ENHANCING TEACHING AND LEARNING THROUGH SMARTBOARDS TECHNOLOGY IN THE FOUNDATION PHASE IN MOPANI RURAL PRIMARY SCHOOLS

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ENHANCING TEACHING AND LEARNING THROUGH SMARTBOARDS TECHNOLOGY IN THE FOUNDATION PHASE IN MOPANI RURAL PRIMARY SCHOOLS

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DEDICATION

I dedicate this research to God, for His guidance, strength, and wisdom throughout this journey. I also dedicate it to my family, whose love, support, and encouragement have been my constant source of motivation.

ABSTRACT

The integration of Smartboards technology in South African basic education reflects national commitments to equitable digital transformation. Although national policies endorse the adoption of educational technologies, there remains limited empirical evidence on how Smartboards are implemented in rural Foundation Phase classrooms. This study investigates how Smartboards technology mediates teaching and learning in the early grades, with particular attention to teacher practice, learner engagement, and the contextual challenges faced by rural primary schools. By investigating these dynamics, the research provides insights into the realities of the integration of Smartboards technology in under-resourced settings and contribute to broader debates on digital equity in education.

The study is theoretically underpinned by the Cognitive Theory of Multimedia Learning, which posits that meaningful learning occurs when learners actively integrate visual and verbal representations while cognitive demand is carefully managed. Guided by this framework, a qualitative interpretivist design was employed. Data were generated through semi-structured interviews with eight Foundation Phase teachers, non-participant classroom observations, and lesson composition analysis. The use of methodological triangulation enhanced the credibility of the study and enabled a contextually grounded analysis of classroom practice

The findings demonstrate that, when pedagogically structured in alignment with multimedia learning principles, Smartboards supported phonemic awareness, strengthened numeracy conceptualization, and enhanced learner participation. Interactive and visually scaffolded activities fostered active cognitive engagement, collaboration, and learner confidence. However, sustainable integration was constrained by infrastructural instability, limited pedagogical professional development, insufficient technical support, and a scarcity of curriculum-aligned digital resources.

The study concludes that Smartboards technology holds significant potential to advance conceptual understanding in rural Foundation Phase classrooms, provided that its implementation is underpinned by coherent pedagogical design and systemic support. By

situating Smartboards technology integration within its rural educational context, this research offers a detailed, context-sensitive contribution to the literature on inclusive digital pedagogy in South African primary education.

Keywords:

Smartboards, Foundation Phase, rural education, technology integration, TPACK, multimedia learning, South Africa

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LIST OF ACRONYMS

CAPS	Curriculum and Assessment Policy Statement
CTML	Cognitive Theory of Multimedia Learning
DBE	Department of Basic Education
DoE	Department of Education
ICT	Information and Communication Technology
OECD	Organisation for Economic Co-operation and Development
SAMR	Substitution, Augmentation, Modification, and Redefinition
SDGs	Sustainable Development Goals
UNESCO	United Nations Educational, Scientific and Cultural Organization
TPACK	Technological Pedagogical Content Knowledge
COVID-19	Coronavirus Disease 2019
HOD	Head of Department
SMT	School Management Team
SA	South Africa
FP	Foundation Phase
FPT	Foundation Phase Teacher
IV	Interactive Visualisation
LCD	Liquid Crystal Display
PC	Personal Computer
WF	Wireless Fidelity

CHAPTER 1

ORIENTATION OF THE STUDY

1.1 INTRODUCTION

The integration of interactive technologies in early childhood education has gained increasing attention in international and South African research contexts (Thaba-Nkadimene, 2020). Within this broader digital transformation, Smartboards technology has emerged as a significant instructional tool intended to enhance teaching and learning practices. In South Africa, policy discussions and educational reforms have increasingly emphasised the role of educational technologies in improving classroom engagement and learner outcomes (Department of Education [DoE], 2023). Scherer et al. (2021) argue that Smartboards technology can improve educational outcomes by providing modern tools that make content delivery more interactive and learner-centred. Similarly, Thaba-Nkadimene (2020) maintains that integrating Smartboards technology in early childhood classrooms supports the development of language proficiency and mathematical reasoning, thereby laying a strong foundation for future academic achievement. Empirical research further indicates that classroom technology integration enhances learner motivation, participation, and digital literacy development, all of which are essential competencies in contemporary education contexts (Arasomwan & Mashiya, 2021).

Various approaches exist for integrating technology into Foundation Phase teaching. Interactive whiteboards and Smartboards enable teachers to present lessons in visually stimulating and participatory ways (UNESCO, 2023). In addition, instructional software and multimedia applications offer differentiated learning opportunities that accommodate diverse learner needs (Scherer et al. (2021). Digital games and online activities promote collaboration and teamwork while also strengthening foundational cognitive skills. E-books, virtual libraries, and virtual field trips expand learners' access to educational resources and provide immersive learning experiences that may not otherwise be available, particularly in under-resourced contexts (DoE, 2023). Furthermore, digital assessment tools facilitate timely feedback and progress monitoring, supporting formative assessment practices. Professional development initiatives are therefore critical to ensure

that educators possess the necessary technological competencies to integrate Smartboards effectively and create inclusive learning environments.

Despite these potential benefits, significant challenges affect the effective integration of Smartboards technology in the Foundation Phase. While UNESCO (2023) suggests that early exposure to technology may positively influence later academic performance, practical implementation remains uneven. Studies indicate that many Foundation Phase educators lack sufficient digital skills, and disparities in infrastructure and resource allocation continue to hinder effective usage (Petko et al, 2022, Scherer et al. (2021). These systemic constraints are particularly evident in rural schooling contexts, where limited connectivity, inadequate technical support, and insufficient training reduce the sustainability of technology initiatives. Therefore, although Smartboards technology presents considerable potential to enhance early learning experiences, its successful integration depends on targeted teacher development, institutional support, and equitable resource distribution. Addressing these factors is essential to ensure that Smartboards integration contributes meaningfully to improved educational outcomes in the Foundation Phase.

