020). There is an increasing disparity across various higher education institutions within the system. It is necessary to guarantee that students enrolled in different academies have equal access to institutional, epistemological, and curriculum experiences without facing any disadvantages (Hlatshwayo, 2020). However, in South Africa, the massification of higher education has been both a blessing and a curse for South Africa's higher education sector. Massification has caused severe overcrowding in classrooms in historically black universities, which has largely affected the quality of education offered. Unlike previously white universities, which are often located in urban areas, historically black universities are typically situated in rural areas. Because of their rurality, historically, black universities have been seen as more affordable than their white counterparts.

Nevertheless, it is worth noting that the massification of higher education has also been viewed as a positive development by the government since the democratic transition in 1994. University students have increased over two-fold, from 495,348 in 1994 to 1,094,808 in 2020. The increase in enrolment also indicates a notable change in the ethnic composition of university campuses, as Black African students now make up the largest racial group. In 1994, the majority of university students, specifically 221,832 individuals, identified as White (Cloete, 2024). The number of African students enrolled in studies in South Africa's universities was 212,030, while the number of Indian students was 34,010, and the number of Coloured students was 27,496. By 2020, the enrolment of African students in universities had increased fourfold, reaching a total of 862,313 students, while the number of White students decreased to 118,505. There was an increase in the number of Coloured students enrolled at universities,

reaching 61,923 enrolments, while Indian students accounted for 41,262 enrolments.

According to Cloete (2024), the DHET categorized 10,805 students as unknown. These statistics for the government meant that, after inheriting a skewed higher education system, the growth of black enrollment in higher education was a triumph for the government of the day. However, situated in rural areas, historically black universities face an overcrowding issue, which then affects the delivery of quality education. For example, in the US, Carr (2023) noted that when HBCUs receive less funding, it can lead to overcrowded classrooms, outdated technology, and limited course offerings. The disparity in educational quality can perpetuate inequities, particularly in the context of historically Black colleges and universities. According to the Times Higher Education (2024), the COVID-19 pandemic has accelerated the transition towards adopting various learning, teaching, and assessment modes in higher education.

Nevertheless, this has exacerbated South Africa's difficulties, where institutions already grappled with insufficient resources and disparities between employers' requirements and students' competencies before the pandemic. In a constantly changing environment, Nyembe (2023) asserts that higher education institutions are more than simply places of study; they are the driving forces behind societal advancement. Adopting change is crucial, particularly in the face of significant transformations propelled by technological progress. The impact of the Fourth Industrial Revolution and the pressing socioeconomic issues require a profound change in how South African higher education institutions approach teaching and learning methods.

3.3. The use of Technology in South Africa's higher education system

There is a growing consensus in South Africa's higher education system that the country needs to keep pace with international trends that have led to the increasing use of technology in delivering quality content. The increasing use of Information and Communication Technologies (ICTs) has generated significant interest and influence in our everyday lives. However, one aspect has been crucial in the wider context of higher education. Online learning, or e-learning, is changing how knowledge is transferred by speeding up the learning process through connected resources and technologies. Staying up to date with advancing technologies is crucial for maximizing the benefits. E-learning has an undeniable impact on higher education by making training easily accessible, improving efficiency, and contributing to better student outcomes (The WizIQ Blog, 2017). Higher education institutions are progressively utilizing technology to

enhance the learning experience by adopting the most suitable models. Online technology can effectively tackle educational disparities and generate opportunities (Gulati, 2008).

The contemporary higher education (HE) environment has widely recognized digital technologies as a key component. The higher education sector in South Africa is transforming the way it utilizes 4IR technology. The teaching and learning environment is undergoing transformation due to the emergence of e-learning, mobile learning, and open educational resources (Donald & Bophelo, 2023). To enhance student outcomes, lecturers must utilize technology-based instructional practices. Adopting technology offers equitable education and collaborative research opportunities. South Africa's higher education sector has the potential to undergo significant transformation and thrive in the digital era by effectively utilizing the technologies associated with the Fourth Industrial Revolution (Donald & Bophelo, 2023). Although there may be some hesitation towards embracing this revolution, the need to provide educational settings that prioritize student-centred learning and align with the Fourth Industrial Revolution is growing. It is equally important to recognize the possible difficulties that technology may present in the context of higher education (Nyembe, 2023).

