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From Pilot Projects to Sustainable Integration: Exploring Teacher Experiences in EdTech Implementation in South African Township Schools

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Abstract. The integration of educational technology (EdTech) in South African township schools has been widely promoted as a strategy for improving teaching and learning, yet questions remain about the sustainability of this effort. This study explored the experiences of teachers in Cosmo City Township to understand the enduring challenges shaping technology use in an under-resourced school environment. Employing a qualitative, cross-sectional design, data were gathered through written responses from purposively selected teachers who had direct engagement with EdTech initiatives. A thematic analysis revealed that unreliable infrastructure, inconsistent maintenance, and insufficient financial planning significantly hinder long-term sustainability. Teachers also reported inadequate professional development, often limited to a short technical workshop, as well as limited involvement in the decision-making process — factors that contributed to misalignment between policy aspirations and classroom realities. As a result, many relied on low-tech tools, such as projectors and WhatsApp, which were more feasible in overcrowded classrooms with poor connectivity. The findings further highlight the persistence of the digital divide, which disproportionately disadvantaged township learners, particularly during the COVID-19 pandemic. Drawing on the UTAUT and Smart Education Framework, the study illustrates how infrastructural, socio-economic, and policy constraints shape teachers' adoption and continued use of technology. These insights add to the growing body of literature on digital sustainability in South Africa's township schools. The study calls for long-term investment, ongoing teacher support, and participatory policymaking to foster more equitable and sustainable EdTech integration.

Keywords: Educational Technology (EdTech); Sustainability; Township schools; Teacher experiences

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1. Introduction

Educational technology (EdTech) is widely regarded as a key strategy for improving teaching and learning in disadvantaged schools and addressing long-term inequalities in South Africa's education system (Sadiki et al., 2023; Spaull, 2015). In line with global digital transformation goals, national policy frameworks have promoted the integration of technology to better support learners for participation in the Fourth Industrial Revolution (4IR) (Mulaudzi, 2024; Hart, 2023). However, despite these ambitions, many EdTech interventions in township schools struggle to progress beyond short-term pilot phases. They often begin with enthusiasm and external support but fail to generate lasting change once initial resources are withdrawn (Cheng et al., 2025; Hart, 2023). Understanding why sustainability is hard to achieve requires examining this challenge in relation to the broader context in which these interventions are introduced.

South Africa's education system remains one of the most unequal globally, with township and rural schools continuing to face inadequate infrastructure and limited digital resources (Sadiki et al., 2023; Spaull, 2015). The White Paper on e-Education (DoE, 2004) and later provincial initiatives such as the Khanya Project, Gauteng Online, and the Classroom of the Future sought to bridge this divide. Yet, despite these efforts, recurring issues such as poor maintenance, insufficient teacher training, and unreliable infrastructure contributed to their decline soon after implementation (Rasool & Naidoo, 2024).

The consequences of this became particularly visible during the COVID-19 pandemic, when many well-resourced schools transitioned to online learning, while a large portion of township schools were unable to sustain any form of digital participation (Sadiki et al., 2023; Pillay, 2021). Temporary measures, such as radio and television broadcasts, offered short-term support but lacked continuity (Zenex Foundation, 2022). These patterns suggest that providing technology alone is insufficient without long-term institutional and pedagogical support.

International frameworks such as the Smart Education Framework emphasise that sustainable digital transformation depends on the alignment of technology, teacher capability, and contextual support as part of an integrated ecosystem (Huang et al., 2024; Zhuang et al., 2023). The framework highlights the importance of creating smart learning environments supported by ongoing professional development and responsive infrastructure. These global insights mirror challenges in South African township schools, where technology is often introduced without the long-term pedagogical and institutional support required for continued success (Mkhize & Davids, 2021).

Existing research has largely focused on the early stages of technology integration and short-term outcomes, such as device distribution, often overlooking what happens once external support is withdrawn and how schools must independently sustain EdTech use (Hart, 2023; Rodriguez-Segura, 2022). Teachers are central to this process, yet their voices are frequently underrepresented in both research and policy. Sustainability ultimately relies on teachers, who must

integrate technology into their daily practice (Kim & Jang, 2020). However, limited teacher involvement in policy and planning can result in interventions that do not reflect classroom realities. This highlights the need to understand sustainability from teacher's lived experiences to identify what helps technology remain useful once the initial project phase concludes. Therefore, this study seeks to investigate the factors that hinder or enable the successful transition of EdTech pilot projects into sustainable educational initiatives in South African township schools.

It is guided by the research question: What are the factors that hinder or contribute to the successful transition of EdTech pilot projects into sustainable initiatives in South African township schools? This research is significant because it shifts attention from short-term implementation to long-term educational improvement. By centring teacher experiences, it provides practical insights that can strengthen future EdTech efforts in under-resourced schools. The findings aim to support policymakers, school leaders, and programme designers in ensuring that investments in digital learning translate into enduring change, contributing to improved equity and learning outcomes.