1.2 BACKGROUND

1.2.1 Policy Context

In Limpopo Province, the Department of Education has pursued an e-Education Strategy aimed at expanding ICT infrastructure and connectivity and strengthening the capacity of schools and teachers to integrate digital technologies into teaching and learning. The province also participated in the national Coding and Robotics pilot for Grades R–3, including implementation in Limpopo schools during 2022, reflecting the broader policy emphasis on developing digital competencies in the Foundation Phase (Department of Basic Education [DBE], 2022). In addition, the Department's 2024/25 Annual Performance Plan identified interactive whiteboards, alongside other ICT equipment and connectivity resources, as part of its efforts to develop ICT-enabled classrooms and strengthen technology-supported teaching and learning. The plan also reported teacher-development initiatives intended to build the competencies required for effective ICT integration

(Limpopo Department of Education, 2024). These developments demonstrate a growing provincial commitment to digital transformation in basic education. However, the availability of digital technologies does not in itself ensure their effective pedagogical integration, particularly where schools face constraints relating to infrastructure reliability, teacher competence, technical support and access to appropriate digital resources. This distinction is particularly important in rural primary schools in Mopani District, where the integration of Smartboard technology needs to be considered within the contextual conditions that shape teachers' capacity to use the technology purposefully to enhance Foundation Phase teaching and learning.

1.2.2 Pedagogical Potential

Smartboard technology can transform the traditional way of teaching into a digital method by shifting pedagogy from teacher-centred instruction towards more interactive and learner-centred approaches. Recent South African studies guided by the TPACK framework confirm that Smartboards foster interactive, multimodal learning when teachers integrate them meaningfully into pedagogy (Mhlongo, Kriek, & Gouws, 2026; Bosman, 2024). Learners benefit from interactive lessons in which they engage with virtual tools such as videos, music, pictures, and shapes in diverse colours, thereby supporting multimodal concept formation (Makhenyane & Gxekwa, 2025).

1.2.3 Foundation Phase Curriculum

Within the South African schooling system, the Foundation Phase programme operates as a distinct pedagogical and curricular unit encompassing Grade R to Grade 3, serving as the critical entry point to compulsory basic education for learners typically aged 5 to 9 years (DBE, 2021a). Officially regulated by the Curriculum and Assessment Policy Statement (CAPS), this phase is highly specialized, requiring a transition from early play-based development to formal academic instruction. During this phase, learners are generally taught in their home language to support cognitive development and conceptual understanding, in accordance with the Language of Learning and Teaching (LoLT) policy, which promotes mother-tongue instruction to optimize early concept formation (Mojapelo, 2023). The core subjects offered in this phase include Home Language, First Additional

Language, Life Skills, and Mathematics (Khan, 2023). As the foundational stage of formal schooling, the Foundation Phase plays a critical role in establishing literacy, numeracy, and cognitive development trajectories that influence learners' future academic success.

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1.2.4 Equity and Policy Vision

The South African government recognizes the potential of Smartboard technology in education, as evidenced by legislation such as the White Paper on e-Education. These strategies present Smartboard technology as a tool for increasing access to learning and addressing apartheid-era educational inequities (DoE, 2023). These inequities stem from historically unequal resource allocation, infrastructure disparities, and the systematic underfunding of rural and previously disadvantaged schools, the effects of which continue to shape present-day digital divides. According to the DoE (2023), the national e-Learning policy aims to make all learners, especially those in the Foundation Phase, competent in the use of Smartboard technology. The goal is to equip both learners and teachers with the skills required to function in a knowledge-driven society by incorporating appropriate technology and encouraging communication and collaboration. However, despite this national vision, these ambitions have not been fully realized in the Foundation Phase, where Smartboard technology integration remains under-prioritized and unevenly implemented within early childhood learning environments.

1.2.5 Literacy and Early Intervention

Research further highlights the importance of strengthening early educational foundations. According to Biesman-Simons (2021), many of the issues that learners confront in higher grades arise from a lack of core knowledge and abilities in their early years of education. Introducing Smartboard technology in collaboration with the CAPS curriculum in the Foundation Phase may improve learning experiences and develop important skills from the start. However, studies show that most research on Smartboard

technology integration has focused on older learners, creating a gap in understanding how such technologies benefit younger children. Furthermore, national literacy outcomes intensify the urgency of effective early intervention. According to the Progress in International Reading Literacy Study (PIRLS), 81% of Grade 4 learners in South Africa are unable to read for meaning in any language (DBE, 2023; Mullis et al., 2023). This statistic highlights systemic weaknesses in foundational teaching and learning processes and underscores the need to explore innovative yet pedagogically sound approaches in the early grades.

1.2.6 Challenges in Implementation

Despite the potential benefits of multimedia resources such as audio, graphics, and interactive activities to support literacy development, contextual and structural challenges continue to limit effective implementation. Limited training, insufficient support, and rural infrastructural constraints (such as intermittent electricity supply and poor connectivity) contribute to teacher hesitation and inconsistent technology use. Consequently, although Smartboard technology is increasingly introduced in rural primary schools in Limpopo, there remains limited empirical research explaining how it is meaningfully integrated into Foundation Phase classrooms within resource-constrained environments. Because early childhood learning significantly influences future educational attainment, the Foundation Phase programme is widely regarded as a pivotal period for pedagogical innovation and learner support. Consequently, the integration of digital technologies such as Smartboards within Foundation Phase classrooms has attracted growing scholarly and policy attention.

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1.3 PROBLEM STATEMENT

Virtual lessons can be pre-recorded and saved for future or continuous use by learners. Smartboard technology offers learners an added opportunity to search for or browse

information, allowing teachers to move beyond hard-copy materials in favour of prescribed digital curriculum resources. While these affordances suggest strong pedagogical potential, empirical evidence indicates that Smartboards remain underutilised in classroom practice. Bosman (2024) reports that Smartboards are rarely used effectively by teachers in rural South African schools, partly due to infrastructural challenges and uncertainty regarding their pedagogical benefits.

From a theoretical perspective, this limited uptake can be understood through the Diffusion of Innovations theory, which posits that the adoption of new technologies depends on perceived relative advantage, compatibility with existing practices, and observable results. Similarly, the Technological Pedagogical Content Knowledge (TPACK) framework emphasises that effective technology integration requires the meaningful intersection of technological, pedagogical, and content knowledge. Where this intersection is underdeveloped, technology risks being avoided or used superficially.

Some teachers perceive Smartboards as a replacement for their role as the authoritative source of information (Mhlongo, Kriek, & Gouws, 2026). Furthermore, Mroz and Ocetkiewicz (2021) state that a lack of awareness and motivation may lead to Smartboards being used primarily for administrative purposes rather than for teaching and learning (Bosman, 2024). Studies have also been unable to determine whether the learner engagement observed during the use of Smartboard technology is due to meaningful pedagogical integration or merely a novelty effect. For example, Valenzuela (2025) demonstrated that digital whiteboards can foster active learning and engagement, but cautioned that such effects may diminish once the novelty wears off and if pedagogical integration remains weak. Similarly, Mendez Reguera and Lopez (2021) found that digital whiteboards increased student participation in distance education, yet highlighted that engagement was often linked to the immediate appeal of the technology rather than sustained instructional transformation. Baldonado and Cajandig (2025) further noted that motivational gains from interactive whiteboards were strongest when teachers demonstrated strong TPACK, suggesting that without pedagogical depth, engagement risks being superficial.

