The adoption of digital technologies in public schools in South Africa

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ABSTRACT

Adopting digital technology in public schools is an important part of modern education systems. This is especially true in South Africa, where access to technology can greatly affect learning outcomes and chances. This qualitative study examines how digital tools are used in South African public schools. Its goal is to find out how complicated this process is and what effects it has on how teachers and students learn. The study looks at key themes like digital infrastructure availability, training and support mechanisms, educational implications, and contextual factors affecting adoption. It does this by using thematic analysis of interviews with School Principals. The results show a complex picture with chances and problems, such as problems with bad infrastructure and insufficient resources. The study shows how important it is to fix systemic problems and create a helpful environment so South African public schools can adopt technology successfully. In the end, South African public schools can better prepare students for the digital age's needs and ensure that everyone has equal access to a good education by using digital tools well.

KEYWORDS

Digital Adoption, digital Divide, digital Infrastructure, technologies, public schools, educators.

DECLARATION

I, Regomoditse Joey Mafikeng, declare that this research report is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Name: Regomditse Joey Mafikeng

Signature: RJ Mafikeng

Signed at Randburg

On the 26th day of February 2024.

DEDICATION

When the time is right, I, the Lord, will make it happen. Isaiah 60:22.

This dissertation is dedicated to my children: my very funny and inquisitive son, who is on the Autism spectrum, and my lovely, girly girl fashionista daughter. Your level of understanding and patience with me throughout this entire journey is beyond measure. Everything I do is for you, and I love you both dearly.

To my mother: Thank you for your prayers and daily check-ins. Your support means the world to me. Thank you for your unwavering love, Koko Melly.

To my sister: Thank you for the moments of laughter; you always know how to lift my spirits when I'm feeling stressed or down. You're truly amazing, Tati.

To my partner: Despite spending nights alone while I was immersed in my studies, thank you for your unwavering love and support. Your constant checking in, printing pages, and asking "How far" each day meant everything to me. You've contributed to this journey more than words can express. I love you!

Lastly, to my friends: Thank you for pulling me out of my studies at times, for checking in on me, and for showing up at my door with a bottle of wine to unwind. Your unwavering support means the world to me. I love each and every one of you dearly!

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LIST OF ACRONYMS

DBE	Department of Basic Education
DC	Digital Competency
ECEC	Early Childhood and Education care
ICT	Information and Communication Technology
IWB	Interactive Whiteboard
LMS	Learning Management System
LTSM	Learning and Teaching Support Material
NGO	Non-Governmental Organisations
RACI	Responsible, Accountable, Consulted, Informed.
SWOT	Strengths, Weaknesses, Opportunities, Threats
TOE	Technology, Organisation, Environment
VR	Virtual Reality

CHAPTER 1. INTRODUCTION

1.1 Statement of purpose

This qualitative research study explored the integration of digital technologies into the curriculum of South African state schools.

1.2 Background of the study

Amid the 2020 coronavirus lockdown, numerous South African state schools suspended their educational activities indefinitely. The state of emergency mandated a restriction on human-to-human contact, leading to the cessation of crucial services such as education. The interruption was primarily attributed to a shortage of resources and a lack of expertise in transitioning to virtual schooling operations. The World Bank (2021) argued that the COVID-19 pandemic might serve as an opportunity for nations to reshape their education systems and envision new scenarios where education is accessible to all, including vulnerable children, across various locations. Furthermore, the pandemic created a notable chance for transformation, allowing for the utilisation of opportunities presented by information and communication technology (Khoza, 2022). While a significant proportion of private schools proceeded with virtual learning, learners in the private education sector were able to maintain their schooling activities (Tremblay & Roseveare, 2012). In contrast, many learners in government schools remained at home for extended periods without engaging in any educational activities. Teachers and school systems have traditionally collected and used data in some way or another, whether it's entering marks in a rating book to track progress and calculate final marks or analysing standardised test scores to assess district-wide accomplishment. However, modern technology has tremendously expanded educators' ability to use data and analytics to improve teaching. Teachers can now employ tools that track their students' comprehension in real time while delivering a session or provide them with the results of assigned homework before organising their future lessons (School of Education, 2019).

South Africa, with its cultural richness and significant socioeconomic gaps, provides a compelling backdrop for investigating the effects of incorporating digital technologies into education. South African state-owned schools frequently confront specific issues because of unequal budget distribution, disparities in infrastructural availability, and differing levels of technological access. (Guruli, Flores, & Laken, 2020) . Despite having the required technology and expertise, South Africa significantly trails in technological advancement. The nation encounters substantial obstacles related to critical factors like consistent electricity supply(loadshedding), affordable data, and supportive legislation. Failing to address these foundational elements makes the development of innovative educational approaches more challenging (Paddock, 2022).

1.3 Research problem.

The use of technology in South African public schools is very limited, often non-existent, or at best ignored (Naidoo & Madida, 2019). The landscape of jobs/careers is transforming due to evolving technologies. Companies are increasingly breaking down job roles into distinct tasks that can be accomplished by remote or outsourced workers, sometimes located in different countries or provinces. Digitalisation and Internet connectivity play crucial roles in enabling innovations like online document sharing, cloud storage, wireless connectivity, videoconferencing, and AI-enhanced process management. In the next two decades, advancements in telepresence technologies, such as virtual reality, are anticipated to enable the completion of more physical tasks remotely. This expansion will extend the trend beyond the realm of traditional office jobs (Global Trends, 2021).

The research problem is that digital skills have become more important in today's professional environment as technology has been integrated across industries. There is a significant demand for individuals who can understand digital technologies, communicate online, and use digital tools efficiently, this trend is projected to continue over time. Individuals with strong digital skills are more likely to succeed in a wide range of jobs (UNLV Continuing Education ,

2022) .There is general agreement on the importance of acquiring digital skills early in one’s upbringing. Foundational and critical secondary education levels offer valuable opportunities to learn and improve digital skills. These stages influence cognitive development, enabling learners to acquire new concepts and adapt to changing technologies (Pearson, 2010). Learners gain familiarity with technology by incorporating digital abilities into basic education, which boosts confidence for more complicated skills in later school years (King, 2017).

Narrowing the digital divide alone will not transform education. To close the digital divide, we must teach all kids how to use technology for creativity and productivity. Instead of consuming passive content, learners should engage in lifelong learning (Global Trends, 2021). The efficient use of digital learning technologies in the classroom can boost student engagement, assist teachers in improving lesson plans, and enable personalised learning. It also helps pupils develop crucial 21st-century abilities. Virtual classrooms, video, augmented reality (AR), robotics, and other technology tools make classes more engaging and create more inclusive learning environments that encourage cooperation and inquisitiveness while allowing teachers to collect data on student performance in real time (School of Education , 2022).

The problem this study focused on is how South African state schools are supporting their learners in preparing for the envisioned future world of work. The research focused on studying the various tactics used by South African State schools to provide learners with access to relevant information and to support the development of digital capabilities. The study's detailed examination of these aspects attempts to provide insights into the efficacy of existing teaching techniques. The goal is to determine how well these techniques prepare learners for success in an ever-changing and technologically driven professional and social environment.

1.4 Research questions.

The primary objective of this study is to gain a nuanced understanding of how these technologies are integrated into the curriculum. The study aims to uncover insights into the challenges, successes, and overall impact of introducing digital technologies into the educational landscape of South African state schools.

Based on this objective, the following research questions are explored.

I. What are the factors that drive the adoption of digital technologies in public schools?
II. What role does the availability of digital infrastructure play in enabling adoption among South African public schools?

1.5 Rationale

The global movement towards digital education informs the analysis of digital adoption in South African schools. Understanding how South Africa aligns with these trends helps determine its readiness to use digital tools effectively (Chomunorwa, Mashoinganyika, & Marevesa, 2023). South Africa's education system faces issues such as socioeconomic inequality and poor infrastructure, how these constraints intersect with digital adoption demonstrates how schools innovate and overcome obstacles (Mouton, Louw, & Strydon, 2022). Addressing historical disparities in education is crucial. Digital tools can help to overcome gaps by providing access and tailored learning. Exploring this potential is critical for both ethical and societal purposes (King, 2017).

Embracing digital technologies in South African public schools necessitates thoroughly analysing a complex network of factors influencing educational performance. This complex analysis process is driven by the dynamic interplay of various elements, including global trends that influence educational practices worldwide, local challenges unique to South Africa, policy frameworks governing education, and technology's overarching potential to address and alleviate educational inequalities within the country. The

convergence of these factors highlights not just the study's critical importance, but also its fundamental complexity. By delving into this deep network of variables, the research bid to uncover the complexities of digital technology adoption in South African public schools. This study's intentions were to provide insights by delving into the complex web of variables that exists in digital technology adoption in South African public schools and providing awareness of policies and practices that can improve educational outcomes and promote diversity.

1.6 Delimitations of the study

i. This research centred its focus on early developmental institutions, primarily emphasising primary schools.
ii. This study concentrated on the existing infrastructure and practices rather than emphasising potential future technological advancements within the school.
iii. This study did not compare the schools' technological advancements but gained an understanding of the current operations and facilities.
iv. The scope of this study was narrowed down to encompass schools within the Gauteng province.

1.7 Definition of terms

1.7.1 *Digital Adoption*

Technology adoption involves incorporating new technologies into existing systems or creating new ones. It entails maximising the use of technology and adapting to evolving demands (Sarkar, Anjan, 2022).

1.7.2 *Digital Transformation*

The culmination of all organisational change initiatives in reaction to technology disruption, which significantly alters the structure and character of the organisation, particularly to enhance its capacity to prosper in the digital era (Armstrong & Lee, 2021).

1.7.3 *Digital Divide*

The digital divide refers to the disparity between individuals who possess access to technology, the internet, and digital literacy education and others who lack such resources. It impacts all age groups, including rural and urban areas, as well as a diverse range of enterprises and sectors (Steele, 2019).

1.7.4 *LTSM (Learning and teaching support Material)*

The 2014 Draft Policy on Learning and Teaching Support Material defines LTSM as the range of items utilised for learning and teaching in a classroom. These include educational materials made by teachers and students, as well as commercially available classroom resources, including wall charts, textbooks, e-books, readers, stationery, scientific kits, dictionaries, and encyclopaedias (Jitsing, 2022).

1.7.5 *Digital Infrastructure*

The complete physical and software infrastructure required to provide digital goods, products, and services. This encompasses data centres, fibre infrastructure, server hardware, personnel, IT virtualisation and infrastructure software, operating systems, and more (S DIA, 2022).

1.7.6 *Digital Maturity*

Digital maturity is the assessment of an organisation’s capacity to generate value using digital technologies. It is a crucial indicator of success for companies initiating a digital transformation (May, 2022).

1.8 Assumptions

i. Fee-paying state schools might exhibit a higher level of technological advancement than schools that do not charge fees.

ii. School principals and educators are knowledgeable about the future employment landscape.

iii. The government allocates funds explicitly for technology in its budget provisions.

iv. Educators are proficient in utilising technology and devices to enhance their teaching methodologies.

v. Learners have engaged with various types of technological gadgets and devices.

1.9 Report Outline

The chapter begins by outlining the research background, focusing on evaluating digital technologies used in South African State Schools.

The need to understand the existing environment of technology use, identify areas for improvement, and equip learners with necessary digital skills is emphasised. The investigation goes into the significance of digital adoption in alleviating educational inequities and its broader societal ramifications. The study's objectives are clearly outlined, encompassing the evaluation of the digital adoption rate and an examination of its impact on equity and student outcomes. This chapter concludes by discussing the study's assumptions and key terms.

- Chapter two - Reviews and evaluates existing academic literature on using digital technologies in schools and organisations. It summarises the study's arguments and suggests a theoretical and analytical framework.

- Chapter three - Provided a detailed explanation of the research methodology, data collection and analysis methods, sample, and population details. Chapter three also establishes the transferability and credibility of the study.
- Chapter four - The study's findings are presented based on the themes identified during the data processing process.
- Chapter five - The study compares its findings with the information gathered from the literature discussed in Chapter Two, highlighting both commonalities and discrepancies.
- Chapter six - Summarises the study's objectives, methodology, and findings, and evaluates the propositions presented in chapter two. The chapter will include recommendations for implementing digital technology in government run schools.

CHAPTER 2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

Technology opens opportunities for individualised instruction to fulfil students' specific requirements as individual learners within a larger classroom setting. (Drexel University School of Education, 2021). Technology can allow teachers to customise lessons to accommodate the different needs of students. Teachers can use software, the internet, and digital tools to design personalised learning experiences tailored to individual students. The ever-changing technology environment demands that learning and education be integrated with technology. Today, incorporating modern technologies into any learning approach is vital. (Nwanua, Mantzaris, Ntshangase, & Olutade, 2023). This research aims to investigate how technology is used in state school classrooms in Gauteng, South Africa. The study includes an analysis of both the incorporation of technology as a separate subject and its application in delivering education to pupils. The study aimed to clarify the dimensions of technological integration within the educational framework, shedding light on how these tools are used to improve the learning experience, shape the curriculum, and contribute to the overall educational environment in Gauteng's public schools. The study aims to provide insights into the existing practices, obstacles, and potentials related to technological integration by investigating its function in teaching approaches and as a separate subject in the school curriculum.

Technology can be used to learn skills such as performing research. Websites such as Easy Bib help learners identify reputable sources using several search engines and educate them on how to cite such sources to avoid plagiarism properly (Khoza, 2022). Technology gives students access to a vast amount of knowledge from all over the world. Search engines and digital libraries make it easy to access online databases, academic journals, eBooks, and multimedia tools.

2.2 Definition of topic or background discussion

Recent years have seen a notable improvement in schooling due to technology. Due to the internet's extensive use and the increasing acceptance of gadgets like laptops, tablets, and smartphones, educators, and students can access many previously unattainable data and tools. The capacity for students to access resources and information at any time and from any location is a significant advantage of technology in the classroom (Zahedi, 2023). Access to digital tools varies depending on affordability and accessibility. In certain communities, particularly in rural South Africa, this access may be seen more as a luxury than a vital educational resource. Bridging the digital divide in South Africa is essential to ensure all learners have access to a wealth of information. Technology has expanded the possibilities for students to learn from a broader array of sources.

Through the internet, students can now tap into lectures, videos, and various educational materials experts and institutions offer worldwide. This enables students to gain insights from diverse perspectives and experiences, enhancing their comprehension and appreciation of various subjects (Zahedi, 2023).

2.2.1 *Digital Divide*

The educational digital divide, as defined by the ACT Centre for Equity in Learning, signifies the disparity between individuals with ample knowledge of and access to technology and those lacking such resources (Gorski, 2015). The digital gap is the difference between people who can afford or have access to technology like computers, the internet, and cell phones and those who do not. People from socioeconomically disadvantaged backgrounds, rural areas, or under-resourced communities often lack access to these essential tools.

Analysing this divide necessitates examining individuals' connectivity capabilities and access levels. For instance, a student with multiple laptops at home and access to high-speed broadband is likely to achieve better

educational outcomes compared to someone who shares one computer with their entire family and has access only to dial-up internet (School of Education , 2020). The digital gap is also caused by differences in how well people can use technology (Digital literacy). Students learn how to use digital tools, navigate websites, and think critically about what they read online if they grow up in tech-savvy homes or get official training in digital literacy. On the other hand, people who don't use technology much might not be sure how to use digital tools correctly, making it harder for them to engage with educational material and get used to digital learning environments.

The digital inequality in South African schools dates to Apartheid: A study by (Makhado & Tshisikhawe, 2020; Nyahodza and Higgs 2017 found that In South Africa, the digital divide in the educational system dates to the apartheid era) when access to technology infrastructure and teaching resources in educational institutions was racially skewed, disadvantaging some groups of students. South Africa still has educational inequality, even though apartheid ended and a free government was put in place in the mid-1990s. Lack of access to technology and digital tools, bad infrastructure, and insufficient funds are some of the systemic problems that schools in historically disadvantaged communities must face. This keeps the digital gap going and makes it worse that students of different races and income levels do not do as well in school.

2.2.2 *Digital Maturity*

One way to conceptualise digital maturity in an educational environment is as digital learning maturity. Using digital tools and resources advances a school's digital learning maturity, whether instruction is provided in-person, virtually, or in a hybrid setting (Rogers, 2023). Digitally mature schools take a systematic approach to developing the digital competencies of their educational staff and students; in contrast, the former use ICT to improve their teaching styles, which focus on the students, to create digital educational content, and to evaluate students' achievements by the learning outcomes and educational objectives. (Research, 2022) Digital maturity means that information and communication technology (ICT) is used in all subjects and grade levels and that technology-

enhanced learning is built into the Program as a whole. Digitally mature schools do not treat technology as a separate or optional part of education. Instead, they use ICT to make teaching and learning activities more natural. This way, students can learn digital skills in real-life situations and use them in different subjects.