2. Theoretical Framework

This study draws on the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Smart Education Framework, which together provide a comprehensive lens for examining both teacher acceptance of EdTech and the broader conditions required for its sustainable integration in township schools. UTAUT, developed by Venkatesh et al. (2003), explains technology adoption through four key constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions (Xue et al., 2024; Hart, 2023; Marikyan & Papagiannidis, 2021).

In the context of this study, these constructs help illuminate how teachers perceive the usefulness of EdTech, how easy or difficult it is to use in resource-constrained classrooms, how school leadership or colleagues influence their adoption, and whether adequate technical and organisational support exists for continued use. While UTAUT effectively captures the behavioural and motivational aspects of teacher technology use, it does not fully account for the broader institutional, infrastructural, and governance challenges that often undermine sustainability in disadvantaged school environments.

To address this limitation, the study draws on the Smart Education Framework, which emphasises the importance of aligned digital ecosystems supported by reliable infrastructure, ongoing professional development, effective school governance, and the creation of interactive, learner-centred digital environments that extend beyond initial implementation phases (Huang et al., 2024; Zhuang et al., 2023; Demir, 2021). The framework is particularly relevant to township schools, where EdTech projects frequently collapse once external support is withdrawn due to unstable connectivity, limited device maintenance, insufficient training, and weak long-term planning. By combining UTAUT's focus on teacher acceptance with the Smart Education Framework's emphasis on systemic readiness and long-term digital sustainability, this study can analyse EdTech

integration as both a human behavioural process and an organisational ecosystem issue.

3. Literature Review

To build a comprehensive understanding of EdTech in under-resourced school contexts, the literature is examined across several key strands, including historical inequalities, policy developments, digital divides, and challenges affecting sustainability.

3.1 The Role of EdTech in the Education System

EdTech is widely recognised as a transformative tool for improving educational quality, equity, and access, particularly in disadvantaged settings. In South Africa, this potential is central to bridging the persistent gaps between affluent and township schools (Bawa & Bawa, 2025; Hart, 2023; Van Jaarsveld & Van der Walt, 2018). National policy, especially the e-Education White Paper (DoE, 2004), emphasises digital textbooks, online platforms, and virtual classrooms as means of addressing historical inequalities (Mulaudzi, 2024). The benefits of EdTech include enhanced access to up-to-date learning content, increased learner engagement, and opportunities for more personalised learning (Bawa & Bawa, 2025; Van Niekerk & Blignaut, 2014). Global evidence echoes this potential.

UNESCO (2023) reports that nearly half of the world's lower-secondary schools were connected to the internet for teaching by 2022, signalling widespread adoption of digital learning (Antoninis et al., 2023). The Organisation for Economic Co-operation and Development (OECD) (2023) highlights how many countries are shifting toward interactive and adaptive digital resources to support equity and personalised learning (Yu et al., 2023). These global trends reinforce that South Africa's EdTech challenges are part of a broader systemic issue requiring sustained implementation capacity.

3.2 Educational Inequality and the Digital Divide in South Africa

The potential of EdTech in township schools is constrained by deep-rooted educational inequalities that originate from the apartheid-era Bantu Education system, which created long-standing disparities in school resources, infrastructure, and teacher quality (Bawa & Bawa, 2025; Khumalo, 2022; Spaull, 2015). Although post-apartheid reforms aimed to equalise school funding, township schools remain significantly under-resourced compared to their affluent counterparts (Bawa & Bawa, 2025; Chisango & Marongwe, 2021). These structural inequities manifest as a persistent digital divide, defined as the unequal access to technology, the internet, and digital skills (Bawa & Bawa, 2025; Gudmundsdottir, 2010).

Studies show that historically disadvantaged schools face limited access to devices, poor connectivity, and inadequate digital literacy training, restricting their participation in modern learning (Rasool & Naidoo, 2024; Chisango & Marongwe, 2021). COVID-19 further exposed this divide: while privileged schools shifted to online learning, township learners were largely excluded due to unreliable electricity, limited device access, and a lack of teacher readiness for remote pedagogy (Dube, 2020). This context highlights that EdTech sustainability

cannot be separated from the broader socio-economic realities shaping schools' capacity to integrate technology.

3.3 EdTech Policies and the Policy-Practice Gap

South Africa has implemented several policies aimed at EdTech integration, including the e-Education White Paper and the Professional Development Framework for Digital Learning (Rasool & Naidoo, 2024; Mulaudzi, 2024). These policies aim to improve equity by developing digital competencies and increasing access to technology. Initial progress, such as the establishment of computer labs, indicates commitment to digital transformation (Sehlako, 2023). However, a persistent gap exists between policy ambition and implementation.

Many township schools continue to experience weak infrastructure, limited internet connectivity, and insufficient technical support (Bawa & Bawa, 2025; Mnisi, 2023). Policies also tend to overlook contextual constraints such as load-shedding (electricity blackouts), device security, and school-level management capacity. A major weakness is the limited involvement of teachers in policy development and the absence of sustained pedagogical training aligned to curricular needs (Hart, 2023). As a result, policies often remain aspirational rather than practical, widening the policy–practice divide.