Therefore, although policy frameworks promote digital integration and infrastructure has been provided, there remains insufficient empirical evidence explaining how Smartboard technology is pedagogically integrated in rural Foundation Phase classrooms in Limpopo. The core problem is not merely one of availability, but whether Smartboard technology enhances creativity, learner engagement, and instructional practice in meaningful and sustainable ways. This study, therefore, addresses the gap between policy expectations and classroom realities within rural early-grade contexts.

1.4 RESEARCH AIM AND OBJECTIVES

1.4.1 Aim

The study aims to explore how Smartboards technology can enhance teaching and learning in the Foundation Phase within rural primary schools.

Objectives

1. To examine the ways in which Foundation Phase teachers in rural schools integrate Smartboards technology into their teaching practices.
2. To identify the perceived benefits and affordances of Smartboards technology in enhancing teaching and learning in the Foundation Phase.
3. To assess the extent and effectiveness of professional development and training provided to Foundation Phase teachers for the use of Smartboards technology.

1.5 RESEARCH QUESTIONS

Main Research Question

How does the integration of Smartboards technology enhance teaching and learning in the Foundation Phase of rural primary schools?

Research Sub-Questions

1. How are Foundation Phase teachers integrating Smartboards technology into their teaching practices in rural primary schools?

2. What are teachers' perceived benefits of using Smartboards technology to enhance teaching and learning in the Foundation Phase?
3. What professional development opportunities are available to Foundation Phase teachers to support the effective use of Smartboards technology in rural primary schools?

1.6 SIGNIFICANCE OF THE STUDY

This study is significant because it provides insight into how digital technologies, specifically Smartboards technology, can strengthen teaching and learning in rural Foundation Phase classrooms. In many rural contexts, access to interactive and engaging learning tools remains limited, which can negatively impact learners' early academic development. Findings from this study may offer practical guidance on how Smartboards technology can be used to improve learner participation, conceptual understanding, and overall classroom engagement.

The study may further inform the Department of Basic Education (DBE) and the Limpopo Department of Education by highlighting specific training needs that should be addressed in future ICT-related professional development programmes for Foundation Phase teachers. By providing evidence on effective integration strategies, the study contributes to broader national goals of digital inclusion, teacher empowerment, and improved learning outcomes. Ultimately, the study supports efforts to promote equity in education by ensuring that learners in rural schools benefit from technology-enhanced teaching approaches.

1.7 RATIONALE FOR THE STUDY

Although traditional teaching methods remain widely used and valuable across South Africa (Spaull & Taylor, 2022), the demands of 21st-century education require the integration of digital tools that promote interactive and learner-centred instruction (Letswalo, 2024). The Foundation Phase presents an ideal stage for introducing Smartboards technology, as young learners are developing the foundational cognitive and academic skills necessary for future success (Leibovitch et al., 2025). Early exposure to

technology prepares learners to participate confidently in globally competitive, digitally rich environments (Zondo, 2025; UNESCO, 2022; World Economic Forum [WEF], 2023).

Smartboards technology offers teachers opportunities to adapt lessons, present content interactively, and accommodate diverse learning needs. It also enables the storage, retrieval, and reuse of educational materials, thereby strengthening pedagogical continuity and efficiency. For teachers, competence in Smartboards technology enhances their ability to create meaningful, engaging learning experiences.

Given the limited resources in many rural primary schools, the study underscores the importance of continuous professional development for teachers. It also highlights the need for the government and the Limpopo Department of Education to ensure equitable provision of Smartboards technology and related ICT infrastructure. By integrating Smartboards technology into Foundation Phase classrooms, schools can improve the quality of teaching and learning, ensuring that all learners, regardless of geographical location, benefit from modern, interactive education.

1.8 CONCLUSION

This chapter has established the overall focus and direction of the study by outlining the research context, background, problem statement, aims, objectives, research questions, significance, and rationale. It has demonstrated that Smartboards technology has the potential to enhance teaching and learning in the Foundation Phase by encouraging learner engagement, creativity, and interactive learning experiences. Existing international and South African research suggests that the effective use of interactive technologies can support early literacy, numeracy, and learner participation, which are essential during the foundational years of formal schooling.

The discussion further highlighted that, despite progressive national and provincial policies promoting digital integration, such as the White Paper on e-Education, the implementation of Smartboards technology in rural Foundation Phase classrooms remains inconsistent. While the provision of technological infrastructure reflects a commitment to redressing historical inequalities, classroom practices in many rural

schools do not yet fully reflect this policy vision. This ongoing disconnect underscores the complexity of technology integration within contexts characterised by limited resources, infrastructural challenges, and uneven professional support.

The core problem identified in this chapter is therefore not the availability of Smartboards technology, but the extent to which teachers are equipped to integrate it meaningfully into their teaching. From a Technological Pedagogical Content Knowledge (TPACK) perspective, effective Smartboards integration depends on teachers' ability to combine technological knowledge with sound pedagogical strategies and strong content understanding. Where one or more of these knowledge domains is underdeveloped, technology use is often restricted, superficial, or avoided altogether. This challenge is particularly evident in rural Foundation Phase classrooms, where professional development opportunities and ongoing technical support are often limited.

In response to these realities, the study aims to explore how Foundation Phase teachers in rural primary schools integrate Smartboards technology into their teaching, the benefits they perceive in relation to teaching and learning, and the professional development opportunities available to support effective use. Importantly, the study addresses a notable gap in existing research by offering an empirical focus on Smartboards technology integration within rural Foundation Phase classrooms in Limpopo Province, an area that has received limited scholarly attention.

In conclusion, this chapter has provided a strong foundation for the study by situating it within relevant policy frameworks, theoretical perspectives, and rural educational contexts. It emphasizes the importance of teacher knowledge, training, and contextual conditions in shaping the pedagogical value of Smartboards technology. Building on this foundation, the next chapter reviews relevant literature to explore the TPACK framework and other theoretical and empirical studies that inform the integration of Smartboards technology in early childhood and Foundation Phase education.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 introduced the study and outlined the research problem, research questions, and the significance of the inquiry. It highlighted the increasing introduction of Smartboards technology in South African schools, particularly in rural contexts, while also drawing attention to the limited understanding of how such technology is meaningfully integrated in Foundation Phase classrooms. Building on this foundation, this chapter reviews literature relevant to the integration of Smartboards technology in the Foundation Phase, with specific attention to teaching and learning in rural school contexts.

