



Gaming and Digital Technology in Healthcare Training: A Scoping Review of Studies in African Countries

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Article Info

Article history:

Received December 21, 2025

Revised June 5, 2026

Accepted July 8, 2026

Available Online 25 August, 2025

Keywords:

African digital technology;

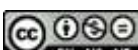
Gaming;

Healthcare;

Technology;

ABSTRACT

Healthcare training institutions worldwide are under increasing pressure to adopt innovative, scalable, and contextually relevant teaching methods to address gaps in workforce skills and training capacity. The integration of gaming and digital technology into healthcare training has accelerated globally. While these technologies have enhanced interactivity, engagement, and skill acquisition, evidence from African contexts remains fragmented and under-reported. This scoping review addresses this gap by identifying, mapping, and synthesizing published studies on the use of digital gaming and technology for healthcare training across African countries, guided by Arksey and O'Malley's (2005) scoping review framework and PRISMA guidelines. Findings show a growing body of African research on digital tools such as virtual reality, serious games, mobile applications, and gamified learning platforms, with a significant increase in studies since 2021. The studies encompassed various technologies such as virtual reality, serious games, and mobile apps, applied across key areas of healthcare. This is the first consolidated overview of how digital gaming and technology are being adopted within healthcare education in Africa. It highlights both the potential of these tools to strengthen training and the need to amplify African-led innovations, foster cross-regional collaboration, and address linguistic and contextual barriers that may limit knowledge sharing.

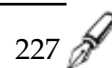


<https://doi.org/10.46627/silet>

INTRODUCTION

Healthcare training programs in the higher education sector have increasingly incorporated gaming and digital technology as effective teaching methods. The global use of gamification, virtual reality, simulations, and serious games has transformed traditional teaching and learning methods. Healthcare students now benefit from enhanced skill development, integrated online learning, virtual environments for practical experiences, and collaborative settings. This shift in teaching and learning culture ensures that educational goals are achieved through multifaceted approaches (Cirino, 2025).

Virtual reality and simulation tools play a crucial role in supporting healthcare students, allowing them to practice and learn in realistic, safe, and immersive environments. This approach improves precision and boosts the confidence of medical professionals. The use of serious games in healthcare training has demonstrated that students exhibit enhanced confidence, clinical skills, and competencies (Lee et al., 2024).



With the right games and practice, gaming may be an important tool in programs aimed at improving spatial skills (Subrahmanyam & Greenfield, 1994) or in healthcare programs that require precise spatial skills, such as surgical training. As early as 1987, the potential of using gaming to train personnel in tasks such as mechanical operations, machinery handling, and radar tracking was recognized (Hunt et al., 1987, as cited in Subrahmanyam & Greenfield, 1994). Augmented reality, virtual reality, and gaming technologies have the potential to provide realistic and authentic learning experiences, revolutionizing medical training, which has traditionally relied on textbook learning and clinical placements (Pappa & Papadopoulos, 2019).

Initially, there was interest in how games designed for entertainment could be beneficial for learning. However, this initial focus of game design for entertainment has shifted to designing games specifically for educational purposes (Connolly et al., 2012). The 'serious games' approach offers the advantage of developing dedicated games specifically designed for learning skills or content, rather than simply adapting existing entertainment games for educational purposes (De Freitas, 2006). Serious games can enhance the effectiveness of learning by improving knowledge acquisition and content understanding, as well as by enhancing affective and motivational outcomes (Connolly et al., 2012).

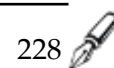
Global Context and Cultural Considerations

Contextual and cultural factors are essential when examining global settings, as each requires specific, relevant skills. Although healthcare professionals develop similar core competencies worldwide, training approaches often differ between developed and developing countries.

In developed countries, healthcare workers typically function within well-resourced, multidisciplinary teams, allowing specialised tasks, such as wound care or routine procedural work, to be delegated to junior staff. This structured division of tasks reduces the need for individual healthcare professionals to develop a broad procedural skill set and limits their exposure to complex or uncommon conditions. In contrast, healthcare professionals in low- and middle-income countries (LMICs) routinely encounter a wider spectrum of diseases, including tuberculosis complications, high maternal mortality, malaria, and other regionally prevalent conditions, which contributes to broader clinical competence (WHO, 2024). Despite these differences in expertise, historical analyses demonstrate that the colonial legacy in African systems undervalues indigenous medical knowledge while establishing inequitable and often inadequate healthcare infrastructures (Bolt & Cilliers, 2025; Tilley, 2016). These structural inequities persist today, compounded by financial and logistical barriers such as the high cost of imported medical equipment, import tariffs, and unfavourable exchange rates, which continue to impede the development of locally relevant health innovations and training systems (Latif & Otieno, 2025).

From a cultural perspective, the Eurocentric nature of material developed in English may hinder comprehension for African first-language speakers and overlook cultural nuances. The disadvantages of multiculturalism in a largely Eurocentric and American-dominated market, coupled with English as the primary language of academic literature, are evident. However, ignoring studies in other languages comes at a cost to academic and global knowledge, as shown by Angulo et al. (2021). Their study emphasised the need for improved communication and collaboration among scientists, practitioners, and policymakers across different languages. Recognising the importance of research studies in different languages and cultures, as well as their positive contributions to international academic platforms, is essential. The contribution of African studies to knowledge about human immunodeficiency viruses (HIV) is a clear example of the value that African studies can provide.