3.4 Lessons from Previous EdTech Initiatives in South Africa

Past large-scale EdTech initiatives provide insight into the recurrent barriers to long-term sustainability. Projects such as Gauteng Online, Khanya, the Smart Schools Programme, and the Open Learning Systems Education Trust (OLSET) achieved initial progress, particularly in expanding device access and raising awareness of EdTech integration. However, these initiatives shared common weaknesses: a narrow focus on hardware, inadequate teacher training, unstable funding, misalignment with school needs, and limited technical maintenance (Hart, 2023; Mahlo & Waghid, 2022; Buzuzi & Chigona, 2021; Isaacs, 2007).

For example, Gauteng Online reached more than 1,200 schools but failed due to insufficient teacher support and limited curriculum integration. Khanya deployed significant numbers of computers but lacked financial continuity and training depth. The Smart Schools Programme fell short of its tablet distribution targets due to budget constraints, and OLSET's radio-based model struggled to remain relevant in a digitalising sector. These cases collectively demonstrate that technology provision alone does not result in sustainable EdTech; sustainability relies on contextual suitability, long-term funding, teacher capacity, and systemic support.

3.5 Barriers to Sustainable EdTech Integration in Township Schools

A synthesis of the literature identifies three interlinked barriers to sustainable EdTech in disadvantaged schools:

Infrastructure and Resource Barriers: Township schools experience shortages of devices, fragile connectivity, unreliable electricity, and limited maintenance capacity (Hart, 2023). Even when technology is provided, poor infrastructure prevents effective use, reflecting a pattern of "technology dumping" without ongoing support (Mwapwele et al., 2019; Van Jaarsveld & Van der Walt, 2018).

Financial and Planning Barriers: High hardware costs, recurring expenses, and dependence on once-off donations hinder long-term sustainability (Spaull, 2015). Short-term funding models lead to project collapse, while insufficient planning results in solutions that do not match school realities (Ramorola, 2013).

Human Capacity Barriers: Teachers often lack digital pedagogical skills, receiving training that focuses more on operating devices than integrating them meaningfully into teaching (Mnisi, 2023; Van Jaarsveld & Van der Walt, 2018). Many educators also experience digital anxiety, resistance to change, or revert to traditional methods due to low confidence (Hart, 2023). Learners similarly lack foundational digital literacy, limiting their engagement and reducing the educational value of available tools (Saputra et al., 2021).

This current study addresses the gap in understanding why many EdTech pilot projects in township schools fail to transition into long-term, sustainable initiatives. It does this by investigating the factors that enable or hinder this transition, providing insights into the challenges and opportunities surrounding digital learning adoption in resource-constrained environments.

4. Methodology

4.1 Research Paradigm

This study was guided by an interpretivist paradigm, which shaped the entire research process by positioning teacher's lived experiences at the centre of inquiry. This meant that the researchers sought to understand how teachers interpret and make sense of EdTech sustainability within the realities of their daily teaching environments. The paradigm guided the researchers to prioritise contextual understanding, subjective viewpoints, and socially constructed realities during both data collection and analysis.

4.2 Research Approach

A qualitative research approach was adopted to align with the interpretivist orientation of the study. This meant collecting descriptive, non-numerical data that captured teachers' personal experiences and interpretations. A cross-sectional time horizon was used, with all data gathered at a single point in time to provide a snapshot of teachers' current views on EdTech integration and sustainability. The qualitative approach allowed the researchers to explore these experiences in depth and interpret emerging factors inductively, ensuring that insights were drawn directly from the data rather than imposed externally.

4.3 Research Design

Cosmo City Township was selected as the single case for this study because it represents a typical, information-rich example of an under-resourced South African township where EdTech initiatives have historically struggled to achieve long-term sustainability. The area is characterised by overcrowded classrooms, inconsistent infrastructure, socio-economic inequality, and limited digital resources, factors that are common in many township schools across South Africa. Selecting one township allowed the researchers to conduct an in-depth, context-sensitive investigation, which would not have been feasible with a wider geographic scope, given the qualitative design. Although the study focuses on a single township, transferability is still possible because the contextual

characteristics of Cosmo City closely mirror those of other Quintile 1–3 schools† nationwide.

4.4 Population and Sampling Strategy

Purposive sampling was used to select teachers who could provide rich, relevant insights into EdTech sustainability in township schools. The population included teachers from Quintile 1–3 Cosmo City schools who had experience using educational technology either during the COVID-19 emergency remote teaching period or who had at least three years of post-pandemic experience with technology integration. Although COVID-19 occurred approximately five years ago, the period of emergency remote teaching remains a valuable reference point for identifying teachers who had engaged with EdTech under constrained and urgent conditions. At the same time, requiring a minimum of three years of recent technology-use experience ensured that participants were also actively engaged in ongoing digital integration efforts.