The literature review is guided by the Technological Pedagogical Content Knowledge (TPACK) framework, which provides an appropriate lens for understanding how teachers combine content knowledge, pedagogical knowledge, and technological knowledge when integrating digital tools in the classroom. The TPACK framework emphasizes that effective technology integration does not occur through technological skills alone, but through the purposeful alignment of subject content, teaching strategies, and technology use. This perspective is particularly relevant to the Foundation Phase, where pedagogical decisions strongly influence learners' early literacy, numeracy, and cognitive development.

In this chapter, the focus shifts to a critical discussion and review of existing research on the use of Smartboards technology in Foundation Phase classrooms. A substantial body of research has examined the use of interactive technologies, particularly in primary education, highlighting their potential to improve learner engagement, participation, and understanding. This review synthesizes previous studies to establish how Smartboards technology can enhance Foundation Phase teaching and learning while also illuminating the challenges teachers face during implementation.

Numerous scholars emphasize that Smartboards technology can support the creation of dynamic and engaging learning environments. Through the use of multimedia resources such as videos, images, animations, and interactive activities, teachers are able to present

content in varied ways that cater for different learning styles. Such approaches encourage interaction, collaboration, and immediate feedback, positioning learners as active participants rather than passive recipients of information. This is especially important in the early grades, where attention, motivation, and conceptual understanding are still developing.

The literature also points to the pedagogical value of using Smartboards technology to help learners connect abstract concepts to real-world contexts. Simulations, visual representations, and interactive demonstrations can make complex ideas more concrete and accessible for young learners. These features are particularly beneficial in the Foundation Phase, where learners are developing foundational language, numeracy, and socio-emotional skills. When used effectively, Smartboards technology has the potential to support meaningful learning experiences rather than surface-level engagement.

At the same time, studies consistently highlight significant challenges faced by Foundation Phase teachers, particularly in rural school settings. These challenges include limited technological skills, low confidence in using Smartboards for teaching, inadequate infrastructure, unreliable connectivity, and insufficient technical and professional support. Many teachers receive once-off or generic training that does not adequately address classroom realities or subject-specific pedagogical needs. As a result, Smartboards technology is often underutilized or used in limited ways that do not fully support teaching and learning.

Understanding these challenges is essential, as poorly supported technology integration risks reinforcing existing inequalities rather than reducing them. Rural schools, which are already affected by historical and structural disadvantages, require context-sensitive approaches to technology use that take account of infrastructure, learner needs, and teacher capacity. For this reason, the literature reviewed in this chapter gives particular attention to contextual factors shaping Smartboards implementation in rural environments.

To ensure clarity and coherence, this literature review is organized into five sections:

1. conceptual foundations of Smartboards technology;

2. pedagogical applications of Smartboards technology in the Foundation Phase;
3. teacher perceptions, competencies, and attitudes towards Smartboards use;
4. contextual factors influencing Smartboards integration in rural schools; and
5. the theoretical framework underpinning the study, with specific focus on the TPACK framework.

Together, these sections develop several key arguments. First, Smartboards technology has the potential to enhance Foundation Phase teaching and learning when aligned with appropriate pedagogy and curriculum goals. Second, teachers' knowledge, confidence, and professional development play a critical role in shaping how technology is used in classrooms. Third, rural contexts present specific challenges that must be addressed for technology integration to be meaningful and sustainable. Finally, the TPACK framework offers a useful theoretical lens for understanding both successful and limited integration of Smartboards technology.

Overall, this chapter provides a structured and critical synthesis of existing scholarship to clarify how Smartboards technology influences Foundation Phase teaching and learning, to identify recurring challenges, and to highlight gaps that the current study seeks to address. The literature reviewed in this chapter directly informs the research questions and supports the investigation of Smartboards technology integration in rural Foundation Phase classrooms.

2.2 DEFINITION AND FEATURES OF SMARTBOARDS TECHNOLOGY

Smartboards technology refers to an advanced form of interactive digital learning tool used to support teaching and learning in classroom environments. It enables teachers and learners to display, manipulate, and interact with digital content through touch-based input. Unlike traditional chalkboards or standard whiteboards, Smartboards are either integrated digital panels or connected to computers and projectors, allowing for real-time interaction with electronic learning materials (Promethean, 2022; Patten, 2024). This understanding of Smartboards technology aligns with the South African Department of Education's vision of using information and communication technologies to promote

learner-centred teaching, collaboration, and improved access to learning resources within basic education (DBE, 2023; DBE, 2025).

From a technical perspective, Smartboards technology integrates specialised software with an interactive display surface. This integration allows users to write, draw, highlight text, move objects, open applications, and display multimedia content during lessons. Teachers can prepare lessons in advance, save annotations made during teaching, and reuse instructional materials for future lessons, thereby supporting continuity and efficiency in instructional practice (Promethean World, 2024). These functions support the goal of improving teaching quality through the effective use of digital tools, as outlined in national e-Education policy (DoE, 2023).

One of the most prominent features of Smartboards technology is touch-based interactivity**.** Teachers and learners can interact directly with lesson content using fingers or digital pens, encouraging active participation in classroom activities. For Foundation Phase learners, this feature is particularly valuable because young children benefit from physical engagement and interactive learning experiences (Sharter, 2024). The use of touch-based interaction supports the Curriculum and Assessment Policy Statement (CAPS) emphasis on learner activity, participation, and engagement in the Foundation Phase (DBE, 2020; DBE, 2023).

Another key feature of Smartboard technology is multimedia integration. Smartboards allow teachers to combine text, images, audio, video clips, animations, and interactive simulations within a single lesson. Research on multimedia use in early childhood education indicates that multimedia tools can support educators' effectiveness and provide opportunities for more engaging technology-supported teaching (Tang, Mohamed Zainal & Li, 2023). These capabilities can support the presentation of learning content through multiple modes, which is particularly relevant in early-grade classrooms where visual and auditory resources can be used to reinforce concept development.

Digital connectivity further enhances the instructional value of Smartboards technology. When connected to the internet or school-based platforms, Smartboards allow teachers

to access online learning resources, digital textbooks, curriculum-aligned content, and educational games. This capability extends learning opportunities beyond traditional print resources, which is particularly important in schools facing resource shortages (Patten, 2024; PlanetParent, 2024). According to the White Paper on e-Education, expanding access to digital learning resources is essential for reducing historical inequalities and improving educational opportunities for learners in rural and under-resourced schools (DoE, 2004).