2.2.3 *Digital Maturity models*

In contrast, digital maturity models are not designed to measure institutions' outcomes directly. Instead, they assess the organisation's performance regarding the various aspects of digital maturity. (Armstrong & Lee, 2021)

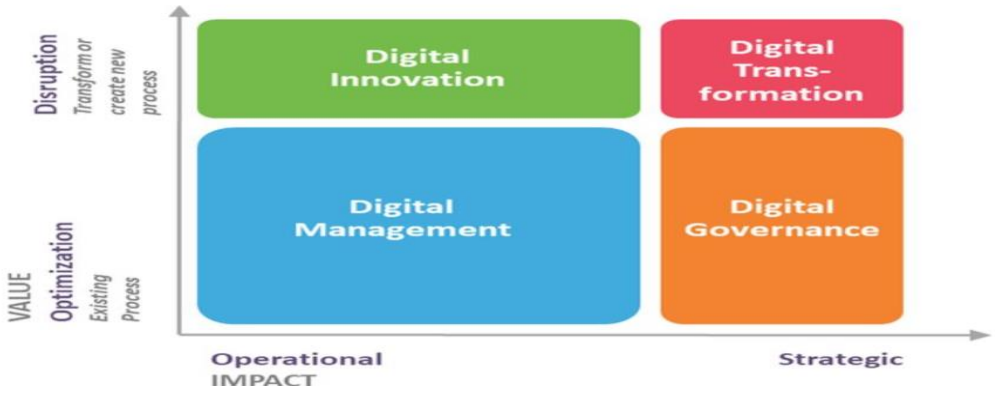

Figure 1: Digital maturity for learning institutions. (Fernández, Gómez, BinjakuKleona, Elinda, & Meçe, 2023).

To achieve the highest level of digital competency, School principals must work with teachers and IT staff to align technology procurement, including learning management systems and collaboration tools. They should work on this project while keeping a close eye on their top priorities, which include the curriculum and other important details (Rogers, 2023).

Digital maturity models usually show how organisations move from one level of growth to the next as they transition to digital. Instead of measuring specific results, the focus is on determining where the organisation is now and where it can be improved.

2.2.4 *Digital Transformation*

Organisations are increasingly creating new divisions to address digital needs. (Armstrong & Lee, 2021) The systems model for digital maturity underscores that successful digital transformation goes beyond excellence in IT/IS, incorporating digital features into products, or digitalising customer touchpoints. Digital transformation must address the underlying factors to be genuinely transformative and enduring (Armstrong & Lee, 2021). The educational landscape has incorporated entirely new tools into its content. Over the past decade, there has been a notable trend among educational institutions to integrate new information technologies that align with contemporary needs. The utilisation of the Internet in educational settings has become commonplace, enabling access to information content and educational materials and the migration of libraries to online platforms (vetlana Zizikova, 2023).

2.2.5 *Quintiles Funding System*

The Quintile funding system has been regarded as a mechanism for promoting equity and addressing historical imbalances. This tiered system allocates more funding to learners requiring financial assistance than their more affluent counterparts (Longueira, 2016).

	Quintiles					
%	1	2	3	4	5	Total
EC	27.3	24.7	19.6	17	11.4	100%
FS	20.5	20.9	22.4	20.8	15.4	100%
GP	14.1	14.7	17.9	21.9	31.4	100%
KZN	22.1	23.2	20.2	18.7	15.8	100%
LP	28.2	24.6	24.2	14.9	8	100%
MP	23.1	24.1	21.5	17.7	13.5	100%
NC	21.5	19.3	20.7	21.4	17.1	100%
NW	25.6	22.3	20.8	17.6	13.7	100%
WC	8.6	13.3	18.4	28	31.7	100%
SA	20	20	20	20	20	100%

Note. EC = Eastern Cape, FS = Free State, KZN = KwaZulu-Natal, LP = Limpopo Province, MP = Mpumalanga Province, NC = Northern Cape, NW = North West, WC = Western Cape, SA = South Africa.

Figure 2 Quintile funding allocation **(Jitsing, 2022)**.

The national aim for South Africa is to distribute 20% of total learners in each province to a certain quintile, ensuring a fair and even distribution across all quintiles. Columns 1-5 show the actual percentage of learners in each province

who fall into specific quintiles. (Dyk & White, Theory and practice of the quintile ranking of schools in South Africa: A financial management perspective, 2019)

The Quintile funding method provides funds to schools and students based on socioeconomic status. Schools that serve children from historically disadvantaged backgrounds and are usually found in lower-income areas are put into lower Quintile levels, like Quintile 1 or 2. Schools in the higher Quintile levels, which serve students from wealthier families, get less funding than schools in the lower Quintile levels. This fair sharing of resources is meant to level the playing field and ensure that all students, regardless of their family income, can get a good education.

2.2.6 *Insufficient Infrastructure*

Structural and institutional disparities in education provision lie at the core of enduring social, economic, and political inequities. Governance challenges in rural, peri-urban, and poor urban communities further intensify these persistent structural disparities, leading to the neglect and deterioration of schools in impoverished neighbourhoods. (Garuli, Flores, & Laken, 2021) Poor infrastructure includes decrepit classrooms, pit toilets, and other damaged school facilities. These issues impact academic achievement and violate the rights to education and the safety and health of both learners and instructors. Poor school infrastructure can also be evident in high student dropout rates and low teacher retention. (DBSA, 2022) Some schools in South Africa still use pit toilets and lack basic facilities like electricity or running water. It is important to remember that students' needs should come first. The importance of digital infrastructure should not outweigh basic conveniences for students, such as running water in school indoor toilets.

2.2.7 *Digital infrastructure*

Digital infrastructure refers to the digital technologies that underpin an organisation's information technology and operations. Examples of digital

infrastructure include the Internet backbone and broadband, mobile telecom and digital communication suites, which include applications, Data Centres, and Networks. (Trava, Cyber Risk Management, 2022)

2.2.8 *Interactive Whiteboard*

An interactive whiteboard, an interactive smart whiteboard or an electronic whiteboard is an educational technology device enabling teachers to project their computer or mobile device screen onto a whiteboard fixed to a wall or a mobile cart. Unlike conventional projector and screen setups, this tool facilitates interaction, collaboration, and data manipulation on the touchscreen using a finger or a stylus tool by both learners and teachers (Glaser, 2022).

The interactive whiteboard (IWB) facilitated both teachers and learners in capturing newly generated knowledge through various means, such as saving brainstorming content from learners as vector diagrams (Akanda & Belle, 2014). The IWB allows teachers and learners to share knowledge through group work and collaboration, refining and solidifying the knowledge construction process. This study suggests that IWBs hold the potential to be advantageous in South African classrooms, offering teachers and learners a novel medium for creating, capturing, and sharing knowledge (Thinyane, Hodgkinson-Williams, & Sieboger, 2018). Students are more likely to be involved and engaged using interactive whiteboards. They are also more interested in learning when interacting with lesson material in real time. For example, they can drag and drop objects, make notes on text, or work together to solve problems.

2.2.9 *Virtual reality*

Virtual reality, abbreviated as VR, refers to a simulated experience of a three-dimensional environment. A virtual reality headset is the predominant method for engaging with VR, exemplified by devices like the Meta Quest, Sony PlayStation VR, or Apple Vision Pro. VR allows users to observe, navigate, and engage with their surroundings dynamically and interactively (i3-

Technologies, 2023). While numerous educators acknowledge the advantages of virtual reality (VR) in education, some remain reluctant to incorporate it into their classrooms. Reasons for this hesitancy vary, from concerns about high costs to resistance from school administrators. Additionally, some perceive the value of both VR and augmented reality (AR) primarily in the realm of entertainment rather than viewing them as effective teaching tools in an educational setting (School of Education , 2019).

2.2.10 *Twin School System*

The Twinning Program involves collaborating between schools from diverse socio-economic backgrounds to establish an environment for exchanging best practices and resources among schools. This initiative aims to address the persistent spatial representation disparities stemming from apartheid. The objective is to create partnerships between well-resourced schools and those facing economic challenges (OPS , 2015). Fixed policies in educational systems worldwide support the separation of twin schooling, operating under the belief that such separation is crucial for fostering individual development (Krog, 2014). Through the Twinning Program, groups from different socioeconomic backgrounds can work together. The plan helps schools from different socioeconomic backgrounds work together and build relationships. This builds empathy, understanding, and community among students, teachers, and communities.

2.2.11 *LTSM (Learning and Teaching support material) Budget*

The Gauteng Department of Education defines LTSM as all relevant resources (print and electronic) learners and educators use.

2.3 First research question literature review heading

This study aimed to find out what makes public schools move towards using digital tools. More and more schools are using digital tools, changing how they

teach and students learn. Policymakers, educators, and other stakeholders need to know what is driving this adoption to develop good methods for integrating technology and improving education.

The factors that drive the adoption of digital technologies in public schools.

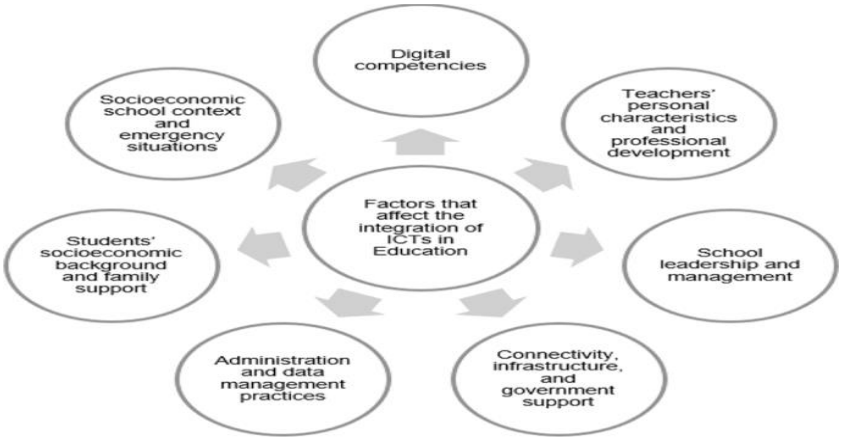

Figure 3 : Factors that influence digital integration of ICT in education: (Stella Timotheou, 2022).

2.3.1 *School Leadership and Management (Governing Body)*

The school principal collaborates with various stakeholders to develop a shared vision, mission, and strategic plan. This collaborative effort seeks to inspire and motivate everyone involved in the school, guiding its continuous development. Strategic planning is essential for shaping and sustaining school improvement, enabling the institution to be proactive and effective in its ongoing development (The South African Department of Education, 2021). The principal is among the most important stakeholders in getting public schools to use digital tools. Principals oversee leading efforts to use new technologies to improve teaching and learning because they are the classroom leaders. How they lead, communicate their mission and make strategic decisions greatly impacts how digital technologies are used in schools.

2.3.2 *Socio-Economic School Context*

South Africa faces enormous socioeconomic issues, such as high unemployment, poverty, social inequality, and limited access to government

services. As a developing country, prioritising education is critical for general growth. Quality education is essential for improving human situations and promoting economic prosperity. While education is vital to economic development, it faces obstacles (DBSA, 2022). Social economics primarily concerns interacting with a community's social dynamics and economic activities. Social economics may describe how a specific social group or socioeconomic class behaves in society (Tarver, 2023). South Africa faces several social and economic issues, such as high unemployment rates, widespread poverty, and obstacles preventing some groups of people from accessing basic government services. Making high quality education a priority is clearly an important endeavour that may have a substantial positive impact on people's lives as well as the economy, but even despite its critical role in promoting national development, education faces significant challenges that compromise its effectiveness and restrict its accessibility to a wider range of individuals.

2.3.3 *Digital Competencies and Capabilities*

“Digital competence (DC)" refers to the entire mix of information, skills, and attitudes (covering abilities, tactics, values, and awareness) required to use ICT (Information and Communication Technology) and digital media. This competency is essential for task completion, issue solving, communication, information management, collaboration, content production and sharing, and appropriately gaining knowledge (Pedaster & Baucal, 2023). Most educators were discouraged from utilising technology due to the state of the existing ICT infrastructure. Some learners received a few tablets that broke easily, while some teachers received computers that had problems. Some teachers and learners became frustrated and demotivated as a result of all of this, which was made worse by their inability to purchase data and their lack of internet connection (Chisango, 2021). The figure below illustrates the outcomes of digital capabilities and literacy realised in an organisation.

Figure 4 Results of digital literacy **: (Cranner, 2014)**

To elaborate, a school that invests in improving the digital capabilities of its teachers, administrators, and students has a number of benefits that have a beneficial influence on the process of teaching and learning. Some results include increased participation and engagement in class activities, easier access to educational materials and information, and more cooperation and communication between students and teachers. Furthermore, schools with strong digital capabilities can better incorporate cutting-edge teaching strategies, adjust to shifting student demands, and personalise learning experiences. In the end, these results highlight how digital empowerment in education can revolutionise education by creating a vibrant, diverse learning environment that supports both academic achievement and all-around growth.

2.3.4 *Connectivity, Infrastructure and Government Support*

The Department of Basic Education's strategic goals for 100% universal access include devices and connectivity for students, teachers, and classrooms; teacher development to integrate ICTs into classroom practice; remote learning support for virtual classes across platforms; and digital content to support learning and teaching through a variety of digital resources. To raise R1 billion per year, the Director-General suggested that each province allocate at least R100 million annually to assist in delivering ICTs to schools. PEDs reacted to the appeal, and we can report that in the fiscal years 2021/22 and 2022/23, they together raised more than R2 billion each, more than doubling the DG's aim. (DBE, 2023) Schools should be permitted to stream educational information that is completely zero-rated, and learners should be equipped with SIM cards that allow them to access educational resources. The DCDT and the Independent Communications Authority of South Africa (ICASA) should develop a National Connectivity Dashboard that will enable stakeholders to verify connectivity at each school. In the long run, the government should provide funds to achieve the SA Connect Policy, which includes providing broadband connectivity to all schools as well as last-mile connectivity. (DBE, 2023)

2.3.5 *Proposition 1*

Several interrelated factors influence the use of digital technologies in South African state schools. The most important factor is the school's and the Government's strategic commitment to promoting the integration of digital technology into the curriculum. This integration is further strengthened by the knowledge and support of instructors, parents, and the governing body.

2.3.6 *PESTEL*

The PESTEL examines the external environment's Political, Economic, Social, Technological, Environmental, and Legal aspects. Threats and weaknesses are found via a PESTEL study and are then utilised in a SWOT analysis

(Washing State University, 2023) Conducting a PESTEL analysis (Political et al., and Legal factors) on the study of digital adoption in South African schools provides a comprehensive view of the factors that can influence the success and challenges of such initiatives. Here is a detailed PESTEL analysis of the adoption of digital technologies in public schools' context:

P	**Government initiatives:** The South African government has launched initiatives like the "Digital Skills for a Digital Economy" program to enhance digital literacy and promote technology adoption in education. **Policy frameworks:** The Department of Basic Education has established policies and guidelines for using technology in schools, such as the "National Education Technology Policy (neil Butcher, 2022).
E	**Budget constraints:** Many state schools in South Africa face limited budgets, making it challenging to invest in digital infrastructure and technologies. **Cost of devices and internet**: The cost of devices, internet connectivity, and data can be

	prohibitively expensive for many schools and students.
S	**Digital divide:** The adoption of digital technologies in schools may exacerbate existing inequalities, as some students may not have access to devices or internet outside of school (Afzal & Khan, Addressing the Digital Divide: Access and Use of Technology in Education, 2023) . **Teacher training:** Teachers require training and support to integrate digital technologies into their teaching practices effectively.
T	Infrastructure: Many state schools in South Africa lack reliable electricity, internet connectivity, and computer hardware, hindering the adoption of digital technologies (Chisango & Morongwe, The digital divide at three disadvantaged secondary schools in Gauteng, South Africa, 2021).
E	**Power outages/load shedding:**

	Frequent power outages in some areas can disrupt the use of digital technologies in schools. **Connectivity challenges:** Rural areas may have limited or no internet connectivity, making accessing digital resources and communicating with teachers and peers difficult.
L	**Privacy and security:** Schools must ensure the privacy and security of student data when adopting digital technologies. **Copyright and licensing:** Schools must navigate copyright and licensing agreements when using digital resources and educational materials.

Table 1 Pestel Analysis

2.4 Availability of digital infrastructure in facilitating uptake among South African public Schools

The crucial relationship between digital infrastructure and technology adoption in educational settings is highlighted by the research question, "What role does

the availability of digital infrastructure play in enabling adoption among South African public schools?" This section explores the main ideas and terms included in this research question, explaining how digital infrastructure is essential to successfully integrating technology in South African public schools.