The COVID-19 pandemic highlighted the need to integrate technology into higher education in South Africa. Ndlovu, Ndebele, and Mlambo (2022) observed severe consequences in South Africa. The traditional teaching method stopped, Students returned home, and classes were moved to online platforms. Although the government was compelled to take measures to contain the spread of the virus, there was insufficient time to train students, particularly in previously disadvantaged universities, on using online learning platforms. Additionally, staff members weren't given adequate time to optimally enhance their proficiency using these systems (Ndebele & Mlambo, 2021). Furthermore, there is a widespread problem of internet availability in numerous rural areas around the country. Not all students have access to the necessary technological devices required for online learning, including laptops, tablets, and routers.

The government's attempt to mitigate the pandemic's impact on the higher education sector was hindered by these problems (Mnguni, 2020). The COVID-19 pandemic underscored the pressing need to enhance connectivity and technology availability to meet the demands of future education in South Africa. Nyembe (2023) noted that although technology integration presents challenges, such as the digital divide and cybersecurity concerns, it also offers enhanced opportunities for engagement, collaboration, and self-directed learning. Tackling these challenges is crucial to fully harness the potential of technology in South African higher education, which will have a positive impact on students,

educators, institutions, and society. Although the need to incorporate technology into higher education institutions in South Africa is well recognized, the question remains whether historically black institutions can effectively incorporate modern technology into their teaching and learning processes, considering the various problems they face. Mlambo, Mahlaba, and Mphurpi (2023) observed that the pandemic exposed significant deficiencies in South African universities, particularly those with limited technology, infrastructure, human resources, transformation, and finance. The abrupt transition from in-person to multi-modal learning has revealed that Historically Black Universities (HBUs) have a constrained ability to adapt to such rapid changes due to their current level of development and lack of preparedness. In addition, Osunkunle (2006) contended that it has become customary for students in historically white institutions (HWUs) in South Africa to have continuous access to computers, the Internet, e-learning resources, online result checking, and even online registration.

Nevertheless, historically black universities (HBUs) are still struggling to obtain access to these resources. At a broad level, there is a problem of limited access to basic ICT facilities, often referred to as a digital divide (Osunkunle, 2006). This is apparent from the gap in ICT accessibility between industrialized nations, such as the U.S.A. and Switzerland, and underdeveloped nations in Africa, like Ethiopia and the Congo. A small digital divide still exists in South Africa. The division is evident across South African universities, with students in historically white schools, such as the University of Pretoria, Rhodes University, and Stellenbosch University, having unrestricted access to ICT facilities, including computers and the Internet (Osunkunle, 2006). Conversely, the situation is different in Historically Black Universities (HBUs), where the availability of ICT facilities is severely restricted. This is evident through personal observation, as many HBUs, such as the University of Fort Hare, the University of Limpopo, and the University of Zululand, continue struggling with limited ICT resource access.

4. FINDINGS: ADAPTION CHALLENGES

4.1. Infrastructure challenges

Limited access to reliable and high-speed internet is a significant issue. Many HBUs are located in areas with poor infrastructure, which affects classroom technology consolidation. The National Education, Health and Allied Workers Union (NEHAWU) stated in the SAHRC report (2014:21) that historically white institutions have historically received an excessive allocation of resources for infrastructure development, unlike historically black universities. This infrastructure disadvantage hinders the progress of transformation and the

attainment of equity. The inadequate infrastructure at HBUs hinders the efficient integration of technology, hindering the need to consolidate the concept of a smart university. Additionally, developing countries face numerous obstacles that hinder their ability to utilize ICT in education. Ogange (2011) states that the main obstacle is a lack of sufficient infrastructure to support the adoption of ICT. Africa experiences limited participation in the ICT revolution network, with only a handful of financially prosperous countries and strong connections to other global networks. Consequently, a significant disparity in access to education is known as the "digital divide." This split separates nations with integrated information and communication technology (ICT) from those excluded from these advantages, enhancing their socio-economic standing (Ntorukiri et al., 2022). Consequently, it is imperative to allocate resources towards developing ICT infrastructure in HBU's to enable them to possess the necessary infrastructure for incorporating technology into their educational practices. It is crucial to ensure that Historically Black universities (HBUs) can narrow the technological gap between themselves and historically white universities.