Smartboards technology also supports lesson storage and retrieval, allowing teachers to save, revise, and reuse lesson content. Stored lessons can be used for revision, to support learners who were absent, or to reflect on teaching practices. This feature can support instructional continuity by enabling teachers to save, revisit, share and adapt digital lesson content, while also creating opportunities for collaborative lesson planning and professional learning (Matemera, 2022; Van der Merwe-Muller & Dasoo, 2021). Such practices are consistent with the emphasis placed on continuous teacher development and the improvement of teaching practice within the South African education system. The development of Smartboards technology reflects the broader evolution of classroom teaching tools, from chalkboards to whiteboards, interactive whiteboards, and modern Smartboards with advanced digital capabilities. This evolution can support a shift away from predominantly teacher-centred instruction towards more interactive and learner-centred pedagogical approaches. By enabling teachers to incorporate multimedia, interactive activities, and opportunities for learner participation, Smartboards can support learners in engaging actively with lesson content and constructing knowledge through interaction with the teacher, peers, and digital learning resources. This perspective is consistent with constructivist learning theory, which views learners as active participants in the construction of knowledge. However, the availability of Smartboard technology does not in itself guarantee constructivist teaching; its pedagogical value depends on how teachers integrate the technology into learning activities and facilitate meaningful learner participation (Ajani, 2021). Thus, Smartboard-supported practices are consistent with South African curriculum principles that emphasise meaningful learning, learner participation, and active engagement in the learning process. When compared to other educational technologies such as tablets or laptops, Smartboards technology serves a

distinct instructional purpose. While personal devices are commonly used for individual or small-group activities, Smartboards provide a shared teaching platform suitable for whole-class instruction. This makes Smartboards particularly appropriate for Foundation Phase classrooms, where guided instruction and collective interaction remain central to effective pedagogy (Patten, 2024).

Despite these advantages, Smartboards technology also presents limitations and challenges. Technical problems such as software malfunctions, unreliable internet connectivity, and power disruptions can interrupt teaching. In rural contexts, these challenges are often intensified by limited infrastructure and insufficient technical support, which may discourage consistent use of Smartboards technology (Bosman, 2024; Sepadi, Kgaphola & Molapo, 2025). The Department of Education recognizes that the provision of ICT infrastructure alone does not guarantee successful integration, emphasizing the importance of teacher competence, confidence, and sustained professional development (DBE, 2023).

There is also a risk that Smartboards technology may be used only as a display tool rather than as an interactive instructional resource. Research indicates that when teachers lack sufficient training or pedagogical understanding, Smartboards are often underutilized, limiting their potential to enhance learner engagement (Matemera, 2022; Sharter, 2024). This reinforces the DBE's emphasis on continuous teacher development and meaningful integration of technology into classroom practice (DBE, 2020).

In the Foundation Phase, the developmental appropriateness of Smartboards technology use is especially important. Young learners require structured guidance, social interaction, and balanced teaching approaches that integrate digital tools with play-based and experiential learning. Technology integration in Foundation Phase teaching is most pedagogically appropriate when it complements, rather than replaces, foundational teaching practices and meaningful teacher–learner interaction. Guidance on technology use in early childhood education emphasises that digital technologies should be intentionally integrated to support active learning, developmentally appropriate experiences, and social interaction rather than displace hands-on learning and

interactions with teachers and peers (Moses, 2023; National Association for the Education of Young Children [NAEYC], 2023). In the context of Smartboard technology, interactive displays can provide opportunities for learners to participate actively in lessons, collaborate with peers, and interact with teachers when their use is aligned with clear pedagogical purposes. This approach is consistent with the South African Department of Basic Education's emphasis on strengthening the foundations of learning and improving the quality of teaching and learning in the early grades (Department of Basic Education [DBE], 2024). Therefore, the pedagogical value of Smartboards lies not simply in their technological capabilities, but in how teachers integrate these capabilities into purposeful, learner-centred teaching practices. In summary, Smartboards technology is a multifunctional instructional tool that combines touch interactivity, multimedia integration, digital connectivity, and lesson storage. Its evolution reflects a shift towards interactive and learner-centred teaching practices. However, within the South African context, the effectiveness of Smartboards technology in Foundation Phase classrooms depends on alignment with curriculum requirements, adequate teacher training, and supportive conditions in rural schools. Understanding these features and limitations provides a strong foundation for examining how Smartboards technology is pedagogically integrated in rural Foundation Phase classrooms.

2.3 THE IMPORTANCE OF SMARTBOARDS TECHNOLOGY

The importance of Smartboards technology in schools extends beyond merely replacing traditional teaching tools with digital alternatives. Its educational value lies in how it supports teaching and learning through the meaningful integration of technology, pedagogy, and content. In the Foundation Phase, where learners are developing foundational cognitive, linguistic, social, and emotional skills, this integration is particularly significant. At this stage of schooling, learning is most effective when concepts are presented in concrete, visual, and interactive ways, and when learners are actively engaged in the learning process. Smartboards technology therefore has the potential to support early learning by enriching teaching methods and improving learner participation when used appropriately.

The importance of Smartboards technology can be understood through the Technological Pedagogical Content Knowledge (TPACK) framework. The TPACK framework explains that effective teaching with technology does not depend on technology alone, but on how teachers combine technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) within specific classroom contexts. This framework is particularly relevant to the Foundation Phase, where teaching decisions must be carefully aligned with learners' developmental levels, curriculum requirements, and classroom realities. Within this framework, Smartboards technology becomes valuable only when it is integrated in ways that support learning goals rather than distract from them.

From the perspective of technological knowledge (TK)**,** Smartboards technology provides teachers with tools that enable interactive and multimedia-rich teaching. Features such as touch-based interaction, large visual displays, animations, videos, and access to digital learning resources allow teachers to present content in ways that are engaging and accessible to young learners. These tools support learners in viewing concepts visually, interacting with learning activities, and receiving immediate feedback. Research shows that when interactive features are used effectively, Smartboards technology can increase learner engagement, motivation, and conceptual understanding (Ndwandwe et al., 2024; Rahayu, 2024). In the Foundation Phase, where learners rely heavily on visual and concrete representations to grasp new ideas, these technological affordances are especially valuable. However, the presence of technology alone does not guarantee improved learning outcomes; its effectiveness depends on teachers' ability to select and use technological tools purposefully.

The role of pedagogical knowledge (PK) is central in determining how Smartboards technology is used in the classroom. Pedagogical knowledge refers to teachers' understanding of teaching strategies, classroom management, learner support, and methods for promoting participation and understanding. Smartboards technology supports learner-centred pedagogical approaches by enabling interactive activities, collaborative tasks, guided practice, and immediate feedback. In the Foundation Phase, learning is most effective when it is active, structured, and supported by the teacher. Research indicates that interactive technologies enhance classroom participation,

collaboration, and learner engagement when they are aligned with appropriate pedagogical strategies (Alzahrani & Woollard, 2023; Tondeur et al., 2021). Teachers therefore need to design lessons that actively involve learners through questioning, discussion, interaction, and guided activities, rather than using Smartboards simply as display screens.

