

PERCEPTIONS OF VIRTUAL AND AUGMENTED REALITY ADOPTION IN SOUTH AFRICAN UNIVERSITIES OF TECHNOLOGY: A SYSTEMATIC REVIEW

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ABSTRACT

Virtual Reality (VR) and Augmented Reality (AR) are increasingly transforming higher education worldwide by enabling immersive, experiential, and simulation-based learning environments. South African Universities of Technology (UoTs), with their strong emphasis on applied, and industry-aligned education, present a particularly relevant context for the integration of these technologies. Despite growing interest, evidence regarding the perceived impact of VR and AR within South African UoTs remains fragmented and dispersed across disciplines. This systematic review synthesises empirical research on the perceived impact of VR and AR adoption in South African Universities of Technology, with a focus on stakeholder perceptions of usefulness and ease of use, key barriers and enablers to implementation, and implications for practical integration models. The review followed the PRISMA guidelines, with searches conducted in Scopus, Web of Science, ERIC, Sabinet, and Google Scholar for studies published between 2020 and 2025. From 55 identified records, 31 peer-reviewed empirical studies met the inclusion criteria and were analysed using thematic synthesis. Three major themes emerged: perceived learning enhancement and industry readiness; institutional readiness and infrastructure constraints; and socio-technical barriers and adoption enablers. Findings indicate that students, lecturers, and administrators generally perceive VR and AR as beneficial for enhancing experiential learning, motivation, and practical skill development aligned with industry needs. However, high costs, infrastructure limitations, limited training, and policy gaps constrain sustainable implementation. The review concludes that while VR and AR demonstrate strong perceived potential to enhance teaching and learning in South African UoTs, successful integration requires structured institutional readiness models, strategic policy alignment, and sustained capacity building. Future research should focus on validating implementation frameworks and conducting longitudinal studies to measure long term educational and institutional impact.

Keywords: Virtual Reality; Augmented Reality; Technology Adoption; Higher Education; Universities of Technology; South Africa; Perceived Impact; Systematic Review.

INTRODUCTION

Global Context of VR and AR in Higher Education

The rapid growth of immersive technologies aligns with Fourth Industrial Revolution (4IR) objectives, emphasising digital literacy, automation, artificial intelligence, and smart manufacturing. International evidence demonstrates that VR and AR improve conceptual understanding, increase student engagement, support experiential learning, and reduce risk in hazardous training environments (Bin Latif, et al., 2024). According to Sánchez-García *et al.* (2025), developed economies have invested significantly in immersive laboratories, simulation centres, and industry partnerships to embed Virtual Reality (VR) and Augmented Reality (AR) into mainstream higher education. These investments typically include purpose-built extended reality (XR) facilities equipped with head-mounted displays, motion-tracking systems, haptic feedback devices, and high-performance computing infrastructure that enable realistic, risk free training environments.

Universities collaborate closely with industry partners in sectors such as manufacturing, healthcare, aviation, construction, and engineering to co-develop simulations aligned with workplace practices, allowing students to acquire job-ready competencies before entering professional environments. In addition, governments and private sector stakeholders often co-fund innovation hubs and digital skills initiatives, ensuring that immersive technologies are integrated not only into teaching spaces but also into research, professional certification, and lifelong learning programmes. As a result, VR and AR are increasingly positioned as core components of workforce preparation strategies rather than optional teaching enhancements (Rajuroy, 2025).

South African Universities of Technology

Masinde and A. Roux (2020) note that South African Universities of Technology (UoTs) originated from former technikons and were restructured to support national skills development and economic growth. As a result, their mandate centres on career-focused, practice-oriented education that bridges academic learning with workplace application. Their curricula therefore emphasise applied sciences, engineering and technology, health sciences, and design and creative industries, with strong components of laboratory work, industry placements, and work integrated learning. This applied orientation positions UoTs as key institutions for producing technically competent graduates who can transition quickly into professional and industrial environments.

Unlike traditional research-intensive universities, Universities of Technology prioritise workplace readiness and close alignment with industry needs, focusing on

practical competencies, professional skills, and hands-on experience that prepare graduates for immediate entry into the labour market (Wessels, 2020).