This approach allowed the study to capture both historical and current perspectives on sustaining EdTech in township schools. The final sample of 13 teachers was considered sufficient because it represented a relatively homogeneous, information-rich group capable of offering detailed accounts of EdTech adoption and sustainability. Repeated rounds of coding indicated that no new codes or themes emerged, demonstrating that data saturation had been achieved and confirming that the sample size was adequate to capture the key patterns and insights required for the study.

4.5 Data Collection Method

Data were collected using an open-ended questionnaire (see Appendix A for the questions asked) designed to elicit detailed, reflective responses on teachers' experiences with EdTech. An open-ended questionnaire allowed teachers to provide thoughtful, reflective responses at a time convenient for them, without disrupting teaching hours. The questionnaire included sections on demographic information, technology use, and factors influencing sustainability. The researchers printed and distributed the questionnaires in hard copy and arranged for teachers to complete them outside of classroom hours to avoid interrupting teaching activities. Once the questionnaires were collected, the researchers reviewed them and conducted follow-up clarification via WhatsApp when responses required further explanation. Because participants did not consent to audio recordings, all follow-up information was recorded manually and incorporated into the main dataset. This process ensured that teachers' perspectives were captured accurately and comprehensively.

4.6 Data Analysis Method

The data were analysed using Braun and Clarke's (2006) thematic analysis procedure. The analysis began with the transcription of all written responses into Microsoft Word, followed by the organisation of the data in Excel. Participants

† South African Quintile 1-3 schools are no-fee institutions that get higher per-learner funding from the government, whereas Quintile 4 and 5 schools charge fees.

were anonymised using codes such as Teacher 1, Teacher 2, and Teacher 3. Researchers familiarised themselves with the data through repeated reading before coding significant phrases and patterns across the responses. These initial codes were then grouped into broader categories and refined into final themes that reflected recurring ideas across participants' experiences. Although the analysis followed an inductive approach, the UTAUT and Smart Education Framework were used as sensitising concepts to help interpret the themes relating to EdTech adoption and sustainability. Care was taken not to force the data into predetermined categories but rather to use the framework to enhance understanding.

4.7 Trustworthiness

The study applied Lincoln, Lynham, and Guba's (2011) criteria of credibility, transferability, dependability, and confirmability to ensure the trustworthiness of the findings. Credibility was strengthened through purposive sampling and follow-up clarification of questionnaire responses. Transferability was addressed by providing detailed descriptions of the Cosmo City context and participant characteristics, enabling readers to determine whether the findings may apply to similar settings. Dependability was supported through the maintenance of a clear audit trail that documented all research procedures, from sampling and data collection to coding and theme development. Confirmability was ensured by grounding interpretations in participants' own words and maintaining systematic documentation that reduced researcher bias. Together, these measures ensured that the study's findings were accurate, transparent, and reflective of participants' experiences.

4.8 Ethical Considerations

Ethical approval was obtained from the Department of Information Systems at the University of Johannesburg prior to data collection. Participants were fully informed about the study's purpose and data use, and only those who provided consent were included. Pseudonyms (e.g., Teacher A, Teacher B), as noted, were assigned to ensure anonymity, and all data were securely stored and used solely for academic purposes. Data collection was conducted respectfully, outside school hours, to avoid disrupting normal school activities.

5. Results

This study examined the factors that hinder the successful transition of EdTech pilot projects into sustainable initiatives in South African township schools. The study identified the key barriers to sustainability, assessed the outcomes of implemented projects, examined the roles of teachers, and drew lessons from the COVID-19 pandemic's remote teaching phase.

5.1 Teacher Demographics and Context

The sample comprised 13 teachers from Quintile 1–3 public schools in Cosmo City. Teaching experience was distributed as follows:

Table 1: Teaching experience

Teaching experience	Number of teachers	Percentage %
=>3 years	3	23%
4-6 years	4	31%
7-10 years	6	46%

Table 2: Grades taught

Grades taught	Number of teachers	Percentage %
Grade 12	6	33%
Grade 11	4	22%
Grade 10	3	17%
Grade 9	2	11%
Grade 8	3	17%

5.2 Barriers to EdTech Sustainability

5.2.1 Infrastructure and resource limitations

The study identified inadequate infrastructure as the primary barrier to sustainable EdTech integration. Teachers highlighted severely overcrowded classrooms and limited access to devices:

> *"Large classes (±50) and poor network make tech use difficult. Sharing devices is common."* (Teacher B)

> *"We share one computer lab among the whole school, and sometimes it's locked because the equipment is not working."* (Teacher F)

Teachers repeatedly described projects that started with enthusiasm but collapsed due to the lack of ongoing support, theft, vandalism, and absent budgets for maintenance, as indicated by the following excerpts:

> *"One-off donations without follow-up support made technology unusable over time"* (Teacher C) and *"…no budget [is] allocated to maintain the devices."* (Teacher D). Consequently, *"These devices are never fixed once they break down."* (Teacher H)

Connectivity was another major issue, with frequent load-shedding and theft of network cables rendering technology unreliable. As one teacher noted: *"many devices... needed software updates which failed without internet."* (Teacher K) The lack of basic consumables was also a problem, with teachers being unable to print tests because printers were either broken or lacked paper. These systemic challenges, including restricted lab access where *"…computer labs are always booked"* (Teacher C), often forced teachers to revert to traditional teaching methods.