Equally important is content knowledge (CK)**,** which refers to teachers' understanding of the subject matter being taught. In the Foundation Phase, content knowledge includes the foundations of literacy, numeracy, and life skills that form the basis for later learning. Smartboards technology enables teachers to represent content in multiple ways, making abstract or complex ideas more accessible to young learners. Research shows that visual and multimedia representations can enhance understanding and support knowledge retention, particularly in early grades (Rahayu, 2024). For example, mathematical concepts can be demonstrated step-by-step using visual models and animations, while language lessons can incorporate images, sounds, and interactive storytelling. When teachers combine strong content knowledge with appropriate technological tools, teaching remains focused on curriculum outcomes while also enhancing learner understanding.

The TPACK framework emphasises that meaningful technology integration occurs when these forms of knowledge are combined. The interaction between pedagogy and content, known as pedagogical content knowledge (PCK)**,** involves selecting teaching strategies that best suit particular content areas. Smartboards technology strengthens PCK by enabling teachers to explain, demonstrate, and scaffold learning in flexible ways. Teachers can break down difficult concepts into smaller steps, adjust explanations based on learner responses, and provide visual support where needed. This strengthens instructional quality and supports deeper understanding in the Foundation Phase.

The relationship between technology and content is described as technological content knowledge (TCK)**.** This refers to teachers' understanding of how technology can represent and transform subject content. Smartboards technology allows teachers to use animations, simulations, and multimedia resources to make content more engaging and meaningful. In the Foundation Phase, where learners may struggle with abstract

reasoning, these tools help make learning more concrete and relatable. By selecting digital resources appropriate for learners' ages and abilities, teachers can enhance how content is presented and understood.

The interaction between technology and pedagogy is referred to as technological pedagogical knowledge (TPK)**.** This involves understanding how teaching strategies change when technology is introduced into the classroom. Smartboards technology supports interactive teaching approaches such as collaborative problem-solving, group participation, and immediate feedback. Teachers must therefore adapt their teaching strategies to make effective use of these features. For example, instead of relying on teacher-centred instruction, teachers can use Smartboards technology to facilitate dialogue, encourage learner participation, and support interactive learning activities.

At the centre of the framework is technological pedagogical content knowledge (TPACK**)**, which represents the integration of all three knowledge domains. Within this study, effective use of Smartboards technology occurs when teachers are able to combine their understanding of technology, pedagogy, and content in ways that support meaningful learning. This integrated approach enables teachers to plan lessons that are interactive, structured, and aligned with curriculum goals. In the Foundation Phase, such integration supports the development of foundational skills by creating learning experiences that are engaging, relevant, and appropriate for young learners.

This integrated use of Smartboards technology also contributes to learner engagement, participation, and motivation. Interactive features such as touch-based activities, visual demonstrations, and immediate feedback encourage learners to take an active role in the learning process. In the Foundation Phase, where learners benefit from hands-on and visually stimulating activities, active engagement is essential. Research suggests that meaningful learner participation supports understanding, memory, confidence, communication skills, and positive attitudes towards learning (Imoke et al., 2024). When effectively integrated, Smartboards technology can therefore contribute not only to engagement but also to improved learning outcomes.

From a theoretical perspective, these benefits align with constructivist views of learning, which emphasise that learners actively construct knowledge through interaction, experience, and social engagement. Smartboards technology supports this process by enabling learners to explore ideas, collaborate with peers, and receive immediate feedback. In this way, Smartboards technology functions as a mediational tool that strengthens the relationship between the learner, the teacher, and the content. This is particularly important in the Foundation Phase, where learning relies heavily on guided interaction and scaffolded support.

However, it is important to adopt a critical perspective. Some researchers caution against techno-determinism, which assumes that technology alone can automatically improve educational outcomes. UNESCO (2023) adopts a critical perspective on educational technology, emphasising that the presence of technology in classrooms does not automatically result in improved learning. Rather, its educational value depends on how it is integrated with pedagogical practices, learning objectives, teacher support, and the contexts in which it is implemented. From this perspective, Smartboard technology should not be regarded as inherently transformative; instead, its potential to support teaching and learning depends on how teachers integrate its affordances into purposeful pedagogical practices and meaningful learner engagement. Within the TPACK framework, this reinforces the idea that technology must be meaningfully integrated with pedagogy and content. Smartboards technology should therefore be understood as a supportive tool rather than a stand-alone solution. Studies show that the impact of digital technologies on learning outcomes can be limited or inconsistent when they are not supported by effective pedagogy and appropriate teacher training (Kaliisa et al., 2023).

This perspective highlights the importance of teacher competence and professional development. Teachers play a central role in determining how Smartboards technology is used, how lessons are structured, and how learners engage with content. In Foundation Phase classrooms, where learners require structured guidance and emotional support, the teacher’s role is particularly critical. Without adequate training, confidence, and ongoing professional development, teachers may struggle to integrate Smartboards technology effectively, limiting its potential impact.

The role of context is also central within the TPACK framework. Teaching does not occur in isolation, but is influenced by the environment in which it takes place. In rural schools, factors such as unreliable electricity, limited internet connectivity, inadequate infrastructure, and a lack of technical support affect how Smartboards technology can be used. Research in primary school contexts indicates that even when Smartboards are available, their effective use varies significantly depending on contextual conditions and institutional support (Madzikanda & Mahlaba, 2026). These conditions shape not only access to technology but also teachers' confidence and willingness to integrate it into daily teaching.

The COVID-19 pandemic further highlighted both the potential and limitations of digital technologies in education. Das (2022) notes that approximately 1.6 billion learners across more than 200 countries were affected by school closures. During this period, digital technologies enabled learning continuity in some contexts, demonstrating their potential to support teaching. However, the pandemic also exposed deep inequalities. UNESCO (2021) reports that many rural schools faced severe challenges related to poor connectivity, lack of devices, limited teacher training, and inadequate technical support. For Foundation Phase learners, these challenges were especially concerning, as young children require face-to-face interaction, guided instruction, and structured learning environments.

The pandemic revealed that while digital technologies such as Smartboards can support learning, their effectiveness depends heavily on existing infrastructure, teacher readiness, and contextual support. In rural schools, where these conditions are often limited, the use of digital technologies was frequently disrupted or inaccessible (UNESCO, 2023). This reinforces the view that technology cannot compensate for systemic inequalities or replace the role of the teacher, particularly in early grades.