2.4.1 *Cost*

International lessons show that alternative funding techniques have been used to reduce digital exclusion in locations where returns on digital infrastructure investments are likely to be lower, particularly when compared to affluent and densely populated areas. One significant example of such a financial mechanism is the provision of direct subsidies for the development of digital infrastructure (Baskaan, 2022). Partnerships and sponsorship have the potential to greatly benefit public schools and yield excellent outcomes. However, they can also be challenging and resource-intensive overall, particularly in the beginning (Nchabeleng, 2023). International lessons show that alternative funding techniques have been used to reduce digital exclusion in locations where returns on digital infrastructure investments are likely to be lower, particularly when compared to affluent and densely populated areas. One significant example of such a financial mechanism is the provision of direct subsidies for developing digital infrastructure (Baskaan, 2022). Cost is a primary factor to be considered when analysing how the availability of digital infrastructure affects the adoption of digital technology in schools. This includes a range of monetary elements, such as the out-of-pocket costs incurred in obtaining the appropriate infrastructure, continuous maintenance and upkeep charges, and investments needed to guarantee the security of digital systems and resources.

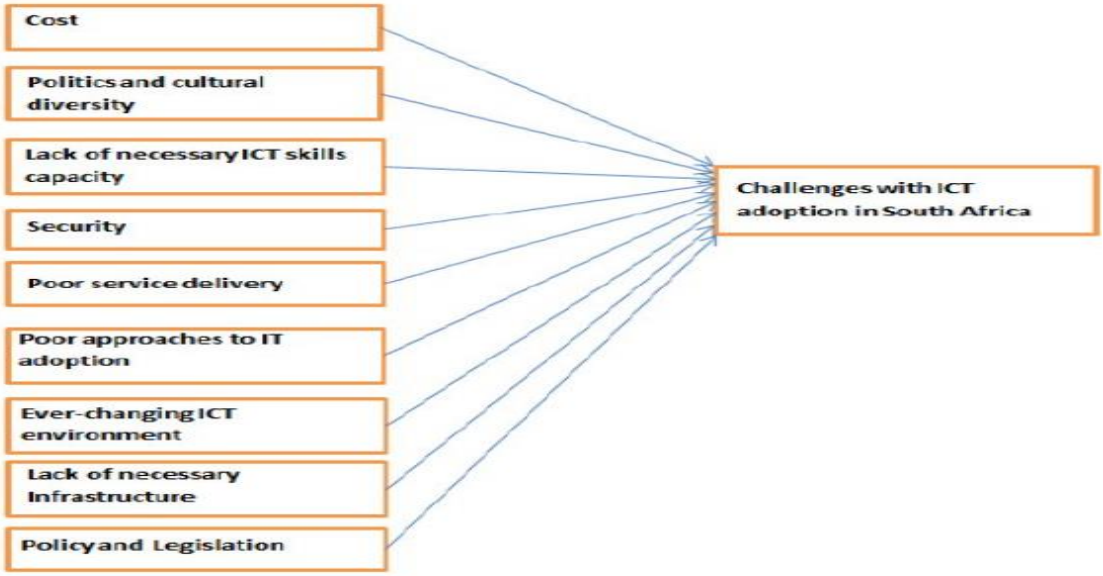

Figure 5: Challenges with adoption in South Africa (Akanda & Belle, 2014)

Teachers require meaningful and well-coordinated ICT development activities to expand their technology expertise and, as a result, build technological pedagogical knowledge to incorporate ICT tools into teaching and learning. (Dlamini, The Independent Journal of Teaching and Learning, 2022) .The digital disparity in South Africa can be dissected into three components, availability of hardware, comprehension of digital communication methods, and affordability of internet access. These factors are adversely influencing two key avenues for the nation's progress and equity – access to education and employment opportunities (Mlaba, 2021).

2.4.2 *Security*

South Africa has a startlingly high crime rate; crimes can occur in any community and occasionally even in the presence of security measures. The neighbourhoods where some of the schools are located have high theft and vandalism rates. ICT equipment has been taken from households and schools. The principals claimed that robbers intimidated and bound school security officers. The Principal of South Africa stated, "The DoE rolled out computers in the Gauteng online laboratory twice, but all the computers were stolen (Chisango, 2021).

Safeguarding against negative or fraudulent online behaviour and data: When most people think about security, they typically picture locks, bars, alarms, and uniformed guards. However, these countermeasures are not the only safety measures to consider when attempting to safeguard an information system (Akanda & Belle, 2014). Security should be regarded at all levels of the technology stack. (Armstrong & Lee, 2021) South Africa's startlingly high crime rate is still a problem. Events can occur in almost every community around the nation. The neighbourhoods with a lot of schools are especially concerning because there have been noticeably more theft and vandalism incidents there. This common criminal activity includes not only stealing information and communication technology (ICT) equipment from private residences but also from educational institutions. Sadly, these illicit activities usually target schools, with attackers brazenly stealing essential communication and information technology tools meant to facilitate learning and academic advancement.

2.4.3 *Proposition 2*

In addition to the intention to incorporate digital technologies into South African state schools, which is primarily influenced by government and school management, the availability and affordability of technological resources, as well as ensuring their security once acquired, are critical factors in promoting and facilitating the adoption of digital technologies in state schools. The cost of availing technological resources and securing these resources once obtained are important factors to avail and facilitate the uptake of digital technologies in state schools.

2.5 Technology-Organisation-Environment (TOE)

Presenting the theoretical framework informing a study on the adoption of digital technologies in South African public schools using the Technology-

Organisation-Environment (TOE) framework requires providing a comprehensive overview of the theoretical concepts, models, and constructs that will guide the research (Jere & Ngidi, 2020). TOE is used as a legitimate, robust, and exact model because its well-defined constructs (both internal and external) depict perspectives on how to create ORE adoption decisions and business performance for organisations (Nguyen, 2022) .The TOE framework comprises three primary elements, Technology, organisation, and environment. Technology encompasses the inherent features of the technology, encompassing its functionality, complexity and user-friendliness. Organisation pertains to the internal context of technology usage, encompassing aspects such as the organisation's size, structure, culture, and resources. Environment refers to the external context in which the organisation functions, encompassing elements like market conditions, regulatory requirements, and social and cultural norms (Technology-Organisation-Environment Framework, 2022).

This study examines the Technology, Organisational, and Environmental aspects that impact digital adoption in South African Government schools.

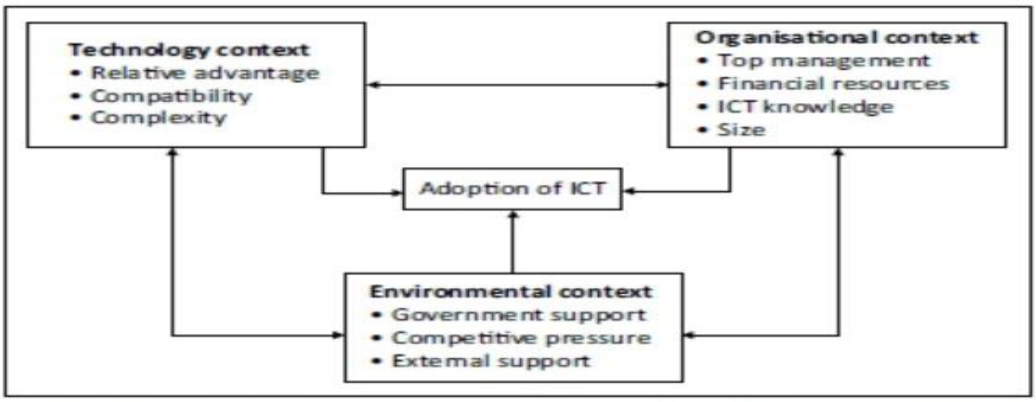

Figure 6 – TOE Framework and its components (Jere J. N., 2023)

This study is based on an analysis of technology that has been implemented in schools and continues to be needed, the environment that influences the update of digital technologies within the school, and the schooling management structure that implements strategic projects for the school when

it comes to the adoption or rate of adoption of digital technologies in South African state schools.

Conceptual Framework

i. **Government Policies and Endorsement (External Context):** This fundamental component includes government-approved Programs, financial backing, and regulatory frameworks targeted at increasing technology integration into education. The level of government commitment, regulatory clarity, and financial support has a considerable impact on the entire landscape of digital technology adoption in state schools (Committee, 2023).

i. **Equitable Access (Technology):** Providing all pupils equal access to digital resources is a critical technological dimension. This entails resolving inequities in access to devices, internet connectivity, and instructional software, fostering inclusivity and equitable opportunity for all students to benefit from digital learning tools.

ii. **Sustainability (Organisational Context):** The long-term viability of digital technology implementation in state schools. This includes the schools' ability to maintain and extend their usage of digital technology over time. Staff training, infrastructure maintenance, and resource allocation all contribute to the organisation's ability to sustain and scale the integration of digital technology into the educational system.

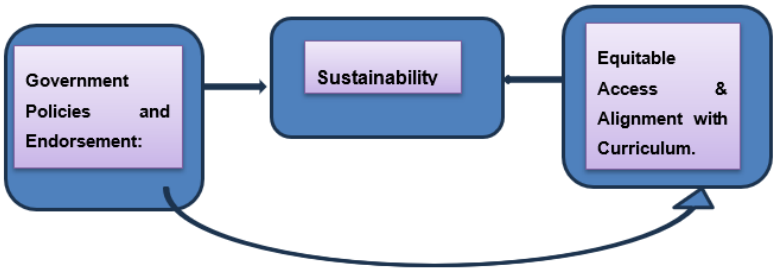

Figure 7: Analytical framework

This study used the Industry Life Cycle paradigm to acquire a complete overview of the current landscape of technology adoption in South African state schools. The research used the Industry Life Cycle principles to examine the current state of technological integration in these educational institutions. This entails looking into a variety of issues, including the quality of technological infrastructure, the integration of digital technologies into instructional techniques, and the overall readiness of South African State schools to accept and exploit technology. The inquiry aimed to provide significant insights into the dynamics of technological adoption in the educational sector, throwing light on difficulties, possibilities, and potential areas for development in creating a digitally empowered learning environment.

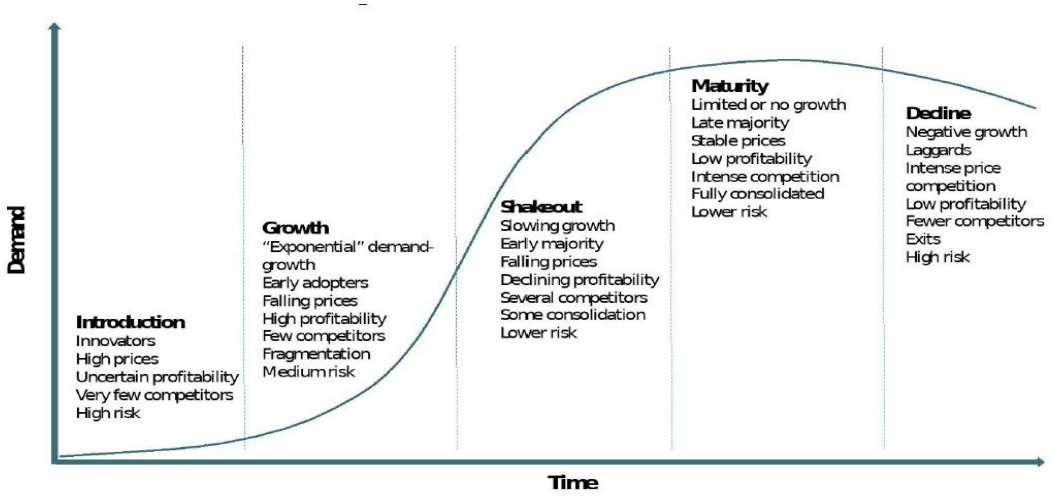

Figure 8: Industry Life Cycle paradigm (Armstrong & Lee, 2021)

2.6 Conclusion of Literature Review

In education sciences, the aim is to evaluate the degree of coherence between society and the digital environment in the educational landscape. This requires assessing how modern information and digital technology balance with traditional social ideals. Focusing on both the information-technological and social-humanitarian aspects, the scientific investigation methodology utilises a wide range of general scientific and philosophical approaches (Solovei, Horban, & Samborska, 2023). This study analysed technology integration in

South African public schools, considering both existing implementations and ongoing needs. It investigated the interplay between technology, the school environment, and administrative systems. The study evaluated the present condition of technology implementations in schools, focusing on issues such as functionality and compatibility. It also investigated how external factors like market conditions, socio-economic issues and regulatory constraints affect the adoption and advancement of digital technology. The report also scrutinises the administrative structure within schools and funding models, concentrating on strategic Programs targeted at encouraging digital technology use. The study intended to uncover significant determinants influencing the rate and efficacy of digital technology adoption in South African public schools by assessing existing managerial practices, digital tools, and resources.

2.6.1 *Proposition 1*

The effective implementation of digital technology in South African state schools is driven by a strategic commitment from both the school and the government, as well as the knowledge and support of teachers, parents, and the governing body.

2.6.2 *Proposition 2*

The successful use of digital technologies in South African state schools depends not only on government and administrative will, but also on the critical variables of resource availability, affordability, and security considerations in the acquisition and utilisation of technology resources.

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Interpretivism Paradigm

The interpretivist paradigm is a sociological study style that focuses on understanding people's subjective meanings and experiences within their social environments (Nickerson, Interpretivism Paradigm & Research Philosophy, 2024).The foundational idea of interpretivism is that reality is shaped by social conceptions, subjective, and varies. Essentially, we can only fully understand an individual's reality considering their own experiences, which can differ from one another depending on personal historical or social viewpoints (Nickerson, Interpretivism Paradigm & Research Philosophy, 2024). Significant disparities exist in South Africa, and as the literature review points out, the use of digital tools in the classroom may be seen as a luxury for poor communities rather than as a means of improving education. It is critical to understand that each participant will have unique viewpoints, circumstances, and socioeconomic standing in relation to their communities and lived experiences. To obtain understanding of the schools surrounds and the external world they work in, research interviews were conducted from the school's premises.

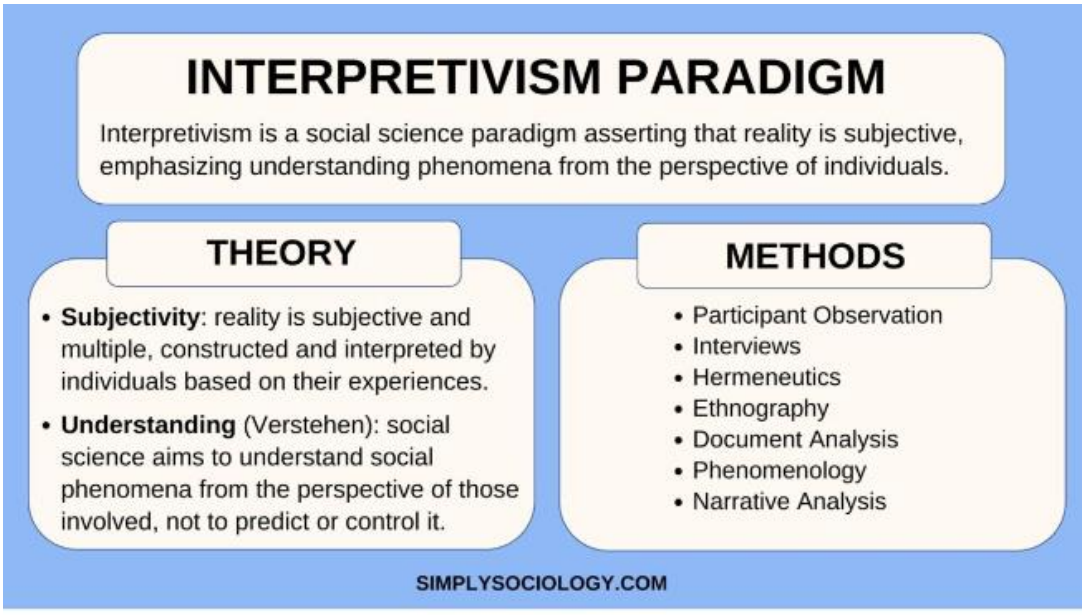

Figure 9 (Nickerson, Interpretivism Paradigm & Research Philosophy, 2024)

3.2 Research approach.

This chapter outlines the study's research methodology, design, and analysis. The qualitative investigation involved examining and interviewing principals from five state schools in Gauteng to delve into the digital technology landscape and adoption within these schools. Semi-structured interviews are typically open-ended, allowing for freedom yet adhering to a predetermined theme framework, providing a feeling of order (George, 2022). To enable participants to express their viewpoints and narrate their own experiences inside their different schools, semi-structured in-person interviews were employed. This approach provides a thorough understanding of participants' school environment by allowing for flexibility and guaranteeing that participants have the chance to express their ideas.