5.2.2 Training and professional development

The lack of proper and continuous professional development was another significant barrier. Teachers reported that the training offered was consistently short-term, fragmented, and focused solely on basic technical operation rather than pedagogical integration. This was captured in comments such as:

> *"Introductory workshops only, no follow-ups."* (Teacher A)
> *"Received basic training that didn't really focus on the technology part."* (Teacher F)

This highlighted the disconnect between device literacy and teaching needs. The one-off nature of this support was a key issue, with teachers stating:

> "*Initial training only, no ongoing support.*" (Teacher D)

> "*One-off training sessions.*" (Teacher E)

This lack of sustained, context-specific guidance left educators feeling unprepared and unsupported, which discouraged consistent use and innovation. Ultimately, it reduced the perceived usefulness and ease of the technology, leading to a reversion to traditional teaching methods.

5.2.3 Exclusion from decision-making

Teachers reported being sidelined and expressed frustration over their exclusion from technology decision-making processes. Representative comments included:

> "*Our voices are often overlooked in decisions, which leads to ineffective tech use.*" (Teacher A)

> "*Rarely considered, decisions made by DBE* [Department of Basic Education] *officials without teacher input.*" (Teacher C)

They noted that choices, frequently made at the district or departmental level without consultation, did not match classroom needs: "*Technology decisions are made by the district.*" (Teacher H) This top-down approach resulted in mismatched interventions, undermined teacher ownership, reduced motivation to sustain initiatives, and ultimately led to ineffective tech use.

5.3 Outcomes of EdTech Integration

Despite the challenges, teachers reported both positive and negative outcomes. Negative experiences involved device breakdowns, misuse, poor maintenance, and learner resistance. Teachers observed:

> "*Devices broke and remained unrepaired, while others [computers] failed to update without internet.*" (Teacher K)

> "[careless handling] *by learners demolished new initiatives.*" (Teacher E)

These failures reinforced the reluctance to adopt tech and produced wasteful procurement cycles. However, teachers also reported significant benefits, pointing out that projectors reduced workload and improved lesson delivery:

> "*Using projectors allowed me to share notes in class, which made it easier than writing long notes with chalk on the board.*" (Teacher I)

They also noted health benefits: "*…not writing on the board, which means not getting dirty by the chalk.*" (Teacher G. Computers and occasional virtual reality (VR) exposure increased engagement. Teachers reported that learners "*…enjoyed participating in a VR workshop, even though access was limited by the number of headsets available.*" (Teacher K) These instances showed potential for pedagogical change when infrastructure and maintenance permit.

5.4 Teachers' Role and Agency in Sustaining EdTech

Teachers played an essential role in sustaining technology use, often compensating for systemic shortcomings. Many taught themselves new tools using online tutorials or collaborated with peers. Teachers B, K, and G noted that they were:

> *"Mostly self-taught, and receive assistance from colleagues."*
> *"Self-taught, [and] mostly rely on YouTube videos for training."*
> *"Never received training, I am self-taught."*

Their adaptability showed resilience and commitment, but also revealed institutional neglect. Teachers emphasised that sustainability depends on leadership support, maintenance systems, and consistent technical assistance. They suggested community-based maintenance teams and partnerships with local businesses to fund repairs and upgrades. Teacher H and I noted:

> *"There should be a clear plan for maintaining and repairing devices locally."*
>
> *"Community involvement can help with sustainability by helping to minimise burglary."*

5.5 COVID-19 Pandemic and Digital Learning

Based on the remote teaching experiences during the COVID-19 pandemic, township teachers demonstrated innovation amidst significant structural constraints. They adapted by using low-tech, high-access channels to maintain learning: *"We relied on radio lessons and SABC TV programs and also shared notes via WhatsApp groups for those who had phones."* (Teacher B) Teachers also used WhatsApp for direct support, as Teacher L noted that they *"sent voice notes on WhatsApp to explain lessons better."* However, these efforts revealed deep digital inequities, as unequal device ownership and high data costs excluded many learners, reproducing pre-existing educational inequalities.

The pandemic also created unequal exposure to EdTech, disproportionately affecting lower grades. Teacher D stated that *"…only teachers of grades 10 to 12 returned to school,"* while Teacher G, who teaches lower grades, confirmed: *"I didn't really get exposed to teaching online... I was helping at school with social distancing only."* This prioritisation introduced a structural inequity in digital competency development. Upon the resumption of in-person teaching, despite technologies such as projectors and smartboards being used, traditional teaching methods continued to dominate. Computer labs remained largely unused due to social distancing concerns, highlighting the tension between policy aspirations and on-the-ground realities in resource-constrained township schools.