These insights point to the need for a balanced and context-sensitive approach to technology integration. While Smartboards technology offers clear benefits, its success depends on multiple factors, including teacher competence, infrastructure, institutional support, and alignment with pedagogical goals. Efforts to promote technology use in

education should therefore focus not only on supplying devices but also on strengthening teacher capacity and addressing contextual constraints.

Overall, Smartboards technology is important because it supports teaching and learning through the integration of technology, pedagogy, and content. Within the TPACK framework, its value lies not in the technology itself, but in how these elements are combined to support meaningful and effective learning. When appropriately integrated, Smartboards technology enhances learner engagement, supports understanding, and contributes to improved learning outcomes in the Foundation Phase. However, its effectiveness is shaped by teacher readiness and contextual conditions, particularly in rural schools. This reinforces the central argument of this study that technology integration must be pedagogically driven and context-sensitive in order to improve teaching and learning.

2.4 THE ROLE OF SMARTBOARDS TECHNOLOGY IN THE FOUNDATION PHASE CLASSROOM

2.4.1 Pedagogical Applications

The 21st century has brought rapid integration of digital technologies into schooling (Fullan & Gallagher, 2022). Classrooms are no longer only sites for content delivery; they are spaces where learners develop digital literacy, critical thinking, collaboration, and problem-solving skills required for participation in a technological society. Within this context, Smartboards technology has emerged as a significant instructional tool in the Foundation Phase, where learners are at a crucial stage of cognitive, social, and emotional development. In these early years of schooling, teaching approaches that are visual, interactive, and structured are particularly effective (Plowman & McPake, 2021).

In the Foundation Phase, Smartboards technology supports pedagogy by allowing teachers to transform abstract concepts into concrete learning experiences, directly reinforcing Piaget's (1972) theory of cognitive development, which asserts that children in the concrete operational and pre-operational stages require tangible, visual scaffolds to process symbolic information (Leibovitch et al., 2025). Teachers can organize lesson materials efficiently, integrate assessment activities, and move flexibly between

curriculum-aligned resources during lessons. The value of Smartboards technology therefore lies not only in its digital features but in its capacity to support learner-centered pedagogy through modelling, guided practice, whole-class demonstration, and immediate feedback (Tondeur et al., 2021; Alzahrani & Woollard, 2023). These practices are aligned with CAPS requirements, which emphasize active learning, learner participation, and structured support in the Foundation Phase (DBE, 2021a).

In practice, Smartboards technology enables a variety of lesson types. In literacy lessons, teachers can model phonics, blending, and word recognition using interactive word-building activities. Learners are able to drag letters, combine sounds, match pictures to words, and participate in shared reading activities using large, visible texts. Teachers can pause lessons to ask questions, highlight key vocabulary, or revisit previous learning, supporting comprehension and language development.

In numeracy lessons, Smartboards technology is used to demonstrate counting, grouping, number patterns, and basic operations through visual manipulatives such as number lines, counters, shapes, and blocks, translating abstract mathematics into semi-concrete representations as advocated by modern Piagetian pedagogical frameworks (Olkun et al., 2024). Teachers can model problem-solving steps while learners observe, and then invite learners to interact with the board to complete tasks. Life Skills lessons may include the use of pictures, videos, and scenarios to support discussion, social learning, and concept development (Zondo, 2025).

Effective Smartboard-supported activity structures can be informed by the Gradual Release of Responsibility (GRR) framework, in which responsibility for learning is progressively transferred from the teacher to learners through focused instruction and modelling, guided instruction, collaborative learning, and independent application (Fisher & Frey, 2021). In a Smartboard-supported lesson, this framework can be operationalised by beginning with teacher modelling of a concept or skill, followed by guided interaction with the Smartboard, collaborative learner activities, and opportunities for independent application. Such sequencing can provide structured scaffolding while gradually increasing learners' responsibility for their own learning. Teacher moves such as

questioning, prompting, scaffolding, and feedback are central in this process. These pedagogical applications demonstrate how Smartboards technology can support structured, scaffolded learning that aligns with effective Foundation Phase pedagogy (Rahayu, 2024).

From a TPACK perspective, these practices illustrate the integration of technological, pedagogical, and content knowledge. (Mishra & Koehler, 2006; Rosenberg & Koehler, 2021). Teachers use Smartboards technology not simply to display information, but to structure learning experiences that support concept development, participation, and understanding (Chai et al., 2023). This is particularly relevant to the present study, which seeks to understand how teachers in rural Foundation Phase classrooms use Smartboards technology to support teaching in practice.

2.4.2 Learner Engagement

Smartboards technology plays an important role in enhancing learner engagement in the Foundation Phase classroom. Engagement refers to the level of learners' involvement in learning activities and can be understood across three key dimensions: behavioral, emotional, and cognitive engagement (Bond, 2021). Each of these dimensions is important in early learning and can be supported through the effective use of Smartboards technology.

Behavioral engagement refers to learners' observable participation in classroom activities, such as paying attention, responding to questions, and interacting with learning materials (Bond & Bedenlier, 2021). Smartboards technology supports behavioral engagement by allowing learners to physically interact with content through touch-based activities. Learners can move objects, select answers, complete matching tasks, and participate in whole-class demonstrations. These activities help sustain attention and reduce passive behavior, which is particularly beneficial for young learners with shorter attention spans (Ndwandwe et al., 2024).

Emotional engagement relates to learners' interest, enjoyment, motivation, and positive feelings towards learning (Dewerte & Quinten, 2023). Smartboards technology supports

emotional engagement through colorful visuals, animations, games, and interactive activities that make learning enjoyable. When learners experience lessons as fun and engaging, they are more likely to participate actively and develop positive attitudes towards learning. Research indicates that interactive digital tools increase learner motivation and enjoyment in early-grade classrooms (Alzahrani & Woollard, 2023; Imoke et al., 2024).

Cognitive engagement refers to deeper thinking processes such as understanding, reasoning, problem-solving, and applying knowledge (Halverson & Graham, 2021. Smartboards technology supports cognitive engagement by allowing teachers to design activities that require learners to think, predict, explain, and reflect. Immediate feedback helps learners recognize errors and adjust their thinking (Chien et al., 2024). Interactive problem-solving tasks encourage learners to engage with content at a deeper level rather than memorizing information.

When effectively integrated, Smartboards technology supports all three forms of engagement. This aligns with Foundation Phase pedagogies that prioritize exploration, talk, multimodal learning, and shared meaning making (DBE, 2021a). For this study, learner engagement is an important indicator of how Smartboards technology influences teaching and learning, as teachers reported increased participation, attention, and interest among learners during Smartboard-supported lessons.