This chapter delves further into the research methodology, including the methods used for data collection and an evaluation of the defined demographic and sample selection. The procedures used are critical to assuring the reliability and validity of the study's conclusions. This chapter strives to increase transparency by describing the precise methodologies utilised to collect data, allowing readers to understand the precision and appropriateness of the chosen research methods. Defining the population clarifies the larger group under research, whereas the sample selection procedure explains why certain individuals or entities were included (Anaesth, 2016). This methodological transparency is critical for justifying the generalisability and relevance of the study's findings to the larger context.

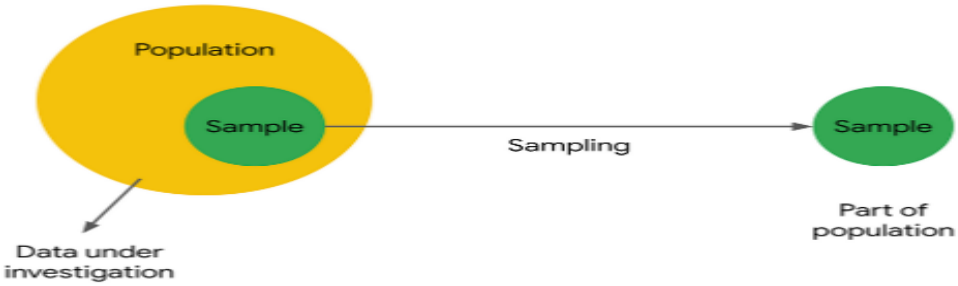

Figure 10: The relationship between sample and population (imino, 2023)

3.3 Research Design

The Research Design this study employed is a generic qualitative design. The generic qualitative approach is structured to uncover and delve into firsthand experiences narrated by individuals within authentic real-world settings (Cooper & Endacott, 2008).

This research methodology is chosen for its capacity to delve deeply into the subjective experiences and views of individuals, offering a rich and nuanced knowledge of how they make meaning of a given occurrence or event. The fundamental goal is to discover not only 'what' participants experience, but also 'how' and 'why' they understand and respond to the phenomenon in question. With generic qualitative research, the goal is to find out how different people make sense of an event or situation by focusing on "what will work best" in answering the research questions (H. Elm, 2023).

The interview process is an appropriate analysis since it serves as a dynamic and participatory platform, allowing participants to share their thoughts and experiences in their own words. This open-ended and exploratory approach is good for generating the depth and diversity of individual responses, revealing insights that quantitative methods may not fully capture (Tenny, 2022).

3.4 Data Collection methods

The major data-gathering technique in this study is direct, in-person contact with School Principals from various schools. This technique ensures a personal and direct interaction, allowing for an examination of the principals' thoughts, experiences, and opinions on the integration of digital technology in their schools. Additionally, data will be gathered through an examination of the technology infrastructure within these schools, offering a comprehensive picture of the technical landscape.

3.4.1 *Advantages of In-Person Interviews.*

i. Face-to-face encounters can produce richer and more detailed data because nonverbal clues and contextual information may be examined and analysed.
ii. Real-time Clarification - The researcher can request quick clarifications or probe deeper into responses, increasing the depth of insight.
iii. Establishing Rapport - In-person meetings help to build rapport and trust, encouraging participants to be more open and honest.

3.4.2 *Disadvantages of In-Person Interviews*

i. In-person meetings can be difficult to schedule and conduct, especially if participants are geographically distant.
ii. Collecting in-person data requires time and travel resources, which may raise the overall cost of the research.
iii. Face-to-face encounters may generate bias because participants may adjust their responses in the researcher's presence (Morrison-Smith, 2020).

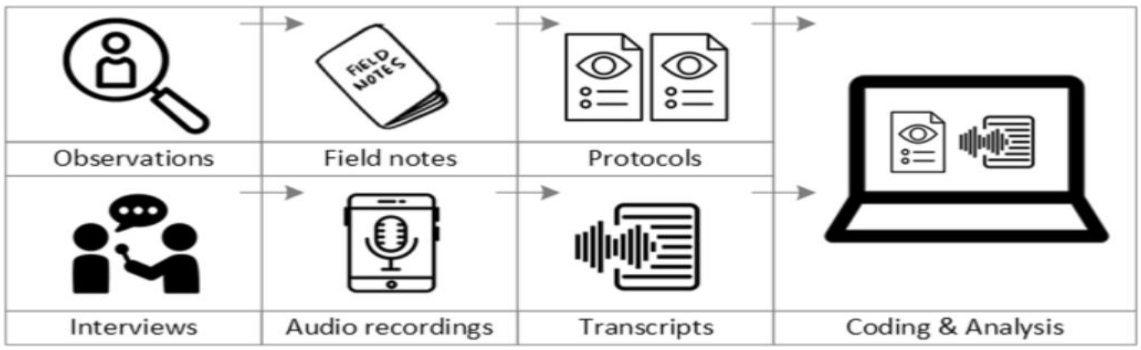

Figure 11– Generic qualitative interview data collection method (Busetto, 2020)

3.5 Population and Sample

3.5.1 *Sample and sample method.*

Purposive sampling, also known as judgmental sampling, involves the researcher's discernment in identifying and selecting individuals, cases, or events that can offer optimal information to fulfil the study's objectives (Nikolopoulou, 2022). The Sampling method employed for this study is purposive, the research centred on an examination of educational practices within the Gauteng district, specifically targeting five schools for in-depth analysis. Among these schools, four were foundation level institutions, catering to primary school education, while the fifth one belonged to the high school level. This intentional selection of schools across different educational stages provides a diverse and comprehensive perspective on the incorporation of digital technology in various phases of the academic journey.

The focus on school principals and deputies is due to their important role in defining and implementing technological initiatives in educational institutions (N Gina ; M Kubayi, 2016). By prioritising data collected from this leadership layer, the study hopes to gather insights into high-level decision-making processes and strategic viewpoints. While acknowledging the importance of technology teachers, confining the focus to school principals provides a more focused analysis of leadership views, adding depth and specificity to the research findings.

Commencing with a group of five individuals is advisable by the Niels Norman group an organisation focusing on Research-Based user experience. Even when summative, qualitative studies do not attempt to estimate how many users will complete a task or face specific usability concerns. Instead, they focus on finding usability issues. This is particularly true for qualitative research techniques like interviews and usability testing (Budiu, 2021) .The decision to expand the sample size by increments of five can be contingent upon the complexity of the subject matter being investigated (Renwick, 2022) .

3.6 The research instrument.

The research interview was designed to address the two research questions. The interview with school principals will include inquiries about the following aspects.

- Understanding the quintile level of the school provides context regarding its socioeconomic status, which can significantly influence technology accessibility and adoption (Longueira, Roxanne, 2016).
- Gathering data on the overall number of learners and teaching staff helps comprehend the scale of the school community and its potential impact on technology implementation.
- Exploring the presence of a technology subject and associated instruments or a dedicated computer lab illuminates the school's existing technological infrastructure.
- Inquiring about the allocation of the budget specifically for technology allows for an examination of the financial commitment to technological initiatives.
- Identifying challenges and opportunities related to technology integration provides insights into the factors influencing success or barriers in incorporating technology within the school.
- Assessing teacher preparedness is crucial for understanding the human factor in technology adoption, ensuring that educators are adequately equipped and ready to integrate technology into their teaching practices (Buabeng-Adoh, 2012).

3.7 Procedure for data collection

The prospective participants were primarily identified through cold calls made to various Government schools in South Africa. During these calls, requests were made to interview the principals, seeking their valuable insights and experiences to contribute to this study. In cases where approval for the interview was sought through the education department, which was a time-sensitive procedure, the decision to include a school in the interview process

was contingent on the department's timely approval, as a response could take several months, and if denied, the school might be excluded. Upon obtaining approval from the headmaster, a meeting schedule was established to conduct the interview at the school. The interviews were documented using a voice recorder, and in cases where consent to record was not given, notes were taken instead.

3.8 Data analysis strategies and interpretation

Qualitative data is frequently characterised by its subjective nature, depth, and reliance on textual expressions. Analysing qualitative data involves reviewing extensive transcripts to identify commonalities or distinctions, followed by the identification of themes and the development of categories (Wong, 2008).The data collected from the schools underwent thematic analysis. During the interviews, recordings were made, and in one instance, notes were taken as the principal did not grant permission for recording.

- Data Collection - Information was gathered from the schools through interviews with the school's principal.
- Inductive Thematic Analysis - The collected data underwent genetic thematic analysis recurring themes and patterns. (Dawadi, 2020) With an inductive approach, themes emerge from the data collected during the study rather than being predetermined.

The following steps were used for the inductive thematic analysis of this study.

1. Familiarising the data (Transcribing and analysis)

To fully understand the breadth of the information gathered, transcripts from the audio recordings of the interviews were reviewed several times. Every time an important concept emerged from the data; notes were made. To acquire a deeper understanding, the recordings were also listened to again, and additional notes were made by the findings.

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2. Generate initial codes (Following the familiarisation create codes by identifying and labelling segments of the transcribed data)
3. Search for themes (Organising related codes into themes)
4. Review themes (Identification of which accurately reflects the content of the analysis)
5. Presenting analysis (Writing up and presenting the results of themes identified.)

- Interview Recordings - Most of the conversations were recorded for accurate records. In cases where records were made, the people being interviewed gave their permission.
- Notetaking In a specific interview, notes were taken instead of recording due to the principal's decision not to permit recording.

Data interpretation was facilitated by Thematic Analysis, which involved thoroughly exploring the obtained data to discover repeating themes and patterns, fully comprehending the underlying insights within the dataset. (Dawadi, 2020)Thematic analysis not only helped identify commonalities but also allowed for the recognition of differences and varied perspectives within the dataset (Lorelli, 2017).

3.9 Quality Assurance

3.9.1 *Transferability*

Transferability is the degree to which research findings can be used in various settings or contexts (Coghlan, 2021). This study contributes to transferability by giving a wide range of experiences drawn from the study's diverse sample of schools. The schools included in this study were specifically chosen to represent a wide range of social, geographical, and cultural backgrounds. This purposeful variation not only improves the study's overall robustness but also

assures that the findings are more broadly relevant to a wide range of educational environments.

Regarding social settings, including schools from varied socioeconomic backgrounds allows for a more thorough knowledge of how economic resources and community dynamics may influence the study's outcomes. This diversity enables readers to comprehend the subtle interaction between social settings and the phenomena under research.

Geographical diversity enhances the study since schools in different places may have unique difficulties and possibilities. Regional variations in educational policy, infrastructure, and community expectations can all substantially impact intervention success. This study acknowledges and tackles potential regional differences by including schools from various geographical contexts, making the findings more applicable to a wider range of educational environments.

The involvement of schools from various cultural backgrounds reflects cultural variety. Educational procedures, parental participation, and student expectations can differ greatly among territories. The study's focus on cultural diversity ensures that its findings are not restricted to a single cultural context, boosting the transferability of insights to educational settings with various cultural nuances.

3.9.2 *Credibility*

The outcomes of this study directly reflect the original data gathered from participants. To ensure the research's legitimacy, the study has completed or undergone a rigorous evaluation process that includes assessments by the academic supervisor and fellow peers within the research cohort (Lange, Pillay, & Chikoko, 2011). This review by informed and experienced academic community members is an important step in ensuring the rigour and credibility of the study's methodology, analysis, and results.

3.9.3 *Dependability*

Dependability within qualitative research is associated with reliability. It represents the degree to which a research study can be replicated by another researcher, yielding consistent findings. (Quantilope, 2024) An audit trail is created by thoroughly documenting all parts of the research process, such as data gathering methods, decisions taken, and adjustments implemented. This transparency enables another researcher to properly comprehend and reproduce the work (D-acity, 2022).

3.10 Ethical considerations

When collecting interview data for a study aimed at analysing digital transformation and adoption in South African public schools, ethical considerations are key. Protecting each participant's rights, well-being, and privacy is critical (Ethical Considerations in Research | Types & Examples, 2021).

i. Informed Consent - Participants received comprehensive information regarding the study's objectives. Voluntary and informed consent is imperative (Stewart, 2021)
ii. Anonymity and Confidentiality - To safeguard participants' identities and sensitive information, assurances were provided. Participants can trust that their responses will be treated confidentially.
iii. Debriefing - Following the interview, participants can seek clarification or support, particularly if the conversation generates emotional or personal concerns.
iv. Reporting—The findings are presented transparently, ensuring an accurate and genuine depiction of the participants' experiences with no misrepresentations.

CHAPTER 4. PRESENTATION OF RESULTS / FINDINGS

4.1 Introduction

This chapter presents the findings from 5 face-to-face interviews conducted with principals from Gauteng state schools, focusing particularly on propositions 1 and 2 as outlined in Chapter 3. The views of school principals, reflecting their perspectives and firsthand experiences concerning the factors affecting technological adoption in state schools, will be utilised in this chapter to generate findings.

These state schools were chosen from various regions of the Gauteng province, spanning from suburban areas to urban and informal settlements. The analytical methodology used to interpret these findings includes a thematic analysis process. This study presents a picture of the many experiences and viewpoints stated by school leaders in several settings throughout Gauteng. Geographic diversity not only adds complexity to the study, but it also improves the findings' transferability, as stated in Chapter 3, by providing insights that may be applied to a broader range of educational settings. A presentation of themes and corresponding responses will be provided to address both the first and second propositions. Each sub-section will be tailored to a specific proposition. Additionally, this chapter will offer an overview of the findings.

4.1.1 *Participants Information*

This subsection presents a table providing an overview of the demographic characteristics and environment in which the five schools operate. The goal is to provide readers with insight into the surroundings and situations that influence these schools.

Description	School A Primary School	School B High School	School C Primary School	School D Primary School	School E Primary School
Quintile level	1	5	4	1	2
Fees	R16 600 per annum per learner	R46 000 per annum per learner	R1200 per annum per learner	No fee paying	No fee paying
Number of Learners and teaching staff	250 learners 25 teaching staff with assistants	987 learners 32 teaching staff	1350 learners 37 teaching staff	2501 learners 65 teaching staff	1320 learners 38 teaching staff
Location	Kensington B - Johannesburg	Greenside Johannesburg	Lotus Gardens – Pretoria	Johannesburg	Alexandra – Johannesburg
School location type	Suburban area.	Suburban area.	Residential suburb.	Urban township.	Urban township

T**able 2** : **Participants information**

- School A is a special needs school in Randburg, Johannesburg, with annual costs of R16,600 per learner. It is intended for pupils who have been diagnosed with an autism spectrum disorder or a severe behavioural disorder. The school has 250 learners and is staffed by 25 teachers and teaching assistants.

- School B, situated in Greenside, Johannesburg, also operates within a suburban area. It operates at a higher Quintile level 5, reflecting a different socioeconomic context. Fees at School are set at R46,000 per annum per learner, accommodating a student population of 987 learners supported by 32 teaching staff.
- The School C, located in Lotus Gardens, Pretoria, is positioned within a residential suburb. This school operates at a Quintile level 4, with comparatively lower fees of R1,200 per annum per learner. The student body is larger, comprising 1350 learners, supported by 37 teaching staff.
- School D operates within an urban township in School D, Johannesburg. This school does not charge fees. It accommodates a significant student population of 2501 learners, supported by 65 teaching staff.
- Similarly, School E, situated in Alexandra, Johannesburg, operates within an urban township. It also operates as a no-fee-paying school, serving 1320 learners with the support of 38 teaching staff.

4.1.2 *Emerging Themes*

This study examines the integration of digital technologies in Gauteng state schools. It explores the technological progress achieved by each school and the tools employed to facilitate teaching and learning. The study aims to address the following objectives.

- Gaining insight into the factors that influence the adoption of digital technology in public schools.
- The significance of digital infrastructure availability in facilitating adoption within South African public schools.

The study findings revealed several recurring themes associated with the two propositions, as defined in this chapter.

- Strategic Commitment of Schools and Government to Digital Adoption
- Teacher Engagement and Training

- Budget Allocation for Technology Infrastructure, Adoption and Operations
- Resource Availability and Affordability
- Security Concerns

4.2

4.2.1 *Strategic Commitment of schools and Government to Digital Adoption*

The key theme of this study is the strategic commitment in the context of digital transformation and adoption, which refers to the deliberate and proactive efforts made by schools and government to promote the integration of digital technology into the educational curriculum. This commitment entails developing clear plans, policies, and initiatives aimed at leveraging digital tools and resources to enhance teaching, learning, and administrative processes. It involves allocating resources, such as funding, infrastructure, and training opportunities, to support the effective implementation of technology in schools. The strategic commitment of both schools and government is essential for driving meaningful digital transformation in education. It ensures that technology adoption is not haphazard or sporadic but instead aligned with educational goals and objectives. By prioritising strategic commitment to digital transformation, schools and government entities can create an enabling environment conducive to the successful adoption and utilisation of technology in education, ultimately leading to improved learning outcomes and better preparedness of students for the digital age.