6. Discussion

This study explored factors hindering the transition of EdTech pilots into sustainable initiatives in South African township schools through an analysis of teachers' viewpoints. The findings revealed that overcrowding, unstable infrastructure, inadequate training, and exclusion of teachers from decision-making constrain EdTech sustainability, while teachers showed resilience by favouring reliable, low-tech tools such as projectors and WhatsApp. The results are discussed within the context of the UTAUT model and the Smart Education

Framework to provide recommendations for more effective technology implementation in South African schools. Figure 1 provides a visual summary of the findings discussed below.

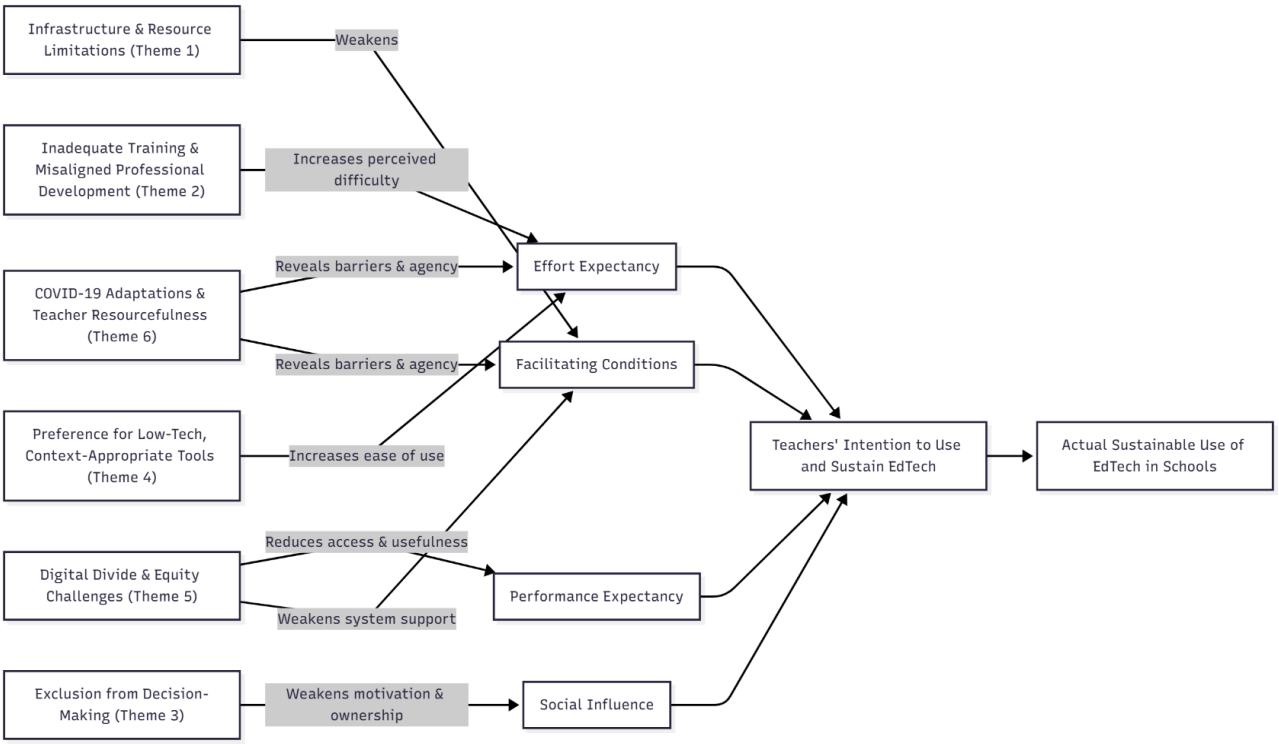

Figure 1: Findings mapped onto the UTAUT model (Venkatesh et al., 2003)

6.1 The Infrastructure Barrier is Systemic and Undermines All Other Efforts

The study found that infrastructure and resource constraints are the most decisive barriers to sustainable EdTech integration in township schools because they directly determine facilitating conditions within the UTAUT framework. As discussed in the literature (Rasool & Naidoo, 2024; Hart, 2023; Chisango & Marongwe, 2021; Ramorola, 2013), unreliable electricity, poor connectivity, and the absence of maintenance systems undermine long-term success by disrupting both access and continuity. These issues were visible in teachers' daily experiences, where broken devices went unrepaired, load-shedding disrupted lessons, and overcrowded classrooms forced learners to share limited devices.

These conditions increased perceived effort and reduced performance expectancy, which explains why teachers struggled to integrate technology consistently. Within the Smart Education Framework, weak infrastructure prevented the creation of interconnected, data-enabled learning spaces, resulting in fragmented and fragile implementation. The repeated collapse of initiatives such as Gauteng Online and the Khanya Project demonstrates how the absence of stable facilitating conditions triggers a predictable cycle of early adoption followed by system failure and abandonment (Buzuzi & Chigona, 2021; Isaacs, 2007). This pattern occurs not because teachers resist change, but because structural deficiencies make sustained use impossible, even for highly motivated staff.