2.4.3 Differentiated Instruction and Inclusion

A key strength of Smartboards technology is its support for differentiated instruction and inclusive education. Foundation Phase classrooms often include learners with diverse abilities, language backgrounds, and learning needs. Smartboards technology allows teachers to present content in visual, auditory, and kinaesthetic ways, accommodating a wide range of learners and learning styles (Kim & Park, 2023).

For learners with disabilities, Smartboards technology can support inclusion through enlarged visuals, audio reinforcement, repetition, and interactive practice. Smartboard technology can support inclusive teaching by providing multiple ways of presenting and

engaging with learning content. Visual displays, enlarged text and images, and audio-visual resources can provide additional means of accessing lesson content, while teachers can adjust the pace of activities and provide additional explanation or scaffolding according to learners' needs. Such flexibility is consistent with inclusive education approaches that seek to reduce barriers to learning and provide appropriate support for diverse learners (Altin et al., 2023; Makhalemele & Jama, 2023). Teachers can revisit content, repeat activities, and provide step-by-step support.

For English language learners, Smartboards technology provides visual cues, images, videos, and animations that support comprehension and vocabulary development. Multimodal explanations reduce reliance on verbal instruction alone and help learners understand concepts even when language proficiency is limited. This supports the CAPS focus on language development and multilingual learning contexts in the Foundation Phase (DBE, 2021b).

For gifted or high-achieving learners, Smartboards technology enables extension tasks such as problem-solving challenges, exploratory activities, and interactive games that promote higher-order thinking. Teachers can design tasks that encourage reasoning, creativity, and independent exploration, ensuring that all learners are appropriately challenged.

These differentiated strategies demonstrate how Smartboards technology supports inclusive teaching when integrated thoughtfully. This is relevant to the present study, as rural classrooms often include learners with diverse needs and limited access to additional support services.

2.4.4 Building Foundational Digital Literacy

Smartboards technology plays an important role in developing foundational digital literacy skills in the Foundation Phase. Digital literacy refers to the ability to use digital tools effectively, understand digital information, and interact responsibly with technology. Introducing these skills early prepares learners for future schooling and participation in a knowledge-based economy (UNESCO, 2024).

Through Smartboards technology, learners can develop specific digital literacy skills such as interpreting visual information, following on-screen instructions, interacting with touch-based interfaces, and responding to multimedia content. Learners begin to recognize icons, navigate simple digital menus, and understand cause-and-effect relationships in digital environments. These early experiences support the gradual development of digital confidence (Rahayu, 2024).

Importantly, digital literacy development in the Foundation Phase complements rather than replaces play-based and interactive learning. Smartboards technology is used as part of structured classroom activities, ensuring that digital learning remains guided, purposeful, and developmentally appropriate. This aligns with national policy goals of integrating ICT while maintaining strong foundational learning practices (DBE, 2021b).

2.4.5 Teacher Capacity and Implementation

The presence of Smartboards technology alone does not guarantee improved learning outcomes. Its impact depends largely on how teachers use it. When Smartboards technology is used only as a projection surface, its educational potential is limited. Effective implementation requires teachers to integrate Smartboards technology into lesson planning, questioning, modelling, formative assessment, and collaborative learning activities.

From a TPACK perspective, teachers require specific competencies. These include technological knowledge (ability to use Smartboard tools), pedagogical knowledge (effective teaching strategies), and content knowledge (subject matter understanding). More importantly, teachers must develop integrated TPACK skills that allow them to design meaningful, interactive lessons. Professional development and sustained support are therefore essential (Tondeur et al., 2021; Ertmer & Ottenbreit-Leftwich, 2023).

Without adequate training and confidence, teachers may limit Smartboards use or avoid interactive features. This aligns closely with the findings of this study, where variations in teachers' skills and training influenced classroom integration.

2.4.6 Context, Infrastructure, and Sustainability

Context plays a critical role in the successful implementation of Smartboards technology. In many rural South African schools, challenges such as unreliable electricity, limited internet connectivity, and insufficient technical support affect classroom practice. DBE reports indicate that infrastructure constraints continue to limit effective ICT integration in rural schools (DBE, 2023).

The COVID-19 pandemic highlighted both the potential and limitations of digital technologies in education. While Smartboards technology supported lesson continuity in some contexts, many rural schools lacked the infrastructure needed for consistent use (UNESCO, 2021; UNESCO, 2023). For Foundation Phase learners, school-based Smartboards provided a familiar and structured platform during unstable schooling periods, but access remained uneven.

Sustainable use of Smartboards technology therefore requires reliable infrastructure, technical support, and ongoing teacher development. Without these conditions, the benefits of Smartboards technology may not be fully realized. This contextual understanding is central to this study, as rural school conditions shape both opportunities and constraints for technology integration.

2.5 ENHANCING TEACHING AND LEARNING THROUGH SMARTBOARDS TECHNOLOGY

Research consistently highlights the potential of Smartboards technology to enhance multiple aspects of teaching and learning, particularly in the early years of schooling. Smartboards technology has been shown to increase learner engagement, improve motivation, and support deeper understanding of concepts through visualization and interactive learning experiences (Rahayu, 2024). By enabling teachers to present content in dynamic and visually rich ways, Smartboards technology supports diverse learning styles and promotes active rather than passive learning.

Smartboards technology enables teachers to make lessons more engaging and stimulating, while also supporting the development of learners' creative and critical

thinking skills (Ndwandwe et al., 2024). Through real-time interactivity, Smartboards promote collaboration among learners, allow for immediate feedback, and support formative assessment practices (Alzahrani & Woollard, 2023). Teachers are also able to access online resources, save notes, reuse lesson materials, and adapt content easily, which reduces workload and strengthens lesson planning and curriculum alignment (Kong et al., 2021; Tondeur et al., 2021).

Recent studies further indicate that Smartboards technology supports active learning environments, where learners are encouraged to participate, respond, experiment, and interact with content rather than simply receive information (Alsaied et al., 2025). This shift from traditional teacher-centered instruction to more interactive approaches is particularly important in the Foundation Phase, where young learners benefit from structured guidance combined with active engagement. These perspectives provide a strong theoretical foundation for understanding how Smartboards technology enhances teaching and learning in Foundation Phase classrooms, particularly in relation to learner participation, conceptual understanding, and motivation.

2.5.1 Learning with Visuals in the Foundation Phase

When learning activities are presented using Smartboards technology, learners are more likely to respond positively. One of the main benefits of Smartboards technology