Some participants noted significant government commitment to digital initiatives, while others, particularly School C, expressed differing views on governmental support and strategy.

> *“I am very supportive of what the department has done because for the last three years, we have not had to increase school fees. This is*

because the government is funding us, and the funding we receive helps us grow." ***School A***

Two other participants expressed a contrasting statement.

“The main challenge is the failure of the education department to provide a functional computer lab.” ***School C***

“The Department of Education rolled out tablets to all schools a few years ago but later retrieved them. When asked why, the department stated that the learners were not using them for educational purposes. The thing is you can't have a knee-jerk reaction; it must be strategically planned. ***“School B***

For the government, ensuring a clear plan and goal for all schools is vital to successful digital adoption. However, this does not appear to be the case, as every school interviewed for this study had differing views and methods regarding technological adoption. School B's viewpoint regarding government assistance mainly focuses on leveraging the LTSM budget to incorporate technological resources into its curriculum. While they may not explicitly mention other forms of government support, such as funding programs or infrastructure improvements, they rely on the LTSM budget to facilitate the integration of technology within their schools.

The commitment demonstrated by three out of four foundation-level schools toward digital adoption is evident despite the constraints imposed by the curriculum framework. Although the government's curriculum does not include technology as an independent subject during the foundational phase, primary schools such as Schools A, D and E have embraced technological tools and have successfully incorporated technology-related lessons into subjects such as Mathematics and English.

“Remember we need to follow a given Curriculum, so Robotics is slotted under the math’s subject, we have to follow a set curriculum.” ***School A***

"Our Grade 7 students use tablets containing eBooks instead of physical textbooks. This initiative was my project, and it has been in place for two years. The funding for these tablets is allocated from the school's LTSM." ***School E***

School A's principal acknowledges the challenges of catering to learners on the Autism Spectrum learners, stating,

"Our children are visual learners, you can't do chalk and talk with them, it will not work." ***School A***

The school's focus on catering to learners on the Autism Spectrum serves as a catalyst for embracing digital technology adoption, with the principal emphasising that conventional teaching methods are inadequate for these students.

School B's strategic orientation is forward-thinking. It recognises the importance of incorporating technology into the curriculum to prepare students for the Fourth Industrial Revolution and thereby increase their competitiveness in the labour market. School Bs is a High school, and Technology is a standalone subject in the Curriculum.

"Our kids are stepping into the real world because we use technology in the classroom. They can now write emails and navigate apps. Considering we are entering the 4th Industrial Revolution; it is our responsibility as educators to ensure that our children are technologically advantaged." ***School B***

School A aligns with a shared vision of preparing for the future and empowering learners to secure their roles in the economy.

"The purpose for us when it comes to technology, is to make the child as independent as possible, to set them up to become an entrepreneur." ***School A***

School D faces challenges related to overcrowding and resource constraints, which impede its strategic dedication to digital transformation. The principal

acknowledges the issue of overcrowding. However, the school has adapted by relocating technology lessons to classrooms due to the lack of space for a dedicated lab.

> *"Because of overcrowding we can't dedicate any space to anything but teaching and learning, the previous computer room had to be turned into a classroom, so when learners do technology, they do it in the classroom."* ***School D***

> *"We've used up all of our mobile classrooms, and we are building more classrooms not linked to technology. The capacity of this school is 1024. Imagine, from that to 2400, it's more than 50% over-capacitated."* ***School D***

Despite challenges, School D and E leverages on strategic partnerships with organisations like the Click Foundation to provide tablets and lessons for learners.

> *"The Click Foundation pays the individuals who train our learners onsite. "***School E**

The Click Foundation is an NGO dedicated to improving fundamental reading, numeracy, and digital competencies in South Africa's underprivileged primary schools through relevant online Programs. The Click Foundation's Programs enable young learners to grow at their own pace and engage with their educational courses through technology.

In contrast, School C encounters obstacles in its strategic commitment to digital transformation and has yet to establish any partnerships with NGOs such as The Click Foundation. The principal underscores the repercussions of limited government support, stating.

> *"The government does not make provision technology for the schools, the budget for technology and securing the schools assets and infrastructure comes from the very stretched school budget*". **School C**

School C struggles with outdated computer equipment and internet accessibility issues, exacerbated by theft and vandalism.

> *“The government does not make provision for security personnel for the schools, the budget for security and securing the schools assets and infrastructure comes from the very stretched school budget.”* ***School C***

While some participants, like School A, commend the government's commitment to funding, others, exemplified by School C, face significant obstacles due to budget constraints and community-related issues. School B emerges as forward-thinking, recognising the importance of technology integration to prepare students for the Fourth Industrial Revolution. Despite limitations within the curriculum framework, schools exhibit resilience in incorporating technology into various subjects, as evidenced by School A and School E's initiatives. However, challenges persist, such as overcrowding and resource limitations, as seen in School D, hindering strategic commitment to digital transformation. Nevertheless, schools like School D and E leverage strategic partnerships with organisations like the Click Foundation to provide essential resources and support for learners.

4.2.2 *Teacher engagement and training*

Teacher engagement and training in technology adoption in South African state schools refers to educators' involvement and professional development in the successful use of digital technologies and resources in the classroom. This includes a variety of activities, such as workshops, training, and continuous assistance, that help teachers improve their digital literacy abilities and confidence in incorporating technology into teaching and learning processes.

The Principal of School B offered the following insights regarding teacher training:

"Firstly, I believe teachers need to be trained, so staff development first, were the is a need for training, we cater to that need, it's like a need analysis. "**School B**

Two other participants share the same sentiments:

"Robotics is available for only Grade R; and their teachers have been trained." ***School E***

Teacher training equips teachers with the skills and knowledge needed to utilise technology effectively in educational settings. This includes understanding how to incorporate digital tools into lesson plans, create engaging digital content, and facilitate interactive learning experiences for students.

"We are trying to roll out the training, getting the teachers to understand the importance of technology and what is available to them." ***School A***

4.2.3 *Budget allocation for technology infrastructure, adoption, and operations*

The allocation of funds for technology infrastructure, adoption, and operations within South African state schools is pivotal for advancing the integration of digital technologies. This allocation encompasses various facets, such as infrastructure development, hardware and software procurement, training, technical support, and security measures. Each institution's approach varies significantly, reflecting their unique circumstances and priorities as outlined below:

School A allocates 5% of its LTSM budget towards technology adoption and operations. While the percentage may seem relatively modest, it signifies a deliberate effort to prioritise digital initiatives within the available resources.

In contrast, School B shows a much stronger commitment by allocating 12% of its LTSM budget to technology adoption and operations. One reason for this is that School B is a high school where Technology is taught as a separate

subject, unlike the other schools, which are foundation level schools. As a fee-paying institution, the principal explained their position on using school fees for technological advancement as follows:

> *"Remember also, parents aren't paying fees; parents do not pay school fees, so now the fees are stretched between maintenance, buildings, and paying teacher salaries. We have a debt collector, but at the end of the day, so many parents don't pay, and that creates a backlog that the debt collector must work through, so the school just doesn't benefit. Our school fees are R45,000 for the year, and you will find that of that R45,000, a parent will only pay R5,000."* ***School B***

Unlike the other schools, School C doesn't have a fixed budget specifically designated for technology adoption and operations. This absence of dedicated funding might impede the school's capacity to introduce extensive digital programs and stay abreast of technological progress. The principal also mentioned exploring alternative avenues to finance technology integration in the school.

> "*Every year, we have a developmental plan, and within that plan, we aspire to secure sponsorship for technological gadgets, but that has not materialised."'* ***School C***

School D takes a pragmatic approach by utilising a combination of an undisclosed percentage of its LTSM budget and a partnership with the Click Foundation for technology adoption and operations. This collaborative effort allows School D to leverage external resources while maximising the impact of its budget allocation.

Similarly, School E allocates 15% of its LTSM budget towards technology adoption and operations and partners with the Click Foundation. This strategic collaboration enables the school to enhance its digital capabilities and provide students with access to cutting-edge technology resources.

While the budget allocation for technology adoption and operations varies among South African state schools, four out of the five schools strive to

optimise its resources to facilitate the integration of digital technologies into education. Whether through direct budget allocation, partnerships, or a combination of both.

School A's principal recognised the current issues with unemployment in South Africa, as well as the difficulties that learners with special needs could face when looking for work.

> *“"If you look at the state of the country, mainstream matriculants and adults with degrees are walking the streets. So, what are the chances of a special needs child finding employment? Therefore, our focus is on*

The School B principal emphasises the importance of collaboration between parents, teachers, and students. He views education as a triangular relationship where the child is at the centre, highlighting the need for collective effort.

> "*It's important for parents, teachers, and learners to work together. I always say it's a triangle, with the child being at the pinnacle point, at the top. It's very important for parents and teachers to work together.* ***“School B***

Plans to introduce a questionnaire to gather feedback from parents and students regarding future initiatives, such as providing tablets to every child. This demonstrates a commitment to inclusivity and involving stakeholders in decision-making processes.

> *"So, moving forward, I am going to introduce a questionnaire where parents and students fill out their own responses. I would like to see what the feedback is. It's no use for me to say, for instance, that the 2030 plan is to get every child a tablet. I need to hear what the parents think about that.*
> *I am all for collaboration; I like to see what people like.* ***“School B***

Continuous Improvement and Technological Advancement: The school is proactive in staying competitive and ensuring that teachers receive necessary

training. Plans for building a robotics room and increasing smartboard installations demonstrate a commitment to technological advancement and innovation.

> "*One of the things on my school's developmental plan for next year is to build a robotics room, where children can come in and do robotics and code, all of it in one venue, because the kids are interested in that sort of thing."* ***School B***

Regarding the efficacy and integrity of student assessment, the principal provided the following insight:

> *"The assessment tasks are designed to foster critical thinking; it's not merely about accessing Google and retrieving information."* ***School B***

Vision for 2030: The principal has a clear vision for the school's future, which includes reliable internet access in half of the classrooms and a focus on preparing students for the 4th Industrial Revolution. This aligns with the school's mission for greater educational equity and inclusion by leveraging technology.

> *"We are in the process of rolling more smartboards and data projectors out, so of the 60 classrooms we have here, I would say we have about 40 smartboards and projectors. I have a vision for the school for 2030."* ***School B***

School C faces significant resource challenges, particularly regarding the maintenance and functionality of its computer lab. Despite having a computer lab, the equipment is old and unusable due to a lack of resources and support.

> *""*We have *a computer lab equipped with outdated computers that remain inactive due to our inability to use them."* ***School C***

The school's access to the internet is restricted to the office area and was only made possible through sponsorship from Vumatel. This limited access hampers the integration of technology into teaching and learning processes.

The school lacks strong parental involvement, which can hinder efforts to address challenges and secure additional resources.

> *“The parents of the learners here don’t get involved with the school; we don’t have a strong parent involvement. “**School C***

The principal questions the quintile classification of the school, advocating for more support from the government. The shift in demographics and resources from its previous status as an Indian predominant school has not been reflected in the school's quintile level.

> *"I feel that the school should not be deemed a quintile four. We need more support from the Government. The school was previously an Indian predominant school with better resources. Now that has changed, and the government has not reviewed the quintile level. **“School C***

In addition, School D's included the following operating environment:

> *"The poverty level in this area is significant; as I said, it's quintile one. Some of our learners have not seen a tablet before.”*

Schools D and E deal with comparable issues. However, school E has made further efforts to guarantee that pupils in the foundation level have access to digital tools.

Students in Grade R can learn robotics, but there are problems if their tablets break because parents don't have a financial commitment to the school.

> *"A challenge arises when tablets used in classes are broken. If a learner breaks a tablet, the school must repair it because the parents inform the school that they are unemployed and unable to cover the repair costs."*

School E works hard to provide fair access to technology and improved educational opportunities, despite financial limits.

While some schools demonstrate consistency across various thematic areas, others exhibit inconsistencies, particularly in government support, parental involvement, and budget allocation. These findings highlight areas where interventions may be needed to ensure uniformity and effectiveness in technology adoption and integration across schools.

4.2.4 *Resource Availability*

The table below provides an analysis of resource availability, affordability, security considerations, and the will of the government and administration across the five schools according to the school principals.

School name	**Resource Availability**	**Affordability**	**Security Concerns**	**Government Will**
School A	High	High	Low	Strong
School B	High	High	Low	Strong
School C	Low	Low	High	Weak
School D	Moderate	Moderate	High	Moderate
School E	Moderate	Moderate	High	Moderate

Table 3– Resource availability analysis

In addition to the intention to incorporate digital technologies into South African state schools, which is primarily influenced by government and school management, the availability and affordability of technological resources, as well as ensuring their security once acquired, are critical factors in promoting and facilitating the adoption of digital technologies in state schools.

Security Concerns: Schools like School C, D and E face substantial challenges due to limited resource availability, affordability issues, and inadequate security measures, particularly in high-crime zone locations. The principal of School C highlights the pressing need for enhanced security measures, emphasising the vulnerability of schools to break-ins and theft, which impedes their ability to introduce costly technology assets.

> *"There are a lot of break-ins in this community, in homes and this school, we have been targeted a few times, Government does not assign private security to school to secure them, we have to get the security right before we bring in expensive TVs and tablets".* ***School C***

School D and E shared the same sentiments.

> *"There is a high crime rate in this area, the Government allocated smart TVs to one of our neighbouring schools and all of them have been stolen, some were found in the neighbouring shacks, we have also been victims of crime on many occasions"* ***School E***

School A and B made no mention of security concerns.

Resource Availability: Each school's unique conditions, such as quintile levels, fee structures, and geographical locations, significantly influence their operations and resource accessibility. Schools like School A, focusing on special needs education, demonstrate a robust strategic commitment to technology integration, evident through defined plans, government initiatives, and ongoing teacher training.

> *"We currently have a media centre with a lot of technology resources, we plan to build another two in the next year and if you go into my classrooms, you will find the most high-tech televisions. "****School A"***

Similarly, School B had the following to share:

> *"We are rolling out more smartboards and data projectors, so out of the 60 classrooms we have here, I would say we have about 40*

smartboards and projectors. Half of all of my classrooms have reliable internet access." ***School B***

Affordability: School C grapples with funding difficulties, whereas Schools D and E navigate budget constraints and overcrowding. Despite these challenges, School D and E leverage partnerships with an NGO the Click Foundation to surmount financial hurdles and effectively integrate technology into their curricula.

> *“Click foundation come with their own instructors and tablets, they move around our classrooms to provide lessons to learners, the school pays for a portion of this from the LTSM budget, and the rest is taken care of by the foundation”.* ***School D***

Government will and administrative support

School A and C hold differing perspectives on the government's commitment and administrative assistance. School A offers the following statement:

> *"Special schools and schools in general are very well looked after by the government; we cannot say they are neglected. In general, schools are being taken care of. When you find schools not being looked after, it's usually due to the school’s mismanagement. I come from Soweto, and I worked in Snake Park for 12 years, so I know what goes on there and I'm familiar with the funding situation."* ***School A***

School C had a distinct viewpoint and shared the following addition.

> *“Our biggest challenge is the failure of the education department to provide computers to the school”.* ***School C***

Each schools’ particular conditions, such as quintile levels, fee systems, and geographic locations, have a substantial impact on its operations and resources.

Resource Availability: School A, which focuses on special needs education, has a strong strategic commitment to technology integration, as seen by defined plans, government initiatives, and regular teacher training. School D demonstrates a similar devotion, albeit with higher fees and more resources available.

Affordability: School C suffers funding difficulties. School D and School E, despite budget constraints and overcrowding, use partnerships with organisations such as the Click Foundation to overcome financial hurdles and effectively integrate technology into their curricula.

4.3 Summary of the findings

Proposition 1 Strategic commitment from the Department of Education and the schools.

Most of the schools in this study demonstrate a proactive approach to digital adoption, independently navigating the challenges posed by governmental curriculum constraints. Schools A, D, and E have strategically incorporated digital studies into their curriculum or formed partnerships with NGOs to facilitate technological integration. Government support primarily manifests through the allocation of LTSM budgets to all state schools, within which Schools A, B, D, and E integrate technology into their educational practices. School B stands out for its advanced digital adoption, boasting a visionary plan aimed at equipping learners for the future. In contrast, School C lags its counterparts, with the LTSM budget mainly contributing to technological enhancements in school administration. Moreover, the school's internet access is limited to the office area, highlighting its technological shortcomings compared to other institutions.