6.2 Financial and Planning Models are Short-term and Create a Cycle of Collapse

Financial and planning weaknesses emerged as another critical constraint because short-term funding models prioritise rollout over sustainability. Many EdTech projects rely on donor funding or once-off government initiatives without ongoing financial planning (Hart, 2023; Kim & Jang, 2020; Spaull, 2015; Ramorola, 2013), which creates a situation where schools receive equipment without the capacity to protect, maintain, or replace it. Teachers described how theft, vandalism, and the absence of maintenance budgets made technology use unsustainable. These problems occur because security and asset protection are treated as secondary considerations during project design. Devices were delivered without funds for repairs, upgrades, or replacements, and once damaged, they were seldom restored.

This process produces a repeating pattern in which resources enter schools, quickly deteriorate, and disappear. From a UTAUT perspective, this instability weakened teachers' trust in organisational support, lowering their intention to invest effort in long-term technology use (Xue et al.; Rashid, & Ouyang, 2024). Within the smart education framework, the absence of sustainability planning disrupted the continuity of smart learning environments, which depend on maintenance, data flow, and system reliability. Research by Ramorolo (2013) explains how this long-standing financial neglect has institutionalised a culture of short-term thinking, where projects are measured by delivery rather than durability. The recurring pattern of project launch and collapse, therefore, reflects structural weaknesses in both organisational design and governance logic.

6.3 Teacher Training is Inadequate, Misaligned, and Fails to Build Pedagogical Confidence

Teacher professional development was identified as a cornerstone of EdTech sustainability, yet it remains a weak point because it directly shapes effort expectancy within the UTAUT framework. The literature (Mathebula et al., 2025; Msila, 2015; Ramorola, 2013) notes that training often prioritises technical operations rather than pedagogical integration, which increases cognitive load and perceived complexity. This study confirmed that most teachers received one-off workshops with no follow-up support. These short sessions failed to build confidence because they did not allow time for practice, feedback, or classroom-based application.

As a result, teachers perceived technology use as high effort and low return, which suppressed behavioural intention. Within the Smart Education Framework, the absence of continuous professional learning disrupted the human capacity element required for adaptive and personalised digital learning environments (Huang et al., 2024; Zhuang et al., 2023). In line with the UTAUT framework (Xue et al., 2024; Hart, 2023; Venkatesh et al., 2003), inconsistent training lowered effort expectancy and weakened facilitating conditions, which directly reduced adoption.

6.4 The Policy–Practice Divide is Perpetuated by Excluding Teacher Voices

A significant gap exists between national EdTech policies and their implementation in township schools because the exclusion of teachers weakens

social influence within the UTAUT framework. Policies such as the e-Education White Paper and the Professional Development Framework for Digital Learning aim to enhance equity and digital integration, but as Mnisi (2023) and Vandeyar (2021) note, they often fail when teachers are not meaningfully consulted. This study confirmed Vandeyar's (2021) findings that teachers were excluded from decisions about technology adoption, which explains why policies appeared disconnected from practical classroom needs.

Teachers reported that most decisions were made by departments or districts without considering classroom realities, leaving them feeling overlooked and disempowered. This exclusion weakens ownership and reduces commitment, which in turn undermines implementation. Within the Smart Education Framework, the lack of participatory design prevented the development of context-responsive, user-centred learning systems. The policy-practice gap is therefore structurally produced by governance models that prioritise central control over collaborative system intelligence.

6.5 Preference for Low-tech, Context-appropriate Solutions is more Sustainable than Advanced Tools

Another key finding is that teachers prefer low-tech, context-appropriate tools rather than advanced, high-cost technologies because their working environments reward reliability over novelty. Studies have shown that in under-resourced settings, sustainability depends more on practicality than innovation (Hart, 2023; Gudmundsdottir, 2010). The study confirmed the findings from studies conducted by Masango et al. (2020) and Mashiyane et al. (2024), that teachers consistently favoured simple, reliable tools such as projectors, WhatsApp, radio, and television because these technologies reduce dependence on unstable electricity, complex maintenance, and specialist support.

In UTAUT terms, these tools increased perceived ease of use and reduced risk, which strengthened adoption intention (Xue et al., 2024). Within the Smart Education Framework, this preference reflects a form of contextual intelligence, where smartness emerges through adaptive alignment with environmental constraints rather than through technological sophistication. By contrast, advanced technologies like VR headsets were considered exciting but unrealistic due to electricity shortages, connectivity failures, and limited technical support (Mashiyane et al., 2024). This pattern occurs because sophisticated tools amplify existing system weaknesses, while simple tools accommodate them.

6.6 Equity and the Digital Divide

The study also concludes that the digital divide remains a deep and enduring barrier because historical inequalities have produced structurally different learning environments across school types (Bawa & Bawa, 2025; Hart, 2023; Van Jaarsveld & Van der Walt, 2018; Spaull, 2015). Teachers confirmed that learners in township schools often lacked devices, connectivity, or affordable data, which reduced both access and participation. In well-resourced schools, stronger exposure to technology normalised digital learning, creating positive social influence and higher behavioural intention (Bawa & Bawa, 2025; Sadiki et al., 2023; Chisango & Marongwe, 2021). This divergence explains how inequality becomes self-reinforcing over time. Within the Smart Education Framework,

unequal access prevents the formation of inclusive, networked learning environments, which require universal connectivity and shared data infrastructures to function effectively. Unsustained EdTech initiatives, therefore, not only fail operationally but also reproduce structural educational stratification.