While HIV research remains the most widely recognised area in which African scholarship contributes to global knowledge, it should not be viewed as the sole domain of African research expertise. African academics must increasingly recognise the value and significance of their broader work, particularly in healthcare, where the continent's diverse disease profiles offer important opportunities for internationally relevant contributions. The growing integration of



digital gaming into healthcare training further represents a promising avenue for shared global learning, enabling greater understanding of how technology can support skill development in varied contexts.

This study therefore examined research on the use of digital technology and gaming in healthcare training across selected African countries, including the Democratic Republic of the Congo, Ghana, Kenya, Nigeria, South Africa, Tanzania, and Uganda. These countries were chosen because they represent diverse geographical regions, linguistic backgrounds, digital readiness levels, and healthcare training environments within the continent. The review aim is to map and synthesise published studies exploring the integration of digital gaming and technology into healthcare training in selected African countries.

By highlighting how these tools are being applied in African training environments, the review showcases the strengths of African research and identifies potential areas for collaboration with more developed countries. Such engagement can help ensure that African innovations and contextual expertise are meaningfully integrated into global healthcare knowledge.

RESEARCH METHOD

Review Approach

This study adhered to the framework established by Arksey and O'Malley (2005) for conducting scoping reviews, while also following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines during the screening and documentation process.

Stage 1: Identifying the Research Question

The global shift in the evolution of teaching and learning has led to an increase in the use of more creative methods in the higher education sector. Gaming and digital technology, including virtual, mixed, and augmented reality, as well as digital and serious games, are increasingly being used as part of healthcare training globally. This review addresses the research question: How does existing literature on gaming and digital technology in healthcare training across African countries map patterns in study design, geographical distribution, technological applications, and thematic focus, and what gaps emerge from this evidence base?

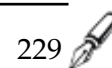
Stage 2: Identifying Relevant Literature

A search strategy should be transparent and comprehensive while still ensuring feasibility (Levac et al., 2010). The literature search was conducted in May 2025 using the EBSCOhost databases (including MEDLINE, APA PsycInfo, Academic Search Ultimate, Africa-Wide Information, CINAHL Ultimate, and Global Health), as well as the Scopus databases.

Search terms and keywords were devised and used to search through article abstracts, ensuring the identification of articles related to the research question. The search terms used in the query were as follows: ("virtual reality" OR "VR" OR "augmented reality" OR "AR" OR "mixed reality" OR "XR" OR "extended reality" OR "video game*" OR "serious game*" OR gamification OR "computer game*" OR "digital game*") AND (healthcare OR "health care" OR medicine OR "medical training" OR "health education" OR rehabilitation OR therapy OR "clinical practice" OR "patient care" OR "nursing education" OR "physical therapy" OR "occupational therapy" OR "speech therapy" OR "audiology") AND (Kenya OR Nigeria OR Ghana OR "South Africa" OR Uganda OR Tanzania OR Ethiopia OR Rwanda OR Zambia OR Zimbabwe).

Stage 3: Selecting Studies

Studies were included based on defined inclusion and exclusion criteria, followed by the identification of articles that satisfied these criteria. Author Moodley conducted the search and identified the relevant articles. Authors Randle and Pillay were given the Excel sheets containing the articles to review the process and assess whether they were in agreement. Whenever



questions arose about whether to include or exclude articles, a meeting was held to discuss them, and a consensus was reached.

The following inclusion criteria were applied:

- Peer-reviewed articles
- Published between January 2010 and December 2024
- Published in English
- Related to research on healthcare training using gaming in any of the selected African countries
- Studies conducted in one of the seven selected African countries: the Democratic Republic of the Congo (DRC), Ghana, Kenya, Nigeria, South Africa, Tanzania, or Uganda.

The following exclusion criteria were applied:

- Not relevant to the topic of gaming
- Not relevant to the topic of healthcare training
- Study not conducted in one of the selected African countries

Stage 4: Finalizing the Study Selection

The database search identified 217 articles, which were exported to Excel for analysis. Thirty-eight duplicate studies were identified and eliminated. After the abstract screening, 135 articles were excluded for not meeting the study criteria. A full text screening of the 44 remaining articles yielded 25 articles for inclusion in this review. A PRISMA flowchart illustrating the literature search, retrieval, and inclusion process for this review is presented in Figure 1.

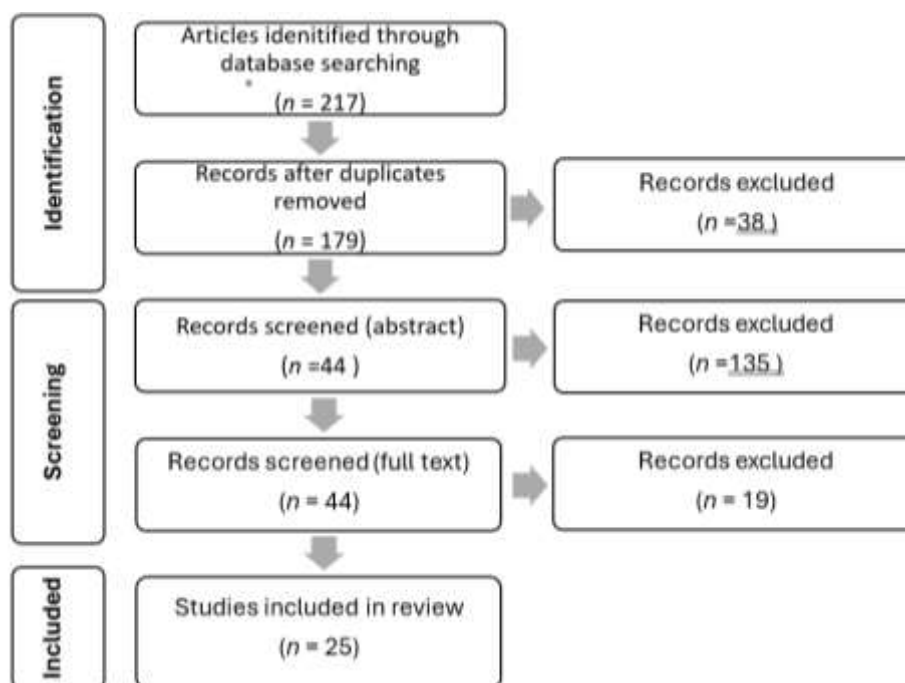


Figure 1. PRISMA chart

Review Analysis

Data Charting

The final list of 25 articles, presented in Table 1, includes relevant descriptors for sorting and analyzing the data. The data were organized into the following categories:

- Type of research (empirical/conceptual)
- Year of study
- Study region: African countries where the research was conducted



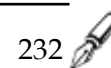
- Healthcare discipline
- Healthcare focus
- Gaming technology

Table 1. Studies included in the review

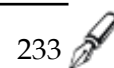
Study title	Authors	Summary
Virtual Reality Exposure Therapy as Treatment for Pain Catastrophizing in Fibromyalgia Patients: Proof-Of-Concept Study (Study Protocol)	Morris et al., 2011	This article focused on the use of virtual reality for pain management, which triggered functional brain activity and assisted in reducing exercise-related pain.
The Use of Xbox Kinect™ in a Paediatric Burns Unit	Lozano & Potterton, 2018	This study investigated the potential of using the Xbox as a tool to distract children with burns and manage their pain during treatment.
“Not Just Another Wii Training”: A graded Wii protocol to increase physical fitness in adolescent girls with probable developmental coordination disorder-a pilot study	Bonney et al., 2018	The focus of this article was on using gaming to motivate and enhance physical fitness, improve motor performance, and increase mobility in teenage patients.
Neuropsychological Benefits of Computerized Cognitive Rehabilitation Training in Ugandan Children Surviving Severe Malaria: A randomized controlled trial	Boivin et al., 2019	This longitudinal study showed improved memory and attention outcomes after rehabilitation training using games for malaria survivors.
A Smartphone Game to Prevent HIV Among Young Kenyans: Household dynamics of gameplay in a feasibility study	Winskell et al., 2019	The aim was to understand the interpersonal and social interactions that can be elicited by digital games for health, specifically in the context of HIV prevention among youth.
Evaluation of Adaptive Feedback in a Smartphone-Based Serious Game on Health Care Providers’ Knowledge Gain in Neonatal Emergency Care: Protocol for a randomized controlled trial	Tuti et al., 2019	The focus was on clinicians learning with different feedback styles, using a smartphone-based game to assess their management of a simulated medical emergency.
An Iterative Process for Developing Digital Gamified Sexual Health Education for Adolescent Students in Low-Tech Settings (Haruna et al., 2019).	Haruna et al., 2019	The article highlighted how the <i>My Future Begins Today</i> game for sexual health education was developed, evaluated, and refined in the real world of low-tech settings, making improvements based on user responses.
Peernaija: A Gamified Mhealth Behavioral Intervention to Improve Adherence to Antiretroviral Treatment Among Adolescents and Young Adults in Nigeria	Ahonkhai et al., 2021	The game discussed in this article aimed to encourage HIV patients who are on antiretrovirals to take their medication regularly. The game provides patients with leaderboard scores and badges,



Study title	Authors	Summary
Ehbb: A Randomised Controlled Trial of Virtual Reality or Video for Neonatal Resuscitation Refresher Training in Healthcare Workers in Resource-Scarce Settings	Umoren et al., 2021	which serve as motivational tools for users. Mobile virtual reality simulations were shown to be effective in providing additional support for the retention of resuscitation skills compared to other digital methods.
Using Serious Mobile Games to Improve Health Literacy in Rural Sub-Saharan Africa: A literature review	Ouedraogo et al., 2022	It was demonstrated that interventions, in addition to training, must be acceptable to healthcare workers in low- and middle-income countries.
Using Mobile Virtual Reality Simulation to Prepare for In-Person Helping Babies Breathe Training: Secondary analysis of a randomized controlled trial (the eHBB/mHBS Trial)	Ezenwa et al., 2022	As the number of serious games for healthcare education and awareness continues to increase, it is essential to identify and address the specific challenges faced by underserved populations, such as rural African communities, to ensure the successful implementation of inclusive mobile health technologies in rural Africa.
Use of Virtual Reality Distraction to Reduce Child Pain and Fear During Painful Medical Procedures in Children with Physical Disabilities in Uganda: A feasibility study	Bannink Mbazzi et al., 2022	This study examined the feasibility and educational efficacy of using mobile virtual reality for neonatal resuscitation training among healthcare professionals.
Telesurgery's Potential Role in Improving Surgical Access in Africa	Mehta et al., 2022	The use of virtual reality glasses may offer an acceptable and effective method for reducing pain and fear in resource-constrained settings and should be further explored in a randomized controlled trial.
Simulating Infection Prevention and Control Through Virtual Reality: A vehicle for equity, diversity, and inclusivity in Africa	Botha et al., 2023	This study explored the role of telesurgery in Africa. While there is a need for telehealth, various challenges exist regarding its implementation in Africa.
A Brief Review of Online Education Resources on Gamification in Addressing Antimicrobial Resistance	Waruingi et al., 2023	This article reviewed the viability of various awareness mobile games regarding antibacterial resistance, focusing on the accessibility, compatibility, and usability of these mobile games through the Play Store. The conclusion was that gamification played a role in raising awareness.



Study title	Authors	Summary
Neurosurgical Education in Tanzania: The Dar es Salaam global neurosurgery course	Shayo et al., 2023	The focus was on reporting about a global neurosurgery course in Tanzania. Despite facing challenges with equipment and internet connectivity, participant feedback was positive.
Innovative Technologies to Address Neglected Tropical Diseases in African Settings with Persistent Sociopolitical Instability	Manyazewal et al., 2024	The article discussed nine promising technologies – artificial intelligence, drones, mobile clinics, nanotechnology, telemedicine, augmented reality, advanced point-of-care diagnostics, mobile health apps, and wearable sensors – that could enhance Africa's response to neglected tropical diseases in the face of persistent sociopolitical instability.
Empowering Sickle Cell Disease Care: The Rise of Technorehablab in Sub-Saharan Africa for Enhanced Patient's Perspectives (Boma et al., 2024).	Boma et al., 2024	The TechnoRehabLab in Lubumbashi illustrated a shift in thinking about patient perspectives by using technologies such as virtual reality, serious games, and mobile health to create a comprehensive and easily accessible rehabilitation framework.
Negotiating Artefacts: Student game creation for education and introspection	Jerrett, 2024	The creation and deployment of two game design assessments for a private higher education institution in South Africa allowed undergraduate students to explore various complex topics.
Comparative Effectiveness of Remote Digital Gamified and Group CBT Skills Training Interventions for Anxiety and Depression Among College Students: Results of a three-arm randomised controlled trial	Bantjes et al., 2024	This study examined a computer-based skills training app as an intervention for anxious or depressed South African undergraduate students.
Attitudes of Patients and Mental Health Professionals Towards Hypothetical Use of Serious Games in Psychotherapy	Spies et al., 2024	E-mental health treatment was shown to be positively received by patients and therapists as a form of therapy, despite a lack of awareness about such methods.
A Mobile Gaming App to Train Teenage Mothers on Appropriate Child Feeding Practices: Development and validation study	Sosanya et al., 2024	This study examined the development and validation of a mobile gaming app called <i>BabyThrive</i> , designed to train Nigerian teenage mothers in appropriate child feeding practices.



Study title	Authors	Summary
A Comparative Analysis of Gamified and Non-Gamified Interventions' Effectiveness in Teaching Adolescent Students About Healthy Sexual Practices in Tanzania	Haruna, 2024	This study examined the effectiveness of serious games and gamification platforms in improving sexual health education in the resource-limited setting of Tanzania.
Virtual Reality Technology for Surgical Learning: Qualitative outcomes of the first virtual reality training course for emergency and essential surgery delivered by a UK-Uganda partnership	Please et al., 2024	The article discussed the implementation of virtual reality technology in relation to medical surgery in Uganda. It utilized a mixed methods approach. The findings indicated that collaboration and shared teaching were impactful and beneficial for the training of surgeons.
Virtual Reality Training to Enhance Clinical Competence and Student Engagement in Ghana	Baidoo & Adu, 2024	This study aimed to evaluate the educational impact of virtual reality, including its potential benefits and challenges, at a health education institution in Ghana.

Collating, Summarizing, and Reporting the Results

Following the recommendations of Arksey and O'Malley (2005), a descriptive content analysis and categorical mapping of articles was conducted to identify the contributions of digital gaming research to healthcare training in the selected African countries. To ensure a systematic and comprehensive mapping of the evidence, the analysis followed scoping review principles by organizing the extracted data into predefined analytical categories. These categories included study design, geographical setting, types of digital gaming or technological interventions, healthcare training contexts, and reported outcomes.

RESULTS AND DISCUSSION

The research results are presented according to the descriptors provided in the data chart.

Type of Research

The majority of the studies reviewed are empirical research, comprising 80% of the total (see Figure 2). The empirical articles focus on the development and testing of games and digital technology, highlighting their practical application in demonstrating the use of digital technology for healthcare training in Africa.

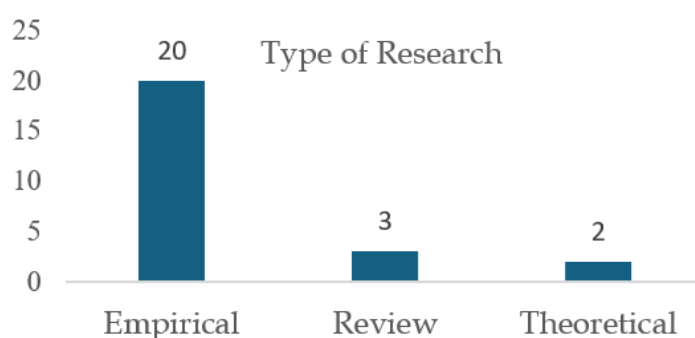
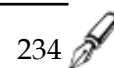


Figure 2. Types of research included in the review



Year of Study

Between 2011 and 2019, there was an increase in the number of studies; however, no research articles were published in 2020 (see Figure 3). Since 2021, there has been a general increase in the number of studies, with 2024 showing twice as many studies conducted as in 2022. This indicates a growing interest in gaming and digital technology within the healthcare sector.

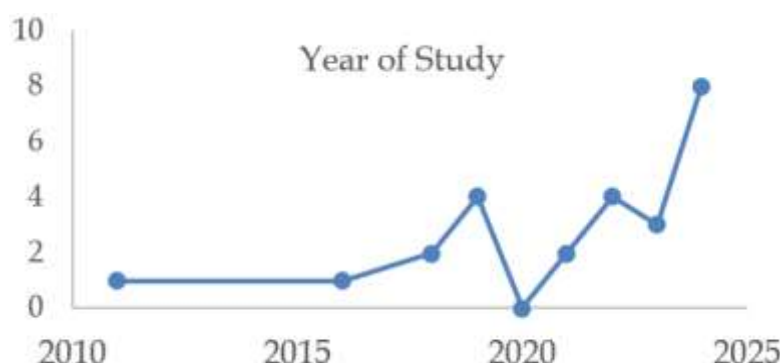


Figure 3. Year in which the study was conducted

Study Region

Africa is the second-largest continent and has the second-largest population in the world. Despite the many challenges the continent has encountered, research has significantly gained momentum over the past decade. Concerted efforts have been made to establish research networks among African countries that foster collaboration, promote mutual benefits, and encourage development.

In the articles included in this review (see Figure 4), five studies (20%) did not indicate the specific African country where the research was conducted. These studies were included because they contributed relevant evidence on how digital gaming and technology are used in healthcare training on the African continent and provided contextual insight into wider African experiences with digital healthcare education that were useful for understanding continental trends.

The remaining 80% of the studies primarily originated from South Africa (27%), with a fairly even distribution across the other six African countries.

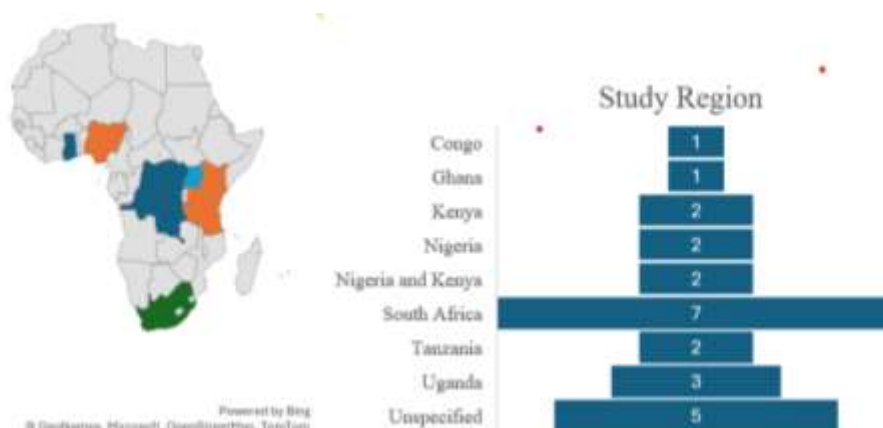


Figure 4. Region where the studies were conducted

Gaming Technology

Most of the articles focused on gaming ($n = 9$, 45%) and virtual reality ($n = 8$, 40%) (see Figure 5). Each region seemed to prefer a specific type of gaming or digital technology. The studies conducted in Nigeria focused on mobile games, while those in Kenya examined serious games. In contrast, research from Nigeria/Kenya and Uganda primarily concentrated on using virtual reality. The South African studies focused on virtual reality and video games.



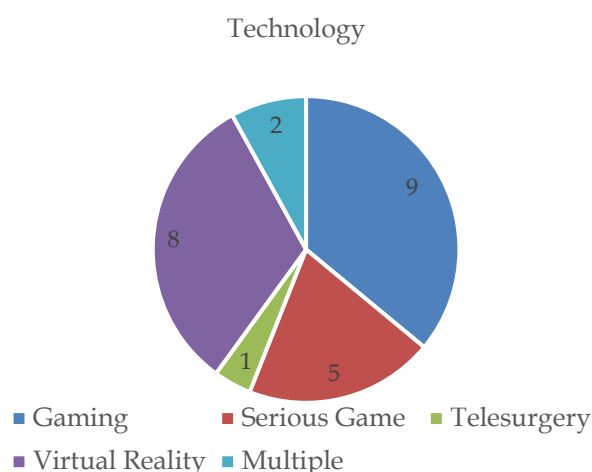


Figure 5. Technology used in the articles about the gaming review

Healthcare Focus

The healthcare focus of the games is divided into those directly related to medical professionals ($n = 10$, 40%) and those focused on patients ($n = 15$, 60%) (see Figure 6). Out of the fifteen articles that focused on patients, six (40%) discussed patient education, six (40%) addressed patient intervention, and three (20%) covered pain management, with two specifically focusing on pediatric pain management (Bannink Mbazzi et al., 2022; Lozano & Potterton, 2018).

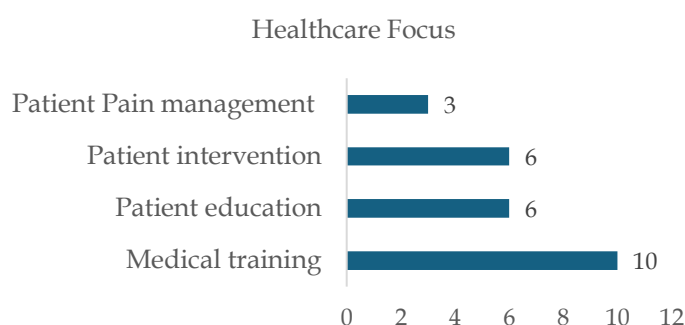


Figure 6. Focus on healthcare in studies

In the field of healthcare, the articles addressed a wide range of topics, including diseases, HIV, mental health, neonatal care, obstetrics, pediatrics, pain management, physiotherapy, sexual health, and surgery (see Figure 7).

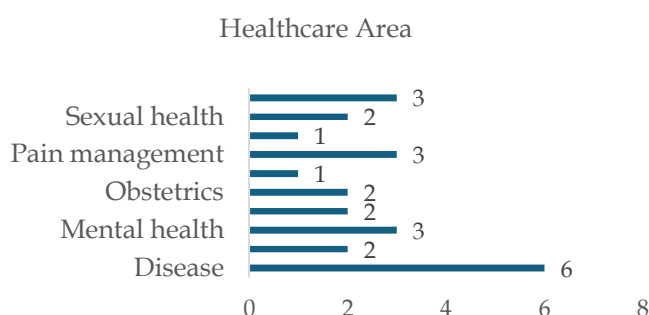


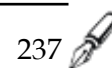
Figure 7. Area of healthcare in studies

A breakdown of the research by healthcare area is presented in Table 2.



Table 2. Breakdown of the research by healthcare area

Area	Summary
Disease	Most articles ($n = 6$, 24%) focused on disease as the overarching theme. The dimensions of disease in the six articles relate to health literacy, infection prevention and control, malaria, neglected tropical diseases, sickle cell disease care, and antimicrobial resistance. Three studies did not specify the location, while the remaining three identified the sites as South Africa, Uganda, and the DRC. Gaming technology varied across artificial intelligence, virtual reality, and serious games in all six articles. The scoping review conducted by Ouedraogo et al. (2022) focused on healthcare education and awareness in rural Africa through the use of mobile technology. Utilizing mobile healthcare technologies to identify and address challenges in underserved populations provides significant benefits. Botha et al. (2023) argued that virtual reality is a potentially low-cost modality that helps create equitable, diverse, and inclusive teaching options for nursing students. However, the lack of training, funding, and support in low- and middle-income countries drastically impacts the effectiveness of these interventions. Nine promising innovative technologies – artificial intelligence, drones, mobile clinics, nanotechnology, telemedicine, augmented reality, advanced point-of-care diagnostics, mobile health apps, and wearable sensors – were proposed to address neglected tropical diseases in Africa (Manyazewal et al., 2024). Boma et al. (2024) presented a positive illustration of how technologies such as virtual reality, serious games, and mobile health can be utilized to create a comprehensive and accessible rehabilitation framework in Africa. Waruingi et al. (2023) discussed gamification as a tool for creating awareness in healthcare. Key variables such as accessibility, compatibility, and usability of mobile games through the Google Play Store were the focal areas.
HIV	Two of the articles ($n=2$, 8%) focused on the use of mobile smartphones in relation to HIV in Kenya and the DRC. Both articles targeted youth and adolescents as participants. Winskell et al. (2019) aimed to understand the interpersonal and social interactions that digital games related to HIV can elicit among youth. The competitive nature of youth was addressed in the article by Haruna et al. (2019), as the game included leaderboard scoring and the attainment of badges among participants.
Mental health	All articles ($n=3$, 12%) focusing on mental health were from South Africa and published in 2024 (Bantjes et al., 2024; Jerrett, 2024; Spies et al., 2024). Each had a different focus on technology, with one addressing the hypothetical use of serious games in the field of psychotherapy (Spies et al., 2024), another examining a mobile gaming app (Bantjes et al., 2024), and the last focusing on game design (Jerrett, 2024). Each of the articles focused on the mental health conditions of depression and anxiety.
Neonatal care and obstetrics	The articles on neonatal care and obstetrics ($n=3$, 12%) were primarily joint studies from Nigeria and Kenya (Ezenwa et al., 2022; Umoren et al., 2021), focusing on the use of virtual reality to develop games for training healthcare workers in neonatal resuscitation. The study conducted solely in Kenya (Tuti et al., 2019) also focused on neonatal emergency care but used serious games to assess healthcare providers' management of a simulated neonatal medical emergency.
Pediatrics	Three articles ($n=3$, 12%) focused on pediatric medicine. The article from Nigeria focused on training young mothers in appropriate child feeding practices through a mobile gaming app (Sosanya et al., 2024). The one from South Africa discussed using gaming to reduce pain in a pediatric burn unit (Lozano & Potterton, 2018), while the Ugandan study (Bannink Mbazzi et al., 2022) examined the use of virtual reality to alleviate pain during procedures in children with physical disabilities.

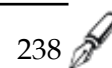


Area	Summary
Pain management	Studies on pain management were conducted in Uganda and South Africa (n=2, 8%). The Ugandan study (Bannink Mbazzi et al., 2022), which focused on pain management in children, is similar to a South African study on adult pain management for individuals with fibromyalgia (Morris et al., 2011) in that both studies utilize virtual reality.
Physiotherapy	The study on physiotherapy (n=1, 4%) was conducted in South Africa and utilized digital gaming technology, specifically a graded Wii protocol, to promote physical fitness among adolescent girls with suspected developmental coordination disorder (Bonney et al., 2018).
Sexual health	This review examined two studies (n=2, 8%) focusing on sexual health, one in Tanzania (Haruna, 2024) and another in unspecified regions of sub-Saharan Africa (Haruna et al., 2019). The 2019 article highlighted the development and evaluation of a game for sexual health education, while the 2024 article examined the effectiveness of serious games and gamification platforms in improving sexual health education. Both studies on this topic focused on the digital technology of gamification. In a Tanzanian study by Haruna (2024), gamification was implemented through a Moodle learning platform enhanced with game mechanics, offering students points, badges, and challenges for completing sexual health modules. The findings demonstrated significant improvements in the motivation, attitudes, and knowledge acquisition of students compared to traditional methods of instruction. The inclusion of game elements has been shown to stimulate intrinsic motivation and foster competitive and collaborative learning experiences, even in environments with low levels of technology.
Surgical training	The studies on surgical training (n=3, 12%) originated from different regions of Africa, including one authored by a Nigerian researcher (Mehta et al., 2022), another conducted in Tanzania (Shayo et al., 2023), and a third conducted in Uganda (Please et al., 2024). The article by Mehta et al. (2022) is a theoretical piece focusing on the need for telehealth in Africa. The other two articles are empirical and employ the digital technology of virtual reality. Shayo et al. (2023) used virtual reality as one of the methods for surgical teaching in Tanzania. According to Please et al. (2024), there is a relatively limited deployment of virtual reality in low- and middle-income countries due to constraints in infrastructure. Innovations such as the UK-Uganda partnership in surgical training (Please et al., 2024) demonstrate that access to specialized knowledge can be democratized through low-cost virtual reality tools. In that case, the training utilized 36 recorded surgical procedures and live-streamed content to users across Africa and beyond, illustrating how scalable and inclusive virtual reality can be when adapted to local contexts.

The articles in this review highlight the growing use of gaming and digital technology in the healthcare sector in Africa. Technological advances that support teaching and learning in healthcare programs rely on funding, manpower, and motivated staff. Critical areas of healthcare education that focus on the prevention and promotion of healthcare needs are vital. The imbalance between the number of patients and healthcare workers in Africa necessitates innovative approaches, such as gaming and digital technologies, to engage the growing African population through means beyond face-to-face communication. The following discussion will connect the research to the various types of digital technology employed.

Discussion

Digital technologies in the 21st century are widely acknowledged as transformative tools that have reshaped traditional methods of learning. In addition, digital technologies have revolutionized the way information is accessed, delivered, and internalized in the education,



health, cultural, and social sectors. Virtual reality, augmented reality, mobile gaming, serious games, and gamification are highly influential digital interventions that are rapidly evolving.

The discussion outlines digital technology, its applications, and relevant studies for each type of technology.

Virtual Reality

Virtual reality is a computer-generated simulation of an immersive three-dimensional environment that allows users to explore and interact quickly. Experiencing virtual reality is made possible by using head-mounted displays such as the Oculus Rift and HTC Vive, as well as more affordable models, such as Google Cardboard, which utilize smartphones as their display units. Virtual reality immerses the user in a simulated environment, allowing them to manipulate objects, perceive depth, and receive sensory feedback such as sound and movement, thereby creating an embodied learning experience (Radianti et al., 2020).

In educational settings, there is widespread acknowledgement of the capacity of virtual reality to promote experiential learning. This is especially relevant in disciplines such as medicine, engineering, and the arts, which require spatial, procedural, or contextual understanding. According to Jensen and Konradsen (2018), virtual reality enhances cognitive engagement by immersing learners in realistic simulations that replicate the complexities of real-world environments. This immersion leads to deeper learning, improved retention, and more effective skill acquisition. In the health sciences, virtual reality is now utilized for surgical training, psychiatric therapy, anatomy teaching, and even empathy development through experiences that align with different perspectives (Ma et al., 2022). This has been shown to be relevant in African countries, particularly in the UK-Uganda partnership in surgical training (Please et al., 2024), indicating the ability of virtual reality to be both affordable and scalable through live streaming. These findings indicate how immersive technologies are being adopted within African health professional training and identify models that demonstrate feasibility, cost-effectiveness, and potential for wider implementation in Africa.

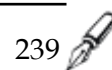
Augmented Reality

Augmented reality differs from virtual reality because it overlays digital elements, such as images, information, or animations, onto the real world in real-time, typically through smartphones, tablets, or augmented reality glasses. Unlike virtual reality, which creates a world that is entirely virtual, augmented reality enhances the existing physical environment with interactive and contextual data. Augmented reality has been extensively applied in education for the visualisation of abstract concepts, particularly in STEM fields, by enabling learners to manipulate three-dimensional models of complex systems, such as molecules, circuits, and historical artefacts (Akçayır & Akçayır, 2017).

In medical education, augmented reality has been employed to teach procedures such as CPR and anatomy. It has also shown promise in assisting surgeons by providing heads-up displays of patient data during operations (Barsom et al., 2016). Its potential stems from its ability to contextualise learning without isolating users from their surroundings. However, despite its promise, augmented reality is implemented less frequently in African educational institutions compared to virtual reality and gamified learning, primarily because it requires a higher technological infrastructure and is limited by the availability of compatible devices. This highlights the digital divide in Africa.

Serious Games

Serious games refer to digital games designed for a primary purpose rather than being created purely for entertainment. The games are structured and built with defined learning objectives, and they are used to convey content or change behavior in fields such as education, healthcare, military training, and civic engagement. Serious games utilize game mechanics such as



narratives, challenges, rewards, and simulations to engage users while teaching specific knowledge or skills (Michael & Chen, 2005).

In the context of adolescent health education, serious games have been instrumental in conveying sensitive topics such as sexual and reproductive health. Games like *My Future Begins Today*, developed for Tanzanian students, demonstrate the importance of serious games in promoting agency, decision-making skills, and accurate knowledge in a non-threatening and culturally relevant manner (Haruna, 2024). These games not only disseminate health information but also do so in a way that respects the learning environment, promotes retention through repetition and interactivity, and offers immediate feedback.

Internationally, the deployment of serious games has been well documented in North America, Europe, and parts of Asia. For instance, *PlayForward*, a serious game developed in the United States, was designed to prevent HIV in minority youth populations. It demonstrated a significant delay in sexual initiation among players (Fiellin et al., 2017). Similarly, *Neighbourhood*, developed in Hong Kong, was developed with the aim of educating adolescents about the prevention of sexually transmitted infections through relatable urban storytelling (Lee et al., 2024). These games often include real-life scenarios and content designed in line with cultural contexts, thereby highlighting the importance of narrative localization. In Africa, the use of serious games is popular in Kenya, focusing on developing the skills of healthcare providers in dealing with a simulated neonatal medical emergency (Tuti et al., 2019).

Gamification

Gamification refers to the incorporation of game elements, such as point systems, levels, leaderboards, badges, and achievements, into non-game settings, such as education, marketing, or professional training. Unlike serious games, gamification does not necessarily require a storyline or a simulated environment; rather, it relies on motivating users through game-based incentives to perform specific tasks or engage more deeply with content (Deterding et al., 2011).

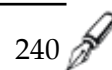
Internationally, gamification has been used in massive open online courses, language-learning apps (like Duolingo), and workplace training programmes. For example, healthcare organisations have gamified patient education to improve adherence to medication, while universities have gamified attendance tracking and peer review systems to increase student engagement (Sardi et al., 2017).

There is a promising future for the application of gamification in sub-Saharan Africa. Although it is still emerging, it is adaptable to mobile platforms and requires a relatively low technological threshold. The studies related to gamification in Africa primarily focus on the topic of sexual health (Haruna, 2024; Haruna et al., 2019).

While international research has focused on the effect of gaming on mental health, South African research has been innovative in exploring how gaming can be used to treat mental health conditions such as depression and anxiety. Spies et al. (2024) focused on serious games in psychotherapy, while Bantjes et al. (2024) used mobile games. This indicates the adaptability of technology and its potential to be used in creative ways. Previous studies have focused on the effects of playing video games on anxiety and depression (Pallavicini et al., 2022) and on the symptoms of depression and anxiety associated with internet gaming disorder (Bonnaire & Baptista, 2019; Idris et al., 2023; Teng et al., 2021). However, there is less emphasis on using gaming and digital technology to treat anxiety and depression. There is potential for this to be addressed in future research.

Mobile Games and Digital Accessibility

Mobile games, which are often delivered through smartphones or tablets, provide one of the most accessible and scalable forms of digital learning in many low- and middle-income countries, especially in locations where there is a relative scarcity of personal computers or virtual reality headsets. The increase in smartphone penetration across Africa makes mobile gaming a viable channel for deploying health education tools, civic training programmes, and skills development



applications. The flexibility of mobile devices, combined with offline functionality and low bandwidth requirements, makes them ideal for rural areas.

Studies, including those by Haruna (2024), have reported that a significant proportion of Tanzanian adolescents use smartphones regularly, not only for social media or entertainment but also increasingly for accessing educational content. When combined with gamification or serious game structures, mobile applications become powerful tools for extending the reach of both formal and informal learning.

The applicability of gaming to address the serious topic of HIV education in Africa was highlighted in the study by Haruna et al. (2019), which included leaderboards, scoring, and badges as motivation for game progression (and thus learning). Mobile games have been used worldwide to address issues ranging from financial literacy to disaster preparedness. In Kenya, games like AfyaSim provide a simulation of health system planning for medical students. In India, mobile games have been used to educate farmers about climate-resilient agriculture. These examples confirm the potential of mobile games to deliver targeted knowledge across diverse sectors in an engaging format.

Immersive technologies such as virtual reality, low-fidelity simulation trainers, and blended digital platforms were the most frequently used tools across the included studies. Research activity was concentrated in a small number of African countries, leaving many regions underrepresented and limiting broader continental insights. The implications for healthcare training based on these findings and the implications for healthcare practice are areas that warrant future research. Overall, the review shows that while gaming and digital technologies demonstrate clear potential for enhancing clinical training, the access and evidence remain uneven and underexplored.

CONCLUSION

This review provides the first consolidated mapping of gaming and digital technology used in health-professional education across African countries. The potential for using digital technology in African countries is enormous. The reviewed studies have demonstrated that African nations are finding innovative ways to apply digital technology in a contextually relevant manner. The uptake of technologies such as virtual reality, simulation trainers, and digital platforms is increasing, with evidence demonstrating feasibility, affordability, and scalability in low-resource contexts. The use of technology to manage healthcare conditions, such as pain, is innovative and relevant given the multilingual nature of South Africa, which complicates the communication of pain-related information. This also suggests that such approaches can be adapted for other multilingual countries.

Research from Africa has demonstrated the ability to make significant contributions to digital technology knowledge and practice in both the Global South and the Global North. Furthermore, it has the potential to provide knowledge that can be adapted and applied in the Global North. The ongoing advancement of existing technology, along with adaptations and collaboration between various African nations and developed countries, makes this an exciting and promising field.

Recommendations for Future Research

There should be studies to evaluate learning outcomes, cost-effectiveness, and scalability, specific to the African context. In addition to the learner experience, there should be studies on the educator experiences. Studies should also focus on acceptability, cultural appropriateness, and integration into existing curricula. In addition, the contribution that African studies could make to poorer regions or areas of European countries should be included in rigorous research. This will provide a novel approach to dealing with global challenges.

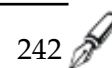


ACKNOWLEDGMENTS

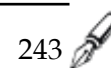
This research was supported by the MICT-SETA 4IR Research Chair in Digital Arts. The use of artificial intelligence in this article is limited to grammar correction and phrasing refinement. All ethical standards were adhered to, including the responsible use of AI-assisted tools.

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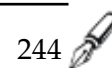
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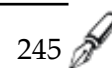


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