Proposition 2 The Availability, affordability, and Security of Digital resources in state schools

In the pursuit of integrating digital technologies into South African state schools, both government initiatives and school management play pivotal roles. However, beyond mere intention, the availability, affordability, and security of technological resources are crucial determinants in facilitating the adoption of digital technologies within these educational institutions.

Security Concerns: Schools like School C, D and E face substantial challenges due to limited resource availability, affordability issues, and inadequate security measures, particularly in high-crime zone locations. The principal of School C highlights the pressing need for enhanced security measures, emphasising the vulnerability of schools to break-ins and theft, which impedes their ability to introduce costly technology assets.

Moderate Levels: School D and School E operate within a middle ground, exhibiting moderate levels across various variables. Despite encountering challenges, both schools demonstrate proactive approaches.

Each school's unique conditions, such as quintile levels, fee structures, and geographical locations, significantly influence their operations and resource accessibility. The data underscores the importance of establishing clear strategic plans, defining performance standards, implementing key performance indicators by the Department of Education, allocating resources judiciously, and fostering collaborative efforts. Such measures are essential for promoting successful technology integration and enhancing educational outcomes across various socioeconomic settings throughout South Africa. The findings suggest a lack of consensus on what constitutes effective use of digital technologies in education. Each institution gave different viewpoints on resource availability, pricing, and security factors, which influenced their approach to technology integration. For example, although certain schools, such as School A, benefit from strong government backing and resource availability, others, such as School C, have issues due to limited resources and inadequate security measures. Technology integration and enhancing educational outcomes across various socioeconomic settings throughout South Africa. The findings suggest a lack of consensus on what constitutes effective use of digital technologies in education. Each institution gave different

viewpoints on resource availability, pricing, and security factors, which influenced their approach to technology integration. For example, although certain schools, such as School A, benefit from strong government backing and resource availability, others, such as School C, have issues due to limited resources and inadequate security measures.

CHAPTER 5. DISCUSSION OF THE FINDINGS

5.1 Introduction

In this chapter, we will delve into the results section, providing explanations and insights. The primary focus will be on addressing the research question and its associated propositions. The study's findings offer insightful information on how digital technologies are being adopted in Gauteng state schools. These findings highlight several important themes with broad ramifications for educational practice and policy.

Research question one.

I. What are the factors that drive the adoption of digital technologies in public schools?

Proposition: Several interrelated factors influence the use of digital technologies in South African state schools. The most important factor is the school's and the Government's strategic commitment to promoting the integration of digital technology into the curriculum.

This integration is further strengthened by the knowledge and support of instructors, parents, and the governing body.

Research Question two

II. What role does the availability of digital infrastructure play in enabling adoption among South African public schools?

Proposition : The successful integration of digital technologies into South African state schools is driven by government and school management's commitment. However, ensuring access to and affordability of technological

resources, along with guaranteeing their security post-acquisition, are crucial factors that significantly influence the adoption of digital technologies in these institutions. The demographics of the study encompass a diverse range of educational institutions, providing insights into various socio-economic and geographic contexts. Among the five schools examined, there was representation from different settings, reflecting the broader landscape of South African education.

In education, inclusion involves respecting individual differences and needs, with a focus on the student. The school system should address common issues for all students. including students with unique educational needs (Gordana Stankovska, 2020). One notable in this research paper was the inclusion of a special needs school catering to children living with autism, highlighting the importance of addressing diverse learning needs within the education system. This school offers specialised support and resources tailored to students with autism spectrum disorder, emphasising inclusivity and individualised learning approaches.

5.1.1 *Objective*

Understanding the factors that influence the adoption of digital technology in public schools.

5.1.2 *Strategic Commitment and Government support to Technology Integration*

There is a communication gap between schools and the provincial education administration regarding managing school infrastructure, Communication is the process of conveying information and meaning to all stakeholders within an Eco-system (Ngema, 2023). At the governmental level, it is crucial to establish a vision and plan encompassing all schools. The schools included in the research seem to hold differing opinions regarding the clarity and effectiveness of the government's articulated strategy and objectives. This observation is evident in both School A and School C. While School A asserts

that the institution receives adequate care and maintains regular communication with the government, School C holds a contrasting perspective regarding government communication and support. School A demonstrates a high strategic commitment to technology integration, as seen by detailed planning, Government funding allocations, and ongoing teacher training. School C faces hurdles due to budget limits and government assistance.

5.1.3 *Governmental strategic input*

Government guidelines concerning the integration of technology in education furnish schools with a framework for strategic planning. The explicit directives and standards established by the government assist schools in aligning their technology initiatives with broader educational goals and objectives (Stevens, 2017). Governmental guidelines, such as policies and curriculum directions, should push for technology to be used in the creation of lessons. The goal is to provide an organised way for schools to use technology in lessons. This does not seem to be the case for schools that took part in study, especially the primary schools.

The objective outlined in South Africa's 2004 White Paper on e-education aimed for every student nationwide to attain ICT proficiency by 2013, alongside teachers utilising ICT to enrich the teaching and learning process. This objective aligns with a primary focus in the country's new development strategy, the National Development Plan (Vision 2030) (NDP) (Greunen, Kativu, Veldsman, & Botha, 2021). The findings reveal divergent outcomes compared to the government's vision for their state schools in 2013. In 2024, 11 years later, there are still schools like School C that have not achieved this vision. In instances of integration, it was primarily the schools taking the initiative in strategising, without significant support or input from the government. To ensure meaningful access to and utilisation of ICTs in all South African schools, there is a need for a supportive policy framework and dynamic technological advancements (Greunen, Kativu, Veldsman, & Botha, 2021), ICT integration in education has been a focal point of policy discussions

in South Africa since 1991 (Vandeyar, 2020). Concerns persist regarding policy constraints within the curriculum, particularly among foundation phase schools.

5.1.4 *School funding /Budget allocation for technology infrastructure, adoption, and operations*

LTSM (Learning and Teaching support material) budget from the Government includes textbooks, library books, charts, models, computer hardware and software, televisions, video recorders, videotapes, home economics equipment, science laboratory equipment, musical instruments, and learner desks/chairs (Makhafola, 2022). The government allocates LTSM funding to every state school, although the amounts vary due to several contributing factors. However, within this budget, schools primarily fund their technological adoption initiatives. Based on the collected data, there is no specific directive from the government to schools regarding the precise utilisation of the allocated funds. There is currently no national policy to steer ICT investments in education, leaving provinces to make their own decisions (Jitsing, 2022) .Schools receive LTSM funding based on their quintile level. The principal of School C expresses the belief that the school does not receive sufficient funding and support from the government due to an inaccurate quintile allocation. The principal contends numerous changes have occurred within the school and the surrounding community since the quintile allocation was determined. As such, the principal advocates for the government's reassessment of the quintile level allocation, urging adjustments were deemed necessary to better reflect the current circumstances. The following supports the assertion made by the principal of School C: To achieve ICT integration in the classroom, the development of digital fluency should not be divorced from the realities of the provinces' socio-cultural context (Dlamini, The Idependent Journal of Teach and Learning, 2022).

The digital divide, marked by discrepancies in access to and utilisation of technology, poses a substantial obstacle in education (Afzal & Khan, 2023).

These disparities are evident in a school that is incorrectly classified as Quintile 4, as expressed by the principal. At School C, students are not provided with opportunities to learn using technological devices. When technology-related lessons are conducted, teachers resort to using their own mobile phones and tablets to demonstrate concepts to learners. The principal holds the belief that if the school were classified as a quintile 2 institution, it would garner the necessary support and attention from the Department of Basic Education to progress technologically. Due to this misclassification, the school faces a shortfall in essential resources and funding required for its advancement. The principal underscores the importance of accurate classification in accessing the appropriate assistance and resources vital for the school's growth and development in the digital age. The principals' concerns are ratified by the following findings in a study: The updated Norms and Standards have had a favourable influence on funding distribution, notably in terms of appropriately recognising schools in Quintiles 1 and 5. With financing connected to quintile classification, a more precise rating should have influenced resource allocation, ensuring that schools receive adequate funding. While Quintile 5 and 4 schools may receive comparatively less financial assistance from the state than Quintile 1 schools, the latter still face greater challenges in terms of school resources and composition (Dyk & White, Theory and practice of the quintile ranking of schools in South Africa: A financial, 2019).

Between 2016/17 and 202/21, The Gauteng Department of Education allocated R3.4 Billion of its R19 Billion budget to the Gauteng province state schools. Gauteng Province is the most populated province in South Africa, with a total population of 15.1 million (Stats SA, 2022), this could potentially explain the rationale behind allocating a significant portion of the educational budget, however as outlined in the findings section, there is no predetermined strategic allocation for technological adoption in state schools by the Government.

The table below illustrates the allocation of the LTSM budget to technology and its integration by the schools interviewed for this study.

Thematic/Code Area	School A	School B	School C	School D	School E
Budget allocation to technology adoption and operations	5% of the LTSM Budget is allocated	12% of the LTSM budget allocated	No set budget allocated	A combination of LTSM budget and partnership with Click Foundation	15% of the LTSM budget and partnership with Click Foundation

Figure 12: School LTSM Budget allocation.

It is evident that the government has not mandated a specific strategic directive to support technological adoption in the budget allocation for different schools.

Non-governmental organisations (NGOs) have been very important to South Africa's development throughout its political history. They have done this by providing important services like education to many people who don't have access to them, emphasising rights-based governance, policies, and laws, and holding the government accountable for its legal and development duties (Volmink & Elst, 2017). Some schools in the lower quintiles, like School E in Quintile 1 and School D in Quintile 2, formed a strategic relationship with a non-governmental organisation (NGO) to make it easier for them to use digital technologies in their lessons. This group effort was meant to do more than just teach students how to use digital tools. It was also meant to use the NGO's knowledge and resources to improve teaching methods and make learners learning more enjoyable and interactive.

Many projects have been started to improve the level of education because of the well-known problems. These projects have received large amounts of

money from private, donor, and public sources. A lot of different groups, including non-governmental organisations (NGOs), are working on these projects to solve these problems. But these efforts haven't really helped improve the quality of education in South Africa if they've helped at all. Even though many people and groups have contributed money and time, the effect has not been maintained or increased enough to make a big difference in how well students do in school (Volmink & Elst, 2017). The sentiment was echoed by Schools E and D, indicating that despite partnering with an NGO to adopt digital technologies, schools still require more visible support from the government regarding the adoption of digital technologies in educational settings.

5.1.5 *Integration of technology into the curriculum and future strategic initiatives.*

Incorporating technology into a curriculum entails transforming technology into a tool that enriches learning within a specific content area or across various disciplines. The objective is for technology to seamlessly integrate into the classroom environment and be as accessible as other classroom resources. (Hoffman, 2020) School B has a systematic approach to technology integration through visible projects such as two computer labs, data projectors and interactive whiteboards. While the school's mission does not expressly include government support, it is consistent with larger educational goals, demonstrating a long-term commitment to technology integration.

Barriers to integration have included insufficient hardware and software, challenges in securing adequate funding, inadequate professional development for staff, and deficiencies in planning. (Hoffman, 2020) School D and School E prioritise technology integration, despite limited budgets, by partnering with organisations like as the Click Foundation (NGO).

The integration of ICT in the classroom requires significant consideration to enhance the competency of the country's education system. (Ghavifekr, 2015) The level of government support influences the strategic planning and resource allocation of schools, ultimately impacting the success and

sustainability of technology integration initiatives. Government assistance takes several forms, including financial support, policy formation, infrastructure provision, and professional development opportunities for educators. (UNESCO, 2023) The primary schools involved in this study do not offer technology or a dedicated technological subject as a standalone curriculum. However, School A integrates robotics into its mathematics curriculum, while School D and School E have incorporated technology into their English lessons. The schools emphasised that they must adhere to the curriculum and its policies. However, it is notable that the curriculum followed by these schools does not place a strong emphasis on technological studies for learners.

Students with intellectual and developmental disabilities demonstrated enhanced competence and performance using digital games in their lessons. (Timotheou & Milliou, 2022) The principal of School A supported this by emphasising the importance of considering that learners on the Autism Spectrum are visual learners. Incorporating digital learning tools into the curriculum can contribute to their success.

5.1.6 *Teacher engagement and training*

In a context where teachers refer to themselves as BBTs (Born Before Technology), confidence plays an important role in ICT integration, especially as it has a strong correlation with attitude. For teachers to develop confidence in the use of ICT in their profession, they must have access to development opportunities. (Dlamini, Factors constraining teacher integration of ICT in Gauteng Schools, 2020) The teachers at School E and School D are not directly involved in teaching technology to students or incorporating technical equipment and infrastructure into their lessons. The Click Foundation accounts for the technological side of teaching; in contrast, both School Band and School A have their teachers actively utilising and instructing on technology. These educators have undergone training and continue participating in further training sessions as needed.

Teachers and parents are pivotal in determining the educational achievement of students. A positive learning environment, characterised by support,

motivation, and high-quality instruction, is essential for student success in school. Given the growing demands on families, parental involvement in student education extends beyond the confines of the school premises (Bunijevac, 2017). The principal of School B reiterated these sentiments, emphasizing the crucial nature of the relationship between parents, teachers, and learners and highlighting its central role in fostering the well-being and development of learners. Research shows that the extent to which schools foster positive relationships with parents and vice versa significantly impacts student outcomes. Students whose parents remain engaged with the school exhibit better attendance and behaviour, achieve higher grades, demonstrate improved social skills, and adapt more effectively to the school environment. (Annie E. Carey Foundation , 22) According to the school principals, parents of learners in the township schools included in this study have exhibited minimal involvement in their children's schooling. Nevertheless, the schools have taken proactive measures to address this issue by ensuring learners access technology through NGO organisations.

Continual professional development among teachers stands as a pivotal factor in achieving successful integration of computers into classroom instruction. This ongoing training ensures educators are adept at leveraging technological tools effectively to enhance the learning experience for learners (Buabeng-Andoh, 2012). All interviewed principals shared a common sentiment regarding the necessity of training teachers to effectively utilise technology in the classroom. While there were evident endeavours to provide teachers with training and enhance their technological proficiency, the principal of School C concurred on the significance of such training. Nonetheless, the school lacked adequate facilities to allow teachers to apply practical skills following their training in digital technologies. The successful initiation and implementation of educational technology programs in schools are heavily reliant on the support and attitudes of teachers. If teachers perceive technology programs as inadequate for meeting their own needs or those of their students, they are unlikely to integrate the technology into their teaching and learning practices (Buabeng-Adoh, 2012). This sentiment was echoed across all schools, exemplified by School B, where it was noted that some older teachers

preferred traditional methods like chalk and talk. However, the introduction of data projectors and pre-planned lessons on Microsoft PowerPoint has persuaded these teachers to embrace technological devices in their teaching. The principal also noted that this facilitated cross-skilling, as students eagerly stepped in to assist teachers who were unsure about certain functions or features.

5.1.7

The discussion on Proposition 1, aimed at understanding the factors influencing the adoption of digital technology in public schools, reveals several key insights. Firstly, a significant communication gap exists between schools and provincial education administrations regarding managing school infrastructure. While communication is vital for conveying information to all stakeholders within an ecosystem, the effectiveness of government strategies and objectives in promoting technology integration varies among schools.

Although government funding, particularly through LTSM budgets, is allocated to every state school, there is no specific directive on how these funds should be utilised for technological adoption. Moreover, the absence of a national policy guiding ICT investments leaves schools (Akande & Belle, 2014) to make independent decisions, resulting in varied approaches to technology integration across schools.

To achieve effective ICT integration in classrooms, it is essential to consider each province's socio-cultural context. While Gauteng, the most populated province in South Africa, allocates a significant portion of its educational budget to state schools, the government does not have a predetermined strategic allocation for technological adoption.

Educators and parents play pivotal roles in student success, with positive relationships between schools and families significantly impacting student outcomes. However, parental involvement in township schools appears limited, necessitating proactive measures by schools to ensure equal access to technology through NGO organisations.

Addressing disparities in technology access and utilisation is crucial for promoting educational equity and inclusion. Strategic planning, supportive government policies, and collaboration between schools, parents, and organisations are essential for successful technology integration initiatives in public schools.

5.2 Discussion pertaining to Proposition 2

5.2.1 *Objective*

Evaluating the accessibility, affordability, and security measures associated with acquiring and maintaining technological resources.