4.2. Lack of skills and the digital divide

A smart University requires robust academic support services, such as tutoring and counselling, which may be underdeveloped. However, there is often a lack of digital literacy among both students and staff. This includes basic computer skills and more advanced competencies required for effective online learning and teaching. Global Resourcing (2023) noted that universities are seeing a growing scarcity of digital, data, and technology workers for both temporary and permanent positions in the higher education industry. With the rising demand for skilled personnel and the decreasing number of qualified candidates, the higher education sector may encounter a significant decrease in filled positions, which can be referred to as a 'talent cliff'. This will lead to a substantial decrease in both capacity and efficiency at a moment when the emphasis on digital transformation in higher education policy has never been greater. In South Africa's historically black universities (HBUs), due to the scarcity of highly skilled individuals and the intense competition for academics among institutions, businesses, and government entities, implementing a salary differential may be the sole viable answer. Another solution may be to augment compensation to allure experienced personnel in HBUs.

4.3. Funding

HBUs typically have less funding compared to historically white universities. This limits their ability to invest in advanced technologies, maintain

existing infrastructure, and provide training for staff and students. A significant obstacle faced by South African colleges is a lack of sufficient financial resources. Consequently, there has been a decreased quality of facilities, a restricted ability to do research, and a scarcity of academic personnel. The insufficient allocation of funds has established a detrimental pattern whereby universities face a dearth of essential resources to enhance their academic productivity, leading to a restricted number of research publications and diminished contributions to the worldwide academic sphere (Ndevu, 2023).

Moreover, insufficient financial resources have compelled some aspiring and up-and-coming scholars to pursue opportunities overseas, thereby exacerbating the scarcity of skilled individuals within the nation. Universities have a significant obstacle in the form of insufficient money to integrate cutting-edge digital learning solutions into the classroom. This difficulty is compounded by the hesitancy of lecturers to use unfamiliar technologies. Ilorah (2006) observes that the apartheid government in South Africa founded historically black universities (HBUs) to provide education to black students who were prohibited from attending racially segregated white-only universities. These universities received inadequate funding compared to the universities that exclusively serve white students.

5. CONCLUSION AND RECOMMENDATIONS

Literature presented in this paper shows that South Africa needs to take necessary steps to empower HBUs to adapt and thrive in the evolving landscape of the Fourth Industrial Revolution, thereby ensuring inclusive growth and development across the country. The above discussion showed that his HBUs in South Africa are behind in terms of a technological revolution in delivering quality content in the classroom. It is, therefore, vital that investments are made to change these dynamics so that HBUs don't fall behind compared to previously white universities. This is vital to bridge the digital gap in South Africa. Higher education sector. Therefore, this paper argues for increased investments in technologically friendly infrastructure in HBUs and increased training for academics to understand how to use technology in the classroom. Moreover, student capacitation is necessary to ensure that learners can effectively utilize online classroom technology systems. This is important to ensure that, in the long run, historically black universities reduce the digital gap between them and historically white universities.

The paper also found that it is vital to give attention and support to the development of new curricula that incorporate 4IR knowledge amid changing patterns for HBUs. In essence, to assist HBUs, partnerships between HBUs and

industry stakeholders must be attained to foster collaboration on research, internships, and technology transfer. This will help ensure that academic programs are aligned with industry needs and developments. Ultimately, acknowledging the status of HBUs as presented in this paper, efforts to develop supportive policies and regulatory frameworks that promote innovation, research, and development at HBUs must be achieved, as this will help address barriers that may hinder their ability to adapt and keep up with international trends that have given rise to the increasing use of technology in delivering quality content. Lastly, the paper encourages national and international collaboration and exchange programs with universities that are leaders in 4IR technologies. This can facilitate knowledge sharing and capacity building for HBUs.

REFERENCES

Badat, S., Barron, F., Fisher, G., Pillay, P., & Wolpe, H. (1994). Differentiation and disadvantage: The historically Black universities in South Africa. Bellville, South Africa: University of the Western Cape. *Education Policy Unit*.