6.7 Crises such as COVID-19 Amplify Inequalities but Can Foster Resourcefulness

The COVID-19 pandemic acted as a national stress test for South Africa's digital education system (Reimers, 2022; Chisango & Marongwe, 2021). As the literature notes (Mashiyane et al., 2024; Sadiki, 2023; Masango et al., 2020; Dube, 2020), under-resourced schools struggled to sustain online learning, relying on temporary solutions such as radio, television, and WhatsApp. These emergency strategies were not sustainable once schools reopened because they were reactive rather than systemically planned. This pattern emerged because crisis conditions intensified constraints on facilitating conditions and increased perceived effort. Teachers selected low-bandwidth tools to preserve minimal functionality under extreme pressure.

Within the UTAUT framework, emergency conditions reshaped effort expectancy and performance expectancy, driving short-term behavioural change without long-term institutionalisation. The pandemic revealed that without proactive investment in infrastructure, affordability, and continuous teacher development, temporary adaptations cannot evolve into permanent solutions. Within the Smart Education Framework, the pandemic exposed the absence of resilient, adaptive infrastructures capable of supporting continuity. These adaptations faded after school reopening because they were not embedded within stable systems. The crisis, therefore, revealed both teacher agency and systemic fragility, demonstrating why reactive innovation cannot substitute for planned, theory-informed system design.

7. Limitations and Implications

This cross-sectional study captured findings at a single point in time, limiting insight into change over time. It relied mainly on open-ended questionnaires, which restricted deeper probing. The study was confined to Cosmo City schools and focused only on teachers, excluding learners, Department of Basic Education policymakers, and technology suppliers. These limitations indicate the need for broader samples, multiple methods, and wider stakeholder inclusion.

8. Recommendations

The study recommends a long-term, system-level approach to sustaining EdTech in township schools. Priorities include strengthening infrastructure, ensuring reliable electricity and internet, securing ongoing funding for maintenance and security, and providing continuous teacher development focused on classroom integration. Policies should move from aspiration to practice by including teachers as co-designers. Practical, low-tech tools should be prioritised where infrastructure is weak, while equity must be addressed through reduced data costs and stronger partnerships. Community involvement and crisis-resilient planning are essential to protect resources and ensure continuity of learning. A potential approach to support these priorities is the introduction of community-

driven funding or partnership-based models, such as crowdfunding initiatives where local businesses, non-governmental organisations (NGOs), and alumni networks commit to supporting schools' technology needs, maintenance, and ongoing technical support on a long-term basis.

9. Conclusion

This study concludes that although EdTech has the potential to improve teaching and learning in township schools, its long-term sustainability is limited by systemic constraints such as unreliable infrastructure, insufficient technical support, limited teacher training, short-term budgeting, and the exclusion of teachers from decision-making processes. Aligned with the research question: What are the factors that hinder or contribute to the successful transition of EdTech pilot projects into sustainable initiatives in South African township schools?, the findings show that enabling factors, such as teacher adaptability, low-tech solutions, and collaborative community support, exist alongside significant barriers, including persistent digital inequalities, poorly maintained infrastructure, and policy approaches that prioritise device distribution over long-term support systems.

The evidence reveals that context-appropriate tools (e.g., projectors, WhatsApp, and radio) are more sustainable than advanced technologies that fail under weak infrastructural conditions, underscoring the need for continuous professional development, reliable connectivity, planned maintenance budgets, and meaningful teacher inclusion in policy implementation. This study bridges the gap between policy ambitions and classroom realities by highlighting the conditions that either enable or hinder sustainable EdTech adoption in disadvantaged settings, offering practical implications for policymakers while signalling the need for future longitudinal and mixed-method research that includes broader stakeholder perspectives across township and rural contexts.

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Appendix 1: Questionnaire Questions

1. What grade(s) do you currently teach?
2. How many years of teaching experience do you have?
3. What types of EdTech tools have you used (e.g., tablets, educational apps, digital whiteboards, learning management systems)?
4. Can you describe your experience using EdTech in your school? What worked well, and what did not?
5. What were some of the main challenges you faced when trying to integrate EdTech into your teaching?
6. In your opinion, what factors support or hinder the continued use of EdTech in your school after a pilot project or initial rollout?
7. What kind of support or training did you receive to help you use EdTech in the classroom?
8. Do you feel that teachers' voices and concerns are heard when decisions about technology are made in your school? Please explain.
9. How did your school manage teaching and learning during the COVID-19 pandemic using technology?
10. What lessons from the COVID-19 period do you think can help improve EdTech use and sustainability going forward?
11. In your view, what does sustainable use of EdTech look like in a school like yours?
12. What changes or support would help make EdTech more effective and long-lasting in your school?