5.2.2 *Securing Digital Resources and Infrastructure*

The deployment of physical elements like metal detectors, locked entrances, perimeter fencing, and surveillance cameras within and around the school is seen as a strategy to enhance the security of the physical infrastructure. (Mogwathi, Graham, Jozua, & Villiers, 2023), this raises the question of who or what will finance the security measures for these resources. Currently, there is no consistent strategy among schools for the implementation of digital technologies, and the LTSM budget is already strained, according to reports from the schools. The analysis reveals notable disparities among the five schools surveyed, with School C facing significant challenges due to limited resources, affordability issues, and security concerns. Principals from schools facing such challenges emphasise the urgent need for enhanced security measures to safeguard costly technology assets, citing incidents of break-ins and theft. Ensuring sufficient provision and security of the physical infrastructure in schools could enhance safety for both teachers and students, potentially leading to improved academic performance among learners. Therefore, it is crucial to consider implementing appropriate measures to address safety challenges related to physical infrastructure in schools. (Mogwathi, Graham, Jozua, & Villiers, 2023), Considerable research suggests that inadequate safety measures within schools might be linked to diminished

academic performance among students of particular significance is the escalating concern surrounding safety issues in South African schools. Ensuring sufficient provision and security of school infrastructure could enhance safety for both educators and students, potentially leading to improved academic outcomes. Therefore, it is crucial to consider implementing suitable measures to address safety challenges related to physical infrastructure in schools. (Mogwathi, Graham, Jozua, & Villiers, 2023). Security appears to be of little concern for schools situated in suburban areas like Schools A and B. The principals did not raise any security risks or concerns when discussing their schools' technological adoption. These schools have ample resources and are progressing well. However, in contrast, schools like School C, located in a high-crime area according to the principal, lack the necessary resources to ensure security on campus. Currently, the school lacks the infrastructure to address security concerns, highlighting the urgent need for resources in this regard. Schools D and E have made strides in digital advancement despite their geographic locations in townships and informal settlements. These schools have emphasised the use of their stretched Learning and Teaching Support Material (LTSM) to enhance school security.

5.2.3 *Availability of resources and Infrastructure*

All public schools in South Africa fall under the jurisdiction of the Department of Basic Education (DBE), tasked with providing essential infrastructure. While participants were not specifically queried about the provision of physical infrastructure from the Government, some did remark on the ongoing challenge of ensuring adequate infrastructure in schools. (Mogwathi, Graham, Jozua, & Villiers, 2023) .Three out of the five schools noted these challenges, with two schools needing to seek resources beyond the Department of Basic Education to facilitate student learning with technological devices, while one school lacked any resources for learners altogether. In contrast, schools such as Schools A and B showcase strong strategic commitments to ensuring technology resource availability, exemplified by their well-equipped media centres and consistent investments in smartboards and projectors. The issue of affordability emerges as another crucial factor impacting technology

adoption, with School C facing funding challenges, whereas schools like D and E mitigate financial constraints by partnering with NGOs. Government will and administrative support also vary, with School A perceiving adequate government assistance while Schools C and D lament the failure of the education department to provide essential resources like computers.

5.2.4 *Government Will*

All five schools included in this study are government-run institutions. They operate under the guidance of the government, which dictates the curriculum and should provide resources to facilitate their daily functioning. Additionally, financial support is allocated by the government to assist these schools in meeting their operational needs. In the Government's draft white paper on e-education, published in 2023, the following statement was made: This White Paper outlines the government's strategy in response to the evolving information and communications technology landscape in education. The objective is to ensure that every school has access to a broad range of quality communication services. The aim is for all learners and local communities to reap the benefits of this investment. The initiative's services are designed to enrich lifelong learning experiences and offer limitless opportunities for personal growth and development to all individuals involved. (Asmal, 2003), This document outlines the government's recognition and readiness to engage in the digital era, facilitating the same for its schools. However, Schools C, D, and E offer differing perspectives and encounters regarding the government's commitment to empowering their schools digitally. The realisation of the e-education policy objective, aiming for every learner in both general and further education and training tiers to be ICT proficient by 2013, necessitates a sustained strategic approach. This approach will establish a blueprint for delineating precise priorities and executing actions over an extended duration. The implementation strategy delineates a multi-year action plan divided into three Medium Term Expenditure Framework (MTEF) cycles: Phase I (2004/07), Phase II (2007/10), and Phase III (2010/13). (Asmal, 2003). Based on the government's planning cycle in 2003, the aim was to ensure that all learners would have access to digital resources and be digitally proficient by

the year 2013. Fast forward to 2024, and there are still schools like School C within the education system that lack essential resources such as computers and internet access for their learners.

5.3 TOE FRAMEWORK

The proposed Technology, Organisation, and environment framework for digital technologies adoption in South African State Schools

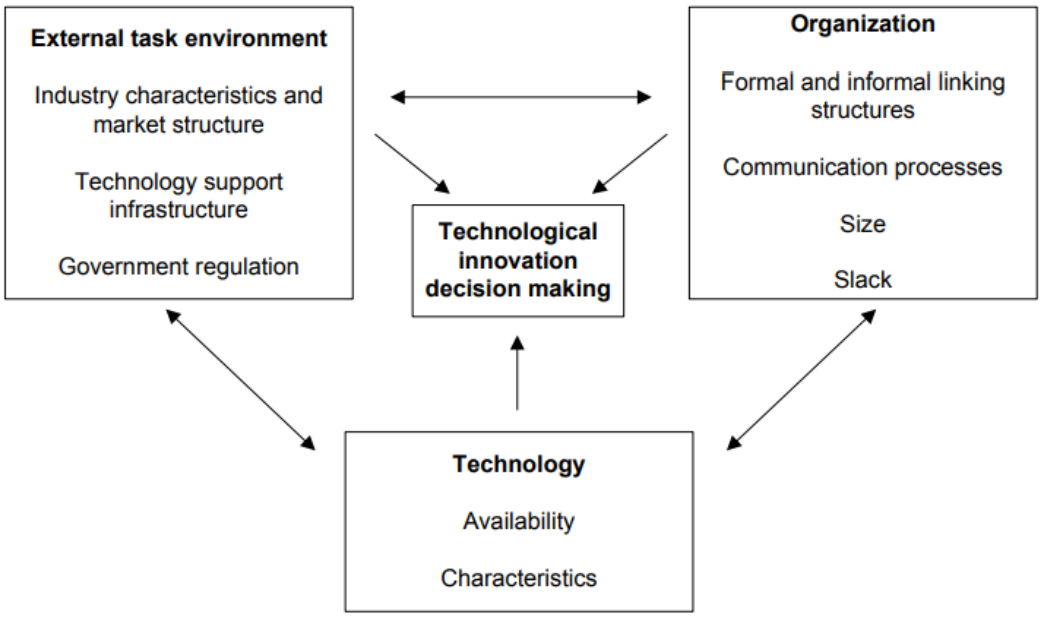

Figure 14 – TOE Framework and its components (Jere J. N., 2023)

The proposed digital adoption framework was adopted in 1990, and Tornatzky and Fleischer came up with the TOE structure. The framework outlines three factors in a business environment that affect how it accepts and uses advanced technology: technology setting, organisational context, and environmental context (Oliveira & Martins, 2011).

Technology (Availability)

This study uncovers disparities in technology availability among state schools, with some schools being more advanced than others. For example, School A stands out for its strong technology integration, evidenced by its well-equipped computer lab, and plans to expand its facilities in the coming year. On the contrary, Schools C and D lack dedicated computer labs. School D faces challenges related to overcrowding, which precludes the establishment of a computer lab, while School C's on-site computer lab contains outdated equipment that has remained unused for years. Despite the challenges of overcrowding, School D has managed to integrate technology into the school and classrooms. The technological landscape varies among the schools included in this study. Each school has its own approach to technology adoption, and notably, one school is currently not integrating technology in its classrooms. The sentiments regarding the factors influencing how schools embrace and advance technology revolve around the support from the Department of Education and budget allocation.

External Environment

Schools A and C, located in a progressive suburban area, did not mention the impact of their external environment on digital adoption. However, a different narrative emerges for schools B, D, and E, situated in poor communities with a high crime rate. The adoption of digital technologies presents a challenge for these schools, as they have been targeted and burgled in the past. Despite these concerns, Schools D and E persevered in integrating technology into their classrooms and operations.

Organisation

By using technology in its lessons and daily operations, School B shows that its leaders are forward-thinking. With an eye towards 2030, the school aspires to become a fully digital institution where students store their books and assignments online on their laptops or tablets instead of carrying heavy school bags. In the same way, School A has plans to upgrade and expand its digital infrastructure. In opposition, Schools E and D currently depend on help from an NGO to maintain their digital skills and adoption. The schools made no

mention of plans to adopt digital tools independently. However, the current partnership model with the NGO works well for the schools as the NGO assists the schools with cost sharing.

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5.4 Conclusion

The discussion chapter delves into various factors influencing the adoption of digital technology in public schools outlined in Propositions 1 and 2, touching upon strategic commitment, government support, funding, policy development, teacher training, and implications for educational equity and inclusion.

Research Proposition 1 aimed to investigate the factors influencing the adoption of digital technology in South African public schools. The analysis revealed a few aspects, with the most apparent being the critical role of government strategy and policy creation in driving this adoption process. Despite various approaches, all schools acknowledged the importance of digital adoption. The research reveals that there is a significant difference in perceptions of government support and communication effectiveness among schools. While some schools expressed satisfaction with the support they received, others have challenges due to budget limits and insufficient assistance. Supported by literature reviews, this in the schools' responses mismatch highlights the multifaceted terrain of digital integration initiatives, emphasising the importance of specific support methods to address the individual issues faced by each school.

Just one provincial policy document outlines the methodology for analysing LTSM requirements and evaluating the disparities between the necessary resources and what schools currently possess. (Jitsing, 2022) This is supported by the research findings that the government's LTSM funding serves as a vital reservoir for schools to fund their technology-enabled Programs. However, there is still a noticeable lack of precise directions outlining how these money should be used for technology adoption. Out of the five schools examined, two have turned to alternate collaborative financing sources and

sponsorships to supplement their technical resources. The national sector plan outlines the processes for planning, procuring, and delivering LTSM. The national plan permits the National Department of Basic Education to administer and coordinate LTSM procedures but does not address the question of value for money (Jitsing, 2022). Research Proposition 2 examines the accessibility, affordability, and security measures involved in acquiring and maintaining electronic resources in South African public schools. The findings shed light on crucial areas of digital resource and infrastructure security and availability.

Availability of Resources and Infrastructure: The study highlights variations in resource availability among schools, with some making substantial commitments to technology integration while others struggle owing to funding constraints. Even though schools are controlled by the government, perceptions of government support and commitment to digital empowerment vary. The government's proposed white paper on e-education explains its strategy for ensuring that all schools have access to high-quality communication services by 2013. However, schools such as Schools C, D, and E have varying viewpoints on the magnitude of government help they receive.

The literature highlights the critical importance of implementing effective security measures to secure key digital assets in schools after they have been gained. As schools incorporate more digital resources into their teaching and learning environments, ensuring the security of these assets becomes vital. However, the proliferation of technology presents security problems in schools located in high-crime areas, such as theft and vandalism.

According to the educational equity and inclusion literature, resource allocation and utilisation have a substantial impact on the learning possibilities available to pupils. To ensure fairness and excellence in educational systems, funding approaches should prioritise access to high-quality early childhood education and care (ECEC), particularly for low-income families; and implement funding mechanisms, such as weighted funding formulas, that recognise the potentially higher instructional costs associated with educating disadvantaged students. Furthermore, it is critical to find a balance between decentralisation/local

autonomy and resource accountability to successfully support the most marginalised kids and schools. (OECD, 2012) Inclusion concerning access special needs schools is evident in School A. However, the inclusion of learners from disadvantaged communities, such as those attending schools like Schools C, D, and E, has yet to be achieved. The Quintile classification of School C highlights this issue.

CHAPTER 6. CONCLUSIONS & RECOMMENDATIONS

6.1 Introduction

This chapter presents conclusions and recommendations regarding the findings established on the research questions defined in Chapter 1 and the propositions associated with them. It not only provides recommendations targeted to the field of digital transformation and adoption but also extends suggestions relevant to the South African public school setting. The primary goal of this research was to clarify the complexities surrounding the use of digital technologies in South African state schools.

6.1.1 *Linkage between the study's findings and its implications for educational practice and policy.*

The study's conclusions have several significant ramifications for educational practice and policy considering Gauteng state schools' incorporation of technology. Several factors, including teacher preparation, resource allocation, strategic commitment, and security concerns, show how these findings relate to their larger implications. The findings have the following implications for educational practice and policy.

Findings on Strategic Commitment:

i. The study showed that the government and schools have different degrees of strategic commitment. Due to a lack of funding and support, some schools—like School C—fall behind while others—like Schools A, D, and E—have demonstrated proactive ways by incorporating technology into their curricula and establishing partnerships with non-governmental organisations.
ii. Practice Implications: To integrate technology effectively, schools must create strategic plans that align with their academic objectives. This

entails establishing clear goals, managing resources wisely, and cultivating alliances with outside groups.

iii. Policy implications: Policymakers must guarantee uniform support for all schools by allocating sufficient funds, facilities, and training. Establishing key performance indicators (KPIs) and performance criteria can help track and direct the use of technology in classrooms.

Findings on Resource Allocation

The availability and affordability of resources vary greatly among schools. Schools with lower quintile levels and no-fee policies (e.g., Schools D and E) have better access to digital resources than schools with higher quintile levels and fee-paying structures (e.g., School B).

i. Implications for Practice: To close resource gaps, schools must make the most of their finances and investigate alternate funding options including collaborations with non-profits and commercial sector sponsorships. Setting priorities for IT investments.

ii. Policy Implications: Educational policies should provide more assistance to underfunded schools to alleviate budget disparities. Implementing equitable funding methods that consider each school's socioeconomic circumstances can facilitate ensuring that all students have access to the digital tools they need.

Findings Regarding Teacher Engagement and Training

i. Insufficient teacher engagement and training impedes the effective integration of technology. While some schools, like Schools A and E, have started teacher development Programs, others are having trouble providing their staff with the training they need.

ii. Consequences for Practice: Educational institutions should provide ongoing professional development Programs for educators, emphasising the pedagogical and digital literacy needed for technology-enhanced instruction. Specialised training programs and continuous assistance can increase teachers' confidence and competence.

iii. Policy Implications: As part of the national education policy, lawmakers should require and support comprehensive teacher training Programs. Working together with technology companies and educational institutions can help create training Programs that are appropriate for the workforce.

Findings Regarding Security:

i. Adoption of technology is severely hampered by security concerns, especially in high-crime regions. Theft and vandalism have undermined the efforts of schools like C, D, and E to maintain and use digital resources.

   Practice Implications: Schools should implement strong security measures to safeguard their resources. These measures include community involvement, secure storage options, and surveillance systems. The foundation of sustainable technology integration is the establishment of a secure and safe learning environment.

ii. Implications for Policy: By providing funding for security upgrades and aiding schools located in high-risk regions, policies should place a priority on the protection of educational facilities. Mitigating security issues can be facilitated by cooperation with community organisations and local law enforcement.

Overall Results in Education

Findings: The study emphasised how technology adoption affects academic performance, with schools that successfully use technology demonstrating more readiness for the digital era. On the other hand, differences in student accomplishment may result from inconsistent assistance and resource availability.

i. Practice Implications: Schools should use digital technologies to improve student engagement, learning outcomes, and student preparation for prospects. Technology integration in a range of courses helps promote digital literacy and critical thinking.

ii. Implications for Policy: To guarantee that all students, regardless of background, have equal access to digital learning opportunities, policymakers should concentrate on developing an inclusive and supportive framework for technology in education. Regular assessment and feedback methods can improve policies and practices and achieve the intended educational outcomes.

6.2 Conclusions regarding the factors that influence digital adoption in South African state schools.

The findings regarding the integration of digital technologies in South African state schools reveal a unanimous recognition among all participating schools regarding the significance of digital technologies in their educational environments. Despite variations in the extent and maturity of their digital adoption, all schools expressed a shared understanding of the importance of incorporating digital tools and resources into their educational practices.

Proposition 1 - Factors that drive the adoption of digital technologies in public schools.

This study identified several factors contributing to the adoption of digital technologies in South African state schools, with one factor standing out prominently, which is the role, engagement, and directives of the Government. Government intervention appeared as a dominant force shaping the scene of digital adoption in these schools. From policy formulation and clear directives

to resource allocation, governmental actions influenced the trajectory of digital integration initiatives across the schools.

The incorporation of policies regarding the adoption of digital technologies in South Africa appears to pose a challenge for primary schools, the study found that technology as a subject is not part of the foundation phase curriculum.

During the collection of data, it was evident that policy formulation and sufficient funding pose significant barriers to entry for digital technology adoption in four of the five schools examined in this study. This highlights the crucial role of governmental policies and financial resources in directly shaping technology integration within schools. The Department of Education does not lead the well-thought-out and well-executed plan necessary for the digital transformation and adoption process in South African public schools. As a result, it was found that different schools had different degrees of digital maturity, with some being noticeably more developed than others.

The table below illustrates a SWOT analysis, detailing the strengths, weaknesses, opportunities, and threats uncovered in this study's findings.