Barakabitze, A. A., William-Andey Lazaro, A., Ainea, N., Mkwizu, M. H., Maziku, H., Matofali, A. X and Sanga, C. (2019). Transforming African education systems in science, technology, engineering, and mathematics (STEM) using ICTs: Challenges and opportunities. *Education Research International*, 2019(1), 6946809.

Barn, B. S. (2020). The Digital Enterprise as an Emerging Landscape for Universities and Their Operation. In *Advanced Digital Architectures for Model-Driven Adaptive Enterprises* (pp. 287-304). IGI Global.

Bunting, I. (2006). The higher education landscape under apartheid. In *Transformation in higher education: Global pressures and local realities* (pp. 35-52). Dordrecht: Springer Netherlands.

Bunting, I. (2006). *The Higher Education Landscape Under Apartheid*. In: N. Cloete, P. Maassen, R. Fehnel, T. Moja, T. Gibbon & H. Perold (eds.), Transformation in Higher Education. Higher Education Dynamics, Vol 10. Dordrecht: Springer, 35-52. https://doi.org/10.1007/1-4020-4006-7_3

Carolissen, R. & Bozalek, V. (2017). Addressing dualisms in student perceptions of a historically white and black university in South Africa. *Race Ethnicity and Education*, 20(3), 344-357. https://doi.org/10.1080/13613324.2016.1260229

Carr, J. (2023). *Where is the Equity? How States Have Disproportionately Underfunded Historically Black Colleges and Universities*. UAB Institute for Human Rights Blog, University of Alabama at Birmingham. https://sites.uab.edu/humanrights/2023/10/24/where-is-the-equity-how-states-have-disproportionately-underfunded-historically-black-colleges-and-universities/

Case, J.M., Marshall, D., McKenna, S. & Mogashana, D. (2018). *Going to university: The influence of higher education on the lives of young South Africans*. Cape Town: African Minds. https://doi.org/10.47622/9781928331698.

Cloete, R. (2024). *South African Universities Face Challenges Despite Significant Enrollment Growth*. Careers Portal https://www.careersportal.co.za/news-updates/south-african-universities-face-challenges-despite-significant-enrollment-growth

Donald, M. F., & Bophelo, H. (2023). The use of technology in higher education: Implications of the Fourth Industrial Revolution. In *Proceedings of the 10th Focus Conference (TFC 2023)* (Vol. 788, p. 426). Springer Nature.

Global Resourcing. (2023). *Bridging Digital, Data and Technology Skills Gaps in Higher Education*. Global Resourcing. https://www.global-resourcing.com/blog/view/150/Bridging-Digital-Data-Technology-Skills-Gaps-In-Higher-Education

Gulati, S. (2008). Technology-enhanced learning in developing nations: A review. *The International Review of Research in Open and Distributed Learning*, *9*(1), 1-16.

Harris, J. (2022). *Development of 'smart' university campuses is within reach*. Global, University World News. https://www.universityworldnews.com/post.php?story=20220211141708587

Hartman Advisors. (2023). The Future of Learning: How Smart Campus Technology is Changing Higher Education. https://hartmanadvisors.com/the-future-of-learning-how-smart-campus-technology-is-changing-higher-education-2/.

Hlatshwayo, M. N. (2020). Being Black in South African higher education: An intersectional insight. *Acta Academica*, *52*(2), 163-180. https://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2415-04792020000200009.

Hötte, K. (2023). Demand-pull, technology-push, and the direction of technological change. *Research Policy*, 52(5), 104740.

Iilorah, R. (2006). The dilemma of the historically black universities in South Africa. *South African Journal of Higher Education*, *20*(3), 442-60.

Isoherranen, V., & Kess, P. (2011). Analysis of strategy focus vs. market share in the mobile phone case business. *Technology and Investment*, *2*(2), 134-141.

Mbombo, A. B., & Cavus, N. (2021). Smart university: A university in the technological age. *TEM Journal*, *10*(1), 13-17.

Mdiniso, J., Shangase, Z. P., Nkwanyana, S., Cele, S., & Mkhasibe, R. G. (2022). Transition to emergency online learning in SA: Reflection of historically black universities. *African Journal of Development Studies*, *12*(1), 209.