Contextual Challenges

Despite their strong alignment with immersive technologies, UoTs face systemic constraints that affect implementation, including unequal ICT infrastructure across campuses, limited funding for emerging technologies, bandwidth and connectivity limitations, high student-to device ratios, and varying levels of digital literacy among both students and staff (Adako & Ekundayo, 2025). These contextual realities highlight the need for a systematic, evidence based understanding of how VR and AR are adopted, perceived, and sustained within this sector in order to inform appropriate policy, investment, and implementation strategies (Sousa, Losada, Melo, & Alén, 2024).

Theoretical Framework

This review is underpinned by the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT).

The Technology Acceptance Model (TAM) proposes that users' adoption of a technology is primarily determined by two key perceptions: perceived usefulness, referring to the extent to which individuals believe the technology will enhance their performance, and perceived ease of use, referring to how effortless they expect the technology to be to operate (Schorr, 2023).

The Unified Theory of Acceptance and Use of Technology (UTAUT) extends this perspective by incorporating additional determinants of adoption, including social influence (the effect of others' opinions), facilitating conditions (availability of supporting infrastructure and resources), performance expectancy (anticipated benefits in task performance), and effort expectancy (perceived ease associated with use) (Refsi & Soma, 2025).

These frameworks guide the interpretation of stakeholder perceptions in this review.

Problem Statement

Although numerous international studies document the educational benefits of Virtual Reality (VR) and Augmented Reality (AR) in higher education, research conducted within the South African context remains fragmented across disciplines, institutions, and individual case studies. In particular, there is insufficient consolidated evidence synthesizing stakeholder perceptions of VR and AR specifically within Universities of Technology. This limited integration of findings constrains policymakers and institutional leaders in making well-informed decisions regarding adoption strategies, resource allocation, and

implementation frameworks (Ruiz, Abella, & Ausín, 2025). This gap limits evidence-based policymaking and strategic planning by reducing the availability of coherent, context-specific insights needed to guide effective and sustainable VR and AR adoption in Universities of Technology.

OBJECTIVES

The objectives of this systematic review are to:

- Examine how students, lecturers, and administrators perceive the usefulness and ease of use of Virtual Reality (VR) and Augmented Reality (AR) in teaching and learning within Universities of Technology.
- Identify and synthesise the key barriers and enablers influencing the adoption of VR and AR in this context.
- Evaluate how the synthesised evidence can inform the development of a practical and context-sensitive model for the successful implementation of VR and AR in Universities of Technology.

Research Questions

The review is guided by the following research questions:

RQ: What are the perceptions of Virtual and Augmented Reality Adoption in South African Universities of Technology?

To address this main question, the following sub-questions are explored:

RSQ1: How do students, lecturers, and administrators perceive the usefulness and ease of use of VR and AR in teaching and learning within Universities of Technology?

RSQ2: What are the main barriers and enablers influencing the adoption of VR and AR in South African Universities of Technology?

RSQ3: How can these perceptions and identified factors inform the development of a practical and effective model for the implementation of VR and AR in this context?

METHODOLOGY

This study adopted a systematic review research design to synthesise existing literature on the perceived impact of Virtual Reality (VR) and Augmented Reality (AR) in South African Universities of Technology (UoTs). A systematic review of the relevant literature was conducted to ensure methodological rigor, transparency, and replicability in the

identification, evaluation, and synthesis of relevant studies (Veginadu, Calache, Gussy, Pandian, & Masood, 2022). The review process was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. The review followed a structured, multi-phase approach, drawing on systematic review development stages outlined in comparable methodological studies. A predominantly descriptive analytical approach was employed as an initial layer of analysis, whereby the characteristics, contexts, and methodological features of the included studies were systematically catalogued. This descriptive mapping was undertaken to enhance transparency and facilitate reproducibility, particularly given the heterogeneity of study designs, disciplinary contexts, and immersive technologies represented in the evidence base (Ruiz, Abella, & Ausín, 2025). According to Shaheen et al. (2023), such descriptive synthesis is considered a critical component of systematic reviews, as it enables the identification of patterns, gaps, and contextual factors prior to deeper analytical interpretation. Building on this foundation, the review incorporated integrative comparisons across studies and thematic analysis to examine stakeholder perceptions, adoption factors, and implementation contexts. This approach allowed for the identification of methodological strengths and limitations, as well as recurring themes and trends across the literature, ensuring that the synthesis remained both comprehensive and interpretative.

Eligibility Criteria

Eligibility criteria were defined prior to the review to ensure consistency and relevance.

Inclusion Criteria:

- Studies focusing on the use of VR and/or AR in South African Universities of Technology
- Empirical studies employing quantitative, qualitative, or mixed methods designs
- Conceptual studies that included stakeholder perceptions or adoption considerations
- Studies published in English
- Studies published between 2020 and 2025

Exclusion Criteria:

- Studies conducted outside the higher education context
- Studies focused on non-educational or purely industrial settings
- Purely technical or engineering-focused papers without educational or perception related data
 - Studies focused on primary or secondary (K–12) education
 - Duplicate publications

Information Sources

A comprehensive search was conducted across multiple academic databases and repositories to capture relevant peer-reviewed and region-specific literature. The databases searched included:

- Scopus
- Web of Science

- Sabinet
- Google Scholar

In addition, selected institutional repositories were consulted to identify relevant South African publications not indexed in international databases.

Search Strategy

The search strategy employed a comprehensive combination of keywords and Boolean operators to ensure broad coverage of the relevant literature. To address variations in terminology across studies, multiple synonyms and related terms were included.

The primary search terms were grouped into four key categories:

- **Technology terms:**

“Virtual Reality” OR “VR” OR “Augmented Reality” OR “AR” OR “Extended Reality” OR “XR” OR “Mixed Reality” OR “MR” OR “Immersive Learning” OR “Immersive Technology”

- **Educational context:**

“Universities of Technology” OR “Higher Education” OR “Tertiary Education” OR “Universities” OR “Colleges”

- **Geographical context:**

“South Africa”

- **Study focus:**

“Perception” OR “Adoption” OR “Impact” OR “Acceptance” OR “Use” OR “Implementation” OR “Experience”

An example of the search string used was:

(“Virtual Reality” OR “VR” OR “Augmented Reality” OR “AR” OR “Extended Reality” OR “XR” OR “Mixed Reality” OR “MR” OR “Immersive Learning” OR “Immersive Technology”)

AND (“Universities of Technology” OR “Higher Education” OR “Tertiary Education” OR “Universities” OR “Colleges”) AND (“South Africa”) AND (“Perception” OR “Adoption” OR “Impact” OR “Acceptance” OR “Use” OR “Implementation” OR “Experience”)

Search strings were adapted across databases to align with platform-specific indexing and search requirements.

Study Selection

The study selection process followed a multi-stage screening procedure in line with PRISMA guidelines. Initially, all identified records were imported into a reference management system, and duplicates were removed. Titles and abstracts were then screened to assess relevance against the inclusion and exclusion criteria. Full-text articles were retrieved for studies that met the initial screening criteria or where eligibility was unclear.

The screening process resulted in the identification of 55 records. After the removal of duplicates, 49 records were screened by title and abstract. Of these, 40 full-text articles were assessed for eligibility, and 31 studies met the final inclusion criteria and were included in the review.

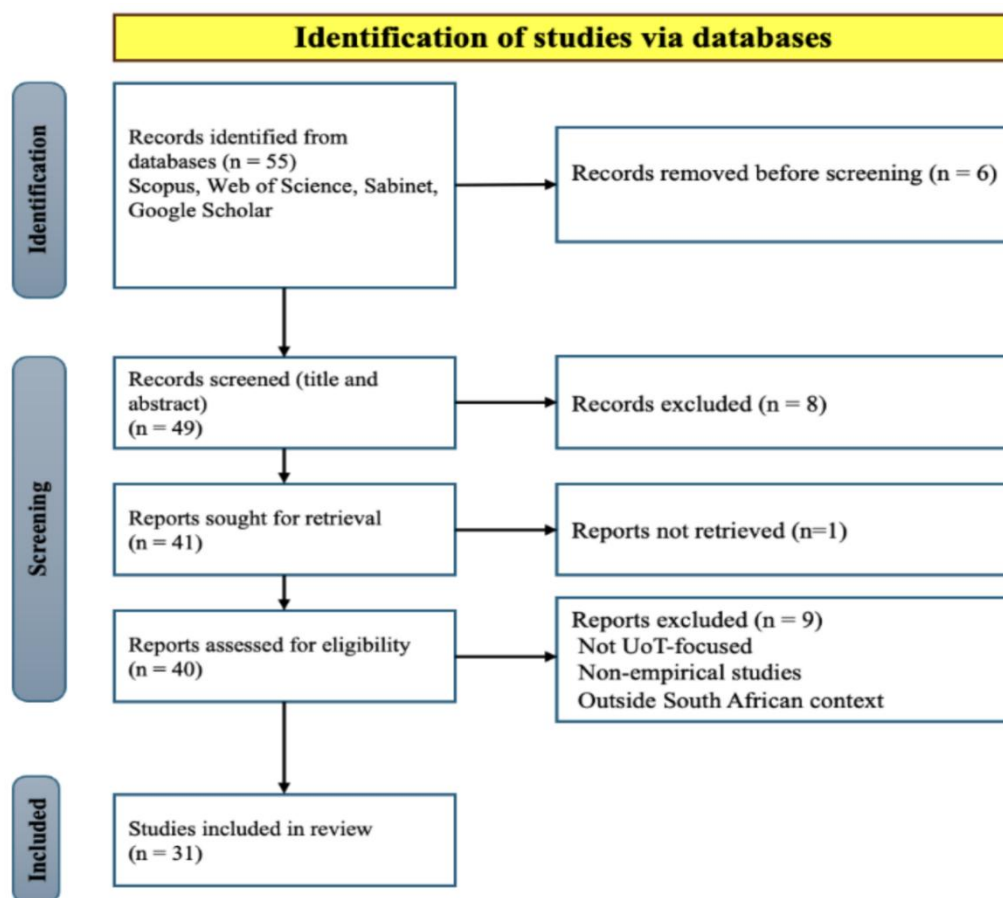


Figure 1. Flowchart of the search process for research articles selected for the systematic review using the PRISMA method

Data Extraction

Data were systematically extracted from the included studies using a structured data extraction form to ensure consistency. The extracted information included:

- Author(s) and year of publication

- Study design and methodology
- Sample characteristics (students, lecturers, administrators)
- Academic discipline or field of study
- Type of immersive technology used (VR, AR, or both)
- Key findings related to perceptions, benefits, barriers, and enablers

Data Synthesis

Given the methodological and contextual heterogeneity of the included studies, a thematic synthesis approach was employed. The synthesis followed three iterative phases:

1. Line-by-line coding of extracted findings to identify recurring concepts and perceptions
2. Development of descriptive themes that grouped related codes into broader categories
3. Generation of analytical themes that interpreted relationships between stakeholder perceptions, adoption factors, and institutional contexts

This approach enabled the integration of findings across diverse study designs while maintaining analytical depth and coherence (Gilmore, McAuliffe, Power, & Vallières, 2019).

RESULTS

Study Selection

Following the PRISMA-guided screening process, a total of 31 studies met the inclusion criteria and were included in the systematic review. These studies formed the evidence base for the synthesis of stakeholder perceptions, implementation challenges, and contextual factors related to the use of Virtual Reality (VR) and Augmented Reality (AR) in South African Universities of Technology.

Study Characteristics

The included studies used a range of methodological approaches, reflecting the interdisciplinary and exploratory nature of VR and AR research in higher education contexts. Of the 31 studies reviewed, 15 adopted quantitative survey designs, 10 used mixed methods approaches, and 6 employed qualitative research designs, including interviews, focus groups, and case studies. The remaining studies combined descriptive evaluations with pilot implementation analyses.

The studies covered several academic disciplines that are central to the mandate of Universities of Technology. These included engineering, applied sciences, architecture and the built environment, and education, with a strong emphasis on practice-based and simulation-oriented learning contexts. Collectively, the studies examined perceptions of VR

and AR among students, lecturers, and, to a lesser extent, institutional administrators. Across the reviewed literature, the primary focus was on examining perceptions of VR and AR among key stakeholders. Students constituted most participants, with studies frequently exploring their engagement, learning experiences, and skill development. Lecturers were also represented, particularly in relation to pedagogical adoption and instructional design considerations. However, institutional administrators were less frequently included, indicating a relative gap in research addressing strategic, policy, and management perspectives.

Table 1. Summary of Studies on V/A R Adoption, Perceptions, and Use in Higher Education (2020–2025)

Author(s)	Year	Context	Methodology	Key Findings
Adako & Ekundayo	2025	Digital divide in low-income education	Conceptual / literature review	Access inequality limits tech adoption; infrastructure and policy critical
Akinradewo et al.	2025	AR adoption barriers (built environment, developing context)	Survey + SEM	Cost, skills gaps, and infrastructure are key barriers
Akinradewo et al.	2024	AR drivers for SDG 4 in education	Quantitative survey	Perceived usefulness and industry relevance drive adoption
Bin Latif et al.	2024	AR/VR in interactive learning	Experimental study	AR/VR improves engagement and interactivity
Bosman et al.	2024	Immersive tech in education	Mixed methods	Enhances experiential learning but requires institutional support
Cabrera-Duffaut et al.	2024	VR for competence development	Systematic review	VR improves skills, especially practical competenci

				es
Chasokela	2025	VR in engineering education	Case study	Improves spatial awareness and problem solving
Clara et al.	2025	VR in healthcare training (SA nurses)	Qualitative interviews	Positive perceptions; useful for safe skill development
Dembe	2024	VR/AR classroom integration	Literature review	Enhances engagement but limited by cost and training
Falebita et al.	2025	Teacher readiness for VR	Survey (TAM based)	Readiness influenced by ease of use and self efficacy
Grewel & Gie	2023	VR and student engagement (SA)	Experimental study	VR significantly increases engagement
Jantjies et al.	2020	Experiential learning via VR/AR	Mixed methods	Supports active and experiential learning
Marutha & Dube	2023	Open distance e learning (SA)	Qualitative study	Digital readiness affects adoption success
Masinde & A. Roux	2020	4IR transformation in SA universities	Conceptual	Emerging tech (incl. VR/AR) critical for future readiness
Meccawy	2023	Teachers' attitudes to XR	Survey	Positive attitudes but concerns about complexity

Moloi & Salawu	2022	Technology institutionalization (SA)	Qualitative	Policy and leadership influence adoption
Moloja	2024	AR and student engagement (SA review)	Literature review	AR enhances engagement and motivation
Moshi et al.	2025	VR/AR effectiveness (SA university)	Quantitative survey	Improves learning outcomes and engagement
Oyetade et al.	2024	ICT adoption factors	Survey	Organisational support and leadership are key
Rajuroy	2025	Emerging tech in vocational training	Conceptual	VR/AR improve employability skills
Ruiz et al.	2025	VR in HE aligned to SDGs	Systematic review	Supports sustainability and inclusive learning
Shi et al.	2025	Digital pedagogy development	Quantitative	Training improves teacher competence and confidence
Sousa et al.	2024	VR adoption (tourism education link)	Survey	Perceived usefulness drives adoption
Sánchez-García et al.	2025	XR skills gap analysis	Mixed methods	Skills shortages hinder adoption
Thangavel et al.	2025	AR/VR innovations in education	Review	Improves learning but faces scalability issues
Tian & Ironsi	2025	AR impact on learning outcomes	Experimental	AR improves academic performance

Titus	2024	XR in health education (Southern Africa)	Mixed methods	Enhances clinical training and simulation learning
Tonga	2025	AR/VR in SA architecture education	Case study	Improves design visualisation skills
Van der Westhuizen et al.	2025	AR/VR in SA architecture education	Qualitative	Positive learning experience; improves understanding
Wessels	2020	4IR workforce preparation (SA)	Conceptual	Universities must adopt emerging tech
Yu et al.	2024	Student perceptions of VR (health)	Survey	High acceptance; improves confidence and learning

Thematic Findings

Thematic synthesis of the included studies resulted in the identification of three overarching thematic categories: perceived benefits of VR and AR, challenges associated with adoption, and contextual factors influencing implementation.

Perceived Benefits of VR and AR (RSQ1)

Across the reviewed studies, stakeholders generally reported positive perceptions regarding the usefulness of VR and AR in teaching and learning (Meccawy, 2023).

Student perceptions highlighted increased engagement, improved spatial and conceptual understanding, enhanced practical and technical skills, and reduced anxiety when learning in simulated or risk-free environments. VR-based simulations were particularly valued in engineering and health sciences, where experiential learning is critical. Perceptions of ease of use among students varied and were strongly influenced by prior exposure to digital technologies and the availability of technical support (Jantjies, Moodley, & Maart, 2018).

Lecturers perceived VR and AR as pedagogically innovative tools capable of supporting complex concept visualisation and experiential learning approaches. Many studies reported that lecturers recognised the alignment of immersive technologies with

constructivist and experiential learning theories. However, concerns were also expressed regarding the additional time required to develop immersive learning materials and the lack of consistent technical and instructional support (Cabrera-Duffaut, Pinto-Llorente, & Iglesias-Rodríguez, 2024).

Administrators generally viewed VR and AR as strategic tools for digital transformation and enhancing institutional competitiveness. From a management perspective, immersive technologies were perceived as contributing to institutional reputation and graduate employability. Nonetheless, administrators raised concerns related to budget constraints, long term sustainability, and the scalability of VR and AR initiatives (Marutha & Dube, 2023).

Challenges and Barriers to Adoption (RSQ2)

Despite the perceived benefits, the review identified several recurring challenges that hinder the effective adoption of VR and AR in Universities of Technology. The most frequently reported barriers included the high cost of hardware and software, inadequate internet and ICT infrastructure, limited staff training and digital skills, and the absence of clear institutional policies and implementation frameworks. In addition, resistance to change among academic staff was reported in some studies, often linked to workload concerns and uncertainty about pedagogical value (Akinradewo, *et al.*, 2025).

Enablers and Contextual Factors

Key enablers facilitating VR and AR adoption included strong leadership commitment, industry partnerships, and access to external funding or grants. Curriculum integration emerged as a critical success factor, with studies indicating that VR and AR were more positively perceived when embedded meaningfully within course outcomes rather than introduced as add on technologies. Student digital readiness and familiarity with emerging technologies also played an important enabling role (Thangavel, Karuppiyah, & K, 2025).

According to Oyetade, Harmse and Zuva (2024), at an institutional level, contextual factors such as institutional readiness, policy frameworks, and organisational culture significantly influenced adoption. Institutions with established digital transformation strategies and supportive governance structures were better positioned to implement immersive technologies successfully.

Evidence Gaps and Implementation Implications (RSQ3)

The review revealed several notable evidence gaps. There is a lack of longitudinal studies examining the long-term impact of VR and AR on learning outcomes and graduate employability. In addition, relatively few studies focus explicitly on administrative

and policy level perspectives, limiting insights into strategic decision-making and sustainability planning (Bosman, *et al.*, 2024).

Drawing on the synthesised findings, a six-phase practical implementation model is proposed to guide VR and AR adoption in Universities of Technology. The model includes:

1. Institutional readiness assessment,
2. Strategic alignment with institutional and Fourth Industrial Revolution goals,
3. Infrastructure development,
4. Capacity building through structured professional development,
5. Pilot implementation in selected departments, and
6. Continuous monitoring and evaluation to support iterative improvement.

This model integrates stakeholder perceptions, contextual constraints, and enabling factors identified across the reviewed studies. It therefore provides a structured and context-sensitive pathway for the sustainable implementation of immersive technologies in higher education.

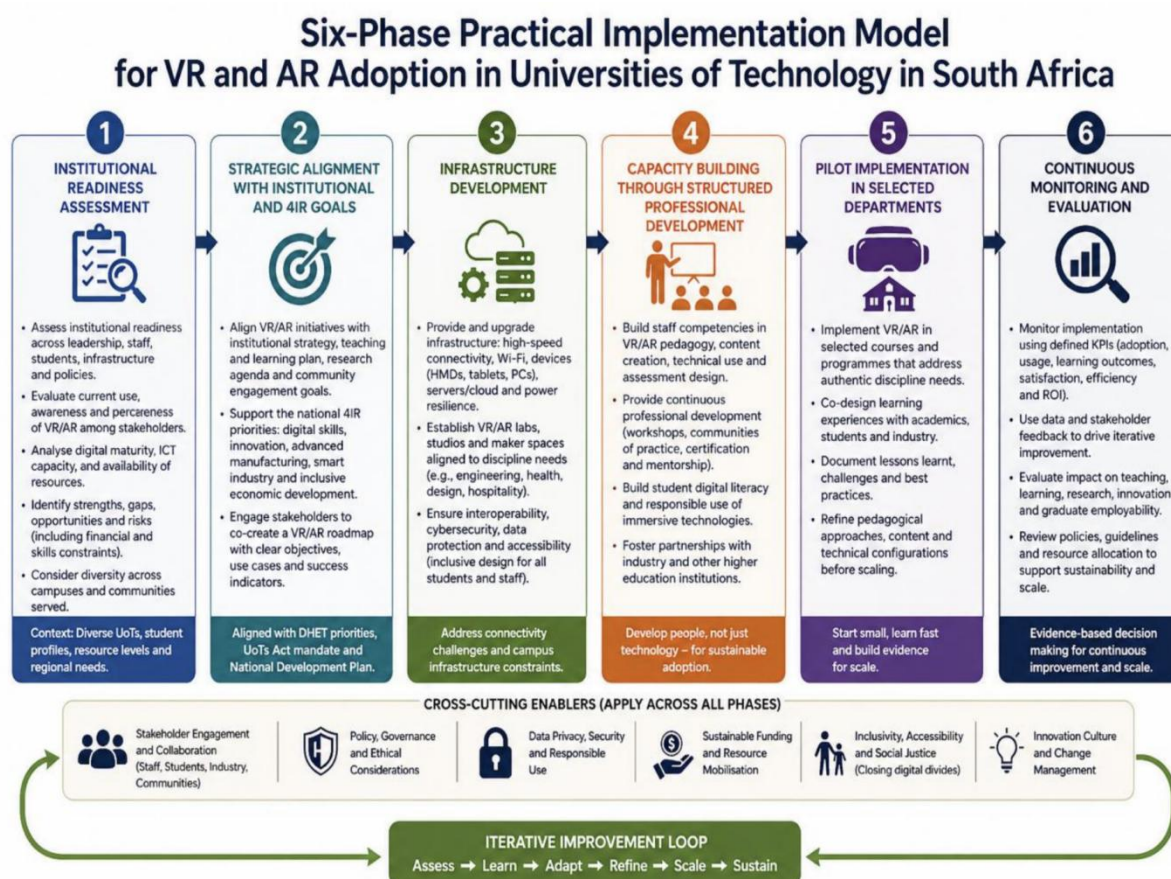


Figure 2. A Six-Phase Implementation Model for VR and AR Adoption in Universities of Technology in South Africa

DISCUSSIONS

Interpretation of Findings

The findings of this systematic review confirm that immersive technologies, including Virtual Reality (VR) and Augmented Reality (AR), are generally perceived positively by students, lecturers, and administrators within South African Universities of Technology (Bosman, et al., 2024; Moshi, Hlatshwayo, & Oyetade, 2025). These perceptions are consistent with international literature that highlights the benefits of immersive technologies for experiential learning, enhanced engagement, and practical skill development. Globally, studies report that VR and AR support active learning and improve understanding of complex concepts, particularly in applied and technical disciplines (Bin Latif, et al., 2024).

However, the South African Universities of Technology (UoTs) context presents distinct structural and socio-economic challenges that influence adoption. Unlike institutions in developed economies, UoTs operate within environments characterised by unequal access to digital infrastructure, limited financial resources, and varying levels of digital literacy. These digital divide factors significantly shape stakeholder perceptions of the feasibility and sustainability of VR and AR implementation (Masinde & A. Roux, 2020). While attitudes toward immersive technologies are largely positive, their adoption is strongly moderated by facilitating conditions such as infrastructure availability, institutional support, and access to training, which aligns with the Unified Theory of Acceptance and Use of Technology (UTAUT).

Implications for Practice

The findings of this review have several practical implications for Universities of Technology.

Curriculum design:

Virtual Reality (VR) and Augmented Reality (AR) should be purposefully integrated into curricula to support clearly defined learning outcomes, rather than being introduced as supplementary or experimental tools. Effective curriculum alignment ensures that immersive technologies enhance experiential learning, practical competence, and industry-relevant skills, particularly in applied and vocational disciplines (Dembe, 2024).

Staff development:

Effective adoption of VR and AR requires targeted professional development initiatives to improve lecturers' digital competencies and pedagogical confidence. Continuous training, instructional design support, and accessible technical assistance can reduce resistance to change and enhance perceived ease of use, thereby supporting sustained adoption (Shi, Sin, & Wang, 2025).

Infrastructure investment:

Institutional investment in ICT infrastructure, including reliable internet connectivity, appropriate hardware, and dedicated technical support systems, is critical for the sustainable implementation of immersive technologies. Strategic partnerships with industry and external funding bodies may help Universities of Technology mitigate financial constraints and improve access to advanced technological resources (Moloi & Salawu, 2022).

Limitations of the Review

This systematic review has several limitations. First, the database coverage may not have captured all relevant studies, particularly unpublished or institution-specific research. Second, the inclusion of only English-language publications may have excluded relevant studies published in other languages. Finally, the review is subject to potential publication bias, as reported by Nair (2019), studies reporting positive outcomes are more likely to be published than those reporting neutral or negative findings.

Future Research Directions

Future research should address the identified gaps by conducting longitudinal studies to examine the sustained impact of VR and AR on learning outcomes, graduate employability, and institutional transformation. Comparative studies across different universities, including traditional universities and Universities of Technology, would provide deeper insight into contextual influences on adoption. In addition, further research should explore the ethical, social, and cultural dimensions of immersive technology use, including issues related to accessibility, inclusivity, and student well-being.

CONCLUSION

This systematic review synthesised existing literature on the perceived impact of Virtual Reality (VR) and Augmented Reality (AR) in South African Universities of Technology (UoTs) and demonstrates a strong perceived potential for these immersive technologies to enhance teaching and learning. Across the reviewed studies, students, lecturers, and administrators consistently reported benefits such as increased engagement, improved experiential learning, and enhanced practical and industry-relevant skills. These findings align with international research and highlight the pedagogical value of immersive technologies in applied and vocational education contexts (Tonga, 2025; Moshi, Hlatshwayo, & Oyetade, 2025).

However, the review also reveals that the effective and scalable adoption of VR and AR within Universities of Technology is constrained by persistent structural challenges. Disparities in ICT infrastructure, funding limitations, skills gaps, and the absence of coherent

institutional and policy frameworks continue to shape both perceptions of feasibility and actual implementation (Ruiz, Abella, & Ausín, 2025). These constraints underscore the reality that positive stakeholder perceptions alone are insufficient to ensure sustainable integration. The review therefore emphasises the need for a structured and context-sensitive implementation model that prioritises institutional readiness, capacity building, and alignment with national and institutional policies. Such an approach is essential not only for the effective adoption of VR and AR but also for ensuring that immersive technologies contribute to equitable access to innovative learning opportunities across the South African higher education sector.

In conclusion, VR and AR hold significant promise for advancing innovative, inclusive, and industry-aligned education in South African Universities of Technology. To realise this potential, coordinated efforts across policy, institutional practice, and investment are required. Future research should focus on empirically validating the proposed implementation model and conducting longitudinal studies to assess the long-term educational, social, and employability outcomes associated with immersive technology adoption.

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