Strengths	**Weaknesses**
Strategic Commitment: Schools like A and B demonstrate strong strategic planning and commitment to technology integration, supported by clear initiatives and resource allocation. Teacher Engagement and Training: Most schools prioritise teacher training, enhancing educators' digital literacy and facilitating effective technology integration into teaching practices.	Funding Constraints: Schools like C face funding difficulties, hindering their ability to acquire and maintain technological resources. Variability in Government Support: Inconsistent government support across schools leads to disparities in technology adoption efforts and resource allocation.
Opportunities	**Threats**

Government Policies: Government initiatives aimed at enhancing technology adoption in schools, such as South Africa Connect, present opportunities for improved support and funding. Professional Development: Investing in ongoing teacher training and development programs can further enhance educators' digital literacy and pedagogical practices.	Budget Cuts: Economic downturns or budget cuts may exacerbate funding constraints, limiting schools' ability to invest in technology infrastructure and resources. Socioeconomic Disparities: Socioeconomic factors, reflected in quintile levels and fee structures, contribute to inequalities in resource access and technology adoption across schools.

Table 4 : SWAT Analysis

Implications for Research Objectives

The SWOT analysis makes clear the necessity of focused interventions to deal with resource restrictions, clear strategic Governmental directives, and budget allocation. The strengths identified in the SWOT analysis are not universal across all schools rather, they are specific to each individual school. However, this underscores a potential weakness in government policy, as it suggests a lack of uniform support to ensure that all schools can achieve the same level of strength and capability. The use of technology is greatly aided by government assistance and efforts, which emphasises the significance of promoting laws that give the digital transformation of education priority. To ensure sustainable technology adoption and infrastructure development, the Government, together with its schools, must implement adaptive strategies and long-term planning. This is especially important given the potential of budget cuts given the current state of the South African economy.

The factors that drive digital adoption in schools discussed in Chapter 2 and the literature review are in line with the findings of this study, especially regarding the important role that the government plays. This study emphasises how important it is for the Department of Education to play a leading role in determining how digital technologies are integrated into public education. To ensure that all state schools have adopted digital learning, the government

must put in place a plan that focuses on standardising instruction across all schools and carefully evaluating each one's particular requirements to correct flaws or advance the cause. Since the government oversees these educational establishments, it becomes clear that it is the one key element affecting the adoption of digital technologies in schools.

6.3 Proposition 2

The role of the availability of digital infrastructure in enabling adoption among South African public schools.

The availability of digital infrastructure plays a crucial role in facilitating the adoption of technology across South African schools, primarily by bridging the digital divide among learners. A significant disparity was noted between Schools C and School A, with infrastructure discrepancies emerging as the primary contributing factor to this gap. Learners at School A benefit from access to a vastly different set of resources compared to those at School C. This divide not only impacts the quality of education but also exacerbates inequalities in learning opportunities and outcomes among students from different schools. The digital gap in South Africa is complex, involving not just the presence of technology but also its accessibility. While certain schools in affluent regions showcase cutting-edge technology, many schools in disadvantaged areas face challenges with even basic computer access, with some lacking computers altogether.

The difficulties with accessibility, price, and security highlight even more how important it is for South African schools to have access to digital infrastructure. There are notable differences between the five schools examined when it comes to the difficulties schools confront in obtaining digital materials. Particularly struggling with security issues are schools like C, D and E which are in high-crime neighbourhoods. This emphasises the urgent requirement for additional resources in these schools, yet an even greater necessity for implementing robust security measures.

Alternative funding avenues for digital infrastructure played a significant role in facilitating adoption for two schools involved in this study. These schools categorised as Quintile 1 and 2, are situated in townships and informal settlements. Recognising the importance of bridging the digital divide for their learners, both schools forged partnerships with a non-governmental organisation (NGO). Through these collaborations, the schools were able to provide their learners with access to digital tools, thereby including learners in the digital age and ensuring learners are not left behind in the ever-evolving technological landscape.

The availability of digital infrastructure in South African schools is important for reasons that go far beyond simple technology, it includes more inclusive learning environments and more possibilities for students to succeed academically. The study's findings and the literature both demonstrate that having access to digital infrastructure opens doors to improved learning opportunities, fair information access, and more inclusivity in the educational system. The availability of digital infrastructure is essential to guarantee that all students, regardless of socioeconomic status or place of residence, have equal opportunities to succeed academically and fully engage in the digital age in South Africa. Therefore, digital infrastructure plays a more significant role in school adoption than just providing technology, it also acts as a catalyst for societal growth, empowerment, and the circulation of knowledge.

6.4 Recommendations

6.4.1 *Governmental support and strategy*

Every school that participated in this study noted the government's lack of a clear, well-documented directive to all schools regarding the adoption of digital technologies. This highlights the necessity of developing and implementing comprehensive policies meant to encourage the adoption of digital technologies in public schools. Make sure that all school policies address concerns about affordability, accessibility, equity, and the security of digital infrastructure. Provide precise instructions and rules for the incorporation of

technology into education at all levels, including foundation phase schools (Primary Schools).

6.4.2 *Enhanced Funding and Resource Allocation*

Most of the study's participating school principals acknowledged the need for additional government funding and support for digital infrastructure, especially in disadvantaged areas outside of the LTSM budget. To ensure that funds are distributed appropriately, it is also crucial to reevaluate the quintile level for the schools. This research revealed that one school was incorrectly positioned in a higher quintile, according to the principal.

To complement government resources and fill financing shortfalls, the Government should look at other funding channels like public-private partnerships or collaborations with NGOs. Two of the study's participating schools have already partnered independently with an NGO to implement digital technologies in their classrooms. The Government is also to ensure that budgetary allocation for digital resource acquisition, upkeep, and security should be given top priority to guarantee long-term technological acceptance and effectiveness.

6.4.3 *Research and knowledge sharing.*

The Government and schools should promote additional study and information exchange on strategies, best practices, and lessons discovered in the development of digital infrastructure from schools that have digitally matured in the Government system. Provide forums where researchers, educators, policymakers, and practitioners may share knowledge, resources, and experiences to support evidence-based decision-making and ongoing improvement. It's possible that this research confirmed what school administrators and the government already knew or has revealed a blind spot for further investigation.

6.4.4 *Establish Smart Objectives*

The study revealed a general lack of clear government directives regarding digital technology adoption across schools, emphasising the urgent need for comprehensive policy development and implementation. Therefore, the following SMART objectives have been formulated to guide this endeavour:

Figure 13 – Smart objectives.

- Specific—Develop and implement clear policy directives for the adoption of digital technologies in public schools, addressing affordability, accessibility, equity, and security concerns. To ensure standardisation, consistency in messaging across all schools must always be maintained.
- Measurable - Ensure that all public schools in South Africa achieve a 100% compliance rate in following the newly established policy directives within a pre-defined implementation framework, with Key Performance Indicators (KPIs) tracking progress at regular intervals.
- Achievable—Because the schools have different levels of digital maturity, the developmental and implementation plan must consider how each stage should be applied to each school's specifics.
- Relevant – As the world increasingly embraces digitalisation, it is important for schools to enhance and embrace the use of digital technology to adequately equip their students for the future workforce.

- Time-bound—Establish a timeline for the phased implementation of the policy directives, with key milestones and deadlines for policy development, dissemination, training, and compliance monitoring, using the set KPIs mentioned above.

6.4.5 *Establishing a RACI to assign responsibilities in the Adoption of Technologies in publics School project.*

Expanding on the SMART goals, it's critical to understand the roles and duties that every stakeholder has in promoting the uptake and transformation of digital technologies in South African State schools.

The RACI matrix of duty assignment serves as a tool to organise each resource's duties and clarify how tasks within a project are related to one another. The study findings indicate a significant disparity and ambiguity over the responsibilities of different parties involved. The Matrix divides each position into four distinct categories, Responsible, Accountable, Consult, and Informed, making it easier to understand who is responsible for what and how to communicate with others on each project task.

Task	Government Agencies	Department of Education	School Administration	Teachers	IT Personnel	Learners	Parents	NGOs	Academic Researchers
Develop Digital policies	R	A	C	I	I	I	I	I	I
Allocate Funding	R	A	C						
Provide Infrastructure	R	A	C	I	I	I	I	I	
Implement training programs	R	A	I	C					
Support technical Maintenance	R	A	I	I	C				
Monitor and Evaluate Progress	R	A	C	C	C	C	C	C	R

Figure 14 : RACI.

Legend

- R - Responsible (Responsible for carrying out the task)
- A - Accountable (Accountable for the success of the task)
- C - Consulted (Provide input and expertise)
- Informed - (Kept informed about the progress and outcomes)

6.4.6 *Justification*

Responsible

Government Agencies - Responsible for setting policies, allocating funding, and providing support for digital adoption initiatives in South African schools.

Principals - Responsible for implementing digital adoption initiatives within their respective schools and managing resources effectively.

Teachers - Responsible for integrating digital tools and resources into their teaching practices and participating in training programs to enhance digital literacy.

IT Personnel/Engineer - Responsible for providing technical support and maintenance for digital infrastructure within schools.

Academic Researchers - Responsible for conducting research on digital adoption in schools, providing insights and recommendations for improvement based on evidence.

Accountable

Department of Education - Accountable for overseeing and giving directives for the implementation of digital adoption policies and ensuring alignment with educational objectives. Ensuring teachers are trained.

Consulted

Leaners - Consulted for their input on digital adoption strategies.

Parents - Consulted for their support and involvement in digital adoption initiatives and informed about their children's digital learning experiences.

NGOs - Consulted for their expertise in community engagement and educational initiatives and may provide resources and support for digital adoption projects.

Informed

Learners and parents - Informed about the benefits of digital technologies in education.

6.5 Suggestions for further research

Further research in this area could explore several avenues to deepen our understanding of digital transformation and adoption in South African public schools:

6.5.1 *The progress of the Adoption of Digital Technologies in Schools*

A longitudinal study aimed at monitoring the evolution of digital adoption initiatives in South African schools over time would offer valuable insights into the efficacy of different strategies and policies enacted by the government and educational institutions. Despite the availability of numerous documents dating back to 2003 about digital adoption in South Africa, the existing literature fails to demonstrate the progress or updates regarding the 2003 strategy document. However, this study provides evidence that most of the strategic objectives outlined in that document have not been realised.

6.5.2 *Policy Formation aligned with the longitudinal study.*

An analysis of how digital adoption Programs have changed over time in South African schools would provide important new information about the

effectiveness of various tactics and laws used by the state and schools. As mentioned in the proposed SMART objectives, even though there are documents by the Department of Education addressing digital adoption in South Africa that date back to 2003, the most recent literature does not show the developments or revisions with respect to the 2003 plan document.

6.5.3 *Assessing student outcomes in a technologically driven environment*

The integration of digital technologies in state schools should prioritise the advancement of student development. It would be valuable to assess how the incorporation of digital technology influences students and academic achievements over time.

6.5.4 *Exploring the impact of digital literacy programs on teacher and student outcomes*

For several reasons, further research is needed to determine how digital literacy programs affect the performance of educators and students. In a world where technology is pervasive, digital literacy is now a necessary ability for teachers and students alike. Developing more potent educational interventions and techniques can be aided by an understanding of how digital literacy programs impact teacher and student outcomes.

Digital literacy programmes can help educators better incorporate technology into their lesson plans, which will lead to more interesting and productive learning experiences for students. Researchers can find best practices and areas for development in digital literacy training for educators by examining the effects of these programs on teacher outcomes such as technological competency, confidence in utilising technology, and pedagogical techniques. Exploring the impact of digital literacy programs on student outcomes is essential for understanding how technology can support learning and skill development. Digital literacy skills are increasingly important for students' academic success and future career opportunities. Research in this area can

shed light on how digital literacy programs contribute to students' academic achievement, critical thinking abilities, and preparedness for the digital workforce.

In general, further research on how digital literacy initiatives affect teacher and student results can illuminate the efficacy of today's education methods and guide the creation of evidence-based policies and interventions that promote digital learning in classrooms.

6.5.5 *Assessing the role of community partnerships in supporting digital infrastructure development in schools.*

Understanding how collaboration between schools and external stakeholders might improve access to technological resources requires evaluating the role that community partnerships play in supporting the development of digital infrastructure in schools. Researchers can find successful models and strategies for harnessing community support by examining how well community partnerships provide funds, knowledge, and resources for the construction of digital infrastructure. Understanding the role of community partnerships in supporting digital infrastructure development can inform policymakers, school administrators, and community leaders about the importance of collaboration in advancing educational technology initiatives and ensuring that all students have access to the resources they need to succeed in the digital age.

6.6 Limitations

The study's limitations were mainly caused by a small sample size and timing constraints. Despite careful planning, there were times when unanticipated changes in the school principals' schedules forced the cancellation of

scheduled interviews at short notice. This limited the number of participants in the study and might have reduced the variety of viewpoints that were included.

The original plan to include interviews with principals of rural-based schools was abandoned. A further layer of red tape and laborious procedures was added when all contacted schools in remote areas needed permission from the education department to take part in the study. This may have limited the study's applicability to rural educational situations because it concentrated mostly on state schools in Gauteng province's urban and suburban areas.

These restrictions point out areas that require more research and emphasise the need for caution when interpreting the study's conclusions. Future research could specifically seek to overcome these constraints by setting aside enough time for data collection, increasing the sample size to encompass a wider variety of participants, and investigating the opportunities and problems related to technology adoption in rural educational settings. It is advisable for researchers to establish close collaboration with education authorities (Department of Education) to expedite the permission process for conducting research in schools, especially in remote and rural locations. By addressing these shortcomings, future studies can advance evidence-based policy and practice in education and provide a more thorough understanding of the variables driving technology adoption in state schools.

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APPENDIX A Research Instrument

Interview Guide Number	Question
1	Total Number of Students in Your School?
2	What is the total number of teaching staff in your school?
3	Is there a technology teach/subject in your school?
4	Does your school have a dedicated computer lab or technology center?
5	Are there interactive whiteboards or smartboards in classrooms?
6	What percentage of your classrooms have internet access for educational purposes?
7	Are students provided with personal devices (e.g., tablets, laptops) for learning?
8	Does your school have a Learning Management System (LMS) or a similar platform for online learning?
9	How frequently are digital tools and resources integrated into the curriculum?
10	What types of digital technology are most used for educational purposes at your
11	What challenges have you encountered in adopting and integrating digital technologies in your school?
12	Are there any specific opportunities or benefits that you've observed from technology adoption in your school??

13	Are there any plans or initiatives to further enhance technology adoption and integration at your school?
14	Please provide any additional comments or insights regarding technology adoption at your school.
15	To what extent do you believe digital technology adoption has influenced educational equity and inclusion in your school?
16	What is the total number of teaching staff in your school?
17	What efforts does your school make to ensure that all students, regardless of socio-economic background, have access to digital resources and tools for learning?
18	What percentage of your school's annual budget is allocated to technology and digital resources?
19	How do you prioritise technology investments in your school? (e.g.,

	hardware, software, professional development)
20	Are there ongoing professional development opportunities for teachers to enhance their digital skills?
21	How do you involve students and parents in discussions and decisions related to technology adoption and use in your school?
211	Can you provide any specific examples of how technology has positively influenced teaching and learning outcomes at your school?
23	Are there any specific barriers that you would like to see addressed at a national or regional level to support technology integration in South African public schools?
24	What are your aspirations for technology adoption in South African public schools in the coming years?

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Dear Sir / Madam

My name is Regomoditse Josephine Mafikeng I am a Masters student staff member in Digital Business Management at the University of the Witwatersrand, Johannesburg. My supervisor is Ms Ayanda Magida, I am conducting a research study about the Digital transformation and adoption date in South Africa State Schools The study title is the adoption of digital technologies in public schools in South Africa.

I am inviting you to take part in an interview on the digital adoption rate of your school. If you decide to take part, your participation in this research study will last about 60 minutes. The interview/research activity will take place at your school premises at after school or during school hours.

The interview will be confidential and anonymous. When I share the results of the research study, I will not include your name or anything else that could identify you. With your permission, other researchers may use the data collected from this research study, but your name and any personal information will not be used or passed on.

If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits, or rights you would normally have if you decide not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study.

This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Regomoditse Jsephine Mafikeng

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Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/DB2518748/154

This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

Project title	The adoption of digital technologies in South African public schools
Investigator / Researcher	Ms Regomoditse Mafikeng
Nature of Project	MM (Digital Business)
Decision of the Committee	Approved, provided stakeholders and participants are advised that anonymity and confidentiality cannot be guaranteed.
Issue Date of Certificate	2023/10/30
Expiry date	Date of submission of the project / research report
Chairperson	Dr Pius Oba ☎ +27 11 717 3976 +27 82 733 6587 ✉ pius.oba@wits.ac.za

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Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.