Mlambo, D. N., Mahlaba, S., Mphurpi, J. H., & Buys, T. (2023). The Changing Environment in South Africa's Higher Education Institutions Due to the COVID-19 Pandemic: Reference from Historically Black Universities

(HBUs). *African Journal of Development Studies*, *13*. https://hdl.handle.net/10520/ejc-aa_affrika1_v2023_nsi1_a13.

Mlambo, V. H., & Ndebele, N. C. (2021). COVID-19 highlights inequalities between historically black and historically white South African universities. *Covid-19: Interdisciplinary Explorations of Impacts on Higher Education*, 37.

Mnguni, L. (2020, April 20). Online learning in lockdown is far from ideal. Mail and Guardian. https://mg.co.za/article/2020-04-08-online-learning-in-lockdown-is-far-from-ideal/.

Momcilovic, S., Germano, J., Ilic, A., & Sousa, L. (2013). A Case study of Technology Push and Market Pull Strategies: Magnomics Start-up and Livedrive Spin-off. *ICTT, 2013*, 141.

Ndevu, N. (2023, April 11). Systemic Dysfunction of South African Universities. https://transformsa.co.za/2023/04/systemic-dysfunction-of-south-african-universities/

Ndlovu, S. G., Ndebele, N. C., & Mlambo, V. H. (2022). The role of distance learning in South African higher education institutions during COVID-19 period: Challenges and perspectives. *Academia*, (27-28), 54-73.

Ntorukiri, T. B., Kirugua, J. M., & Kirimi, F. (2022). Policy and infrastructure challenges influencing ICT implementation in universities: a literature review. *Discover Education*, 1(1), 19. https://doi.org/10.1007/s44217-022-00019-6

Nuñez-Jimenez, A., Knoeri, C., Hoppmann, J., & Hoffmann, V. H. (2019). Balancing technology-push and demand-pull policies for fostering innovations and accelerating their diffusion. In *Full paper submission for the 4th International Conference on Public Policy P08 The Design and Organisation of Innovation Policy. Concordia University, Montreal, Canada*.

Nyembe, S. (2023). Navigating the Digital Era: Enhancing South African Education through AI Integration. https://www.linkedin.com/pulse/navigating-digital-era-enhancing-south-african-education-sipho-nyembe-psuef/

Ogange, B. O. (2011). *An analysis of ICT policy development and practice in teacher education in Kenya between 1997-2007*. Open University (United Kingdom).

Osunkunle, O. O. (2006). Bridging the Digital Divide and the Use of Information and Communications Technology (ICT) in South African Universities: A Comparison Study among Selected Historically Black Universities (HBUs) and Historically White Universities (HWUs). *Online Submission*, *3*(3), 70-76.

Plumwood, V. 1993. *Feminism and the Mastery of Nature*. London: Routledge.

Pornphol, P., & Tongkeo, T. (2018, January). Transformation from a traditional university into a smart university. In *Proceedings of the 6th International Conference on Information and Education Technology* (pp. 144-148). https://dl.acm.org/doi/10.1145/3178158.3178167

South African Human Rights Commission. (2014). Transformation at Public Universities in South Africa. Available at; https://www.sahrc.org.za/index.php/sahrc-media/news/item/602-transformation-in-higher-education-perspective-of-the-sahrc#:~:text=Transformation%20in%20South%20Africa%20Universities,teaching%20and%20learning%2C%20research%20and

Subotzky, G. (1997). Redefining equity: Challenges and opportunities facing South Africa's historically black universities relative to global and national changes. *Journal of Negro Education*, Autumn, 496-521. https://doi.org/10.2307/2668176

The WizIQ Blog. (2017). How successful has eLearning been in education? https://blog.wiziq.com/higher-education-software-success/.

Times Higher Education (2024). South African higher education's opportunity to embrace digital transformation. https://www.timeshighereducation.com/campus/south-african-higher-educations-opportunity-embrace-digital-transformation.

Tjønneland, E. N. (2017). Crisis at South Africa's universities–what are the implications for future cooperation with Norway?. *CMI Brief*, 16(3), published by Chr. Michelsen Institute. http://hdl.handle.net/11250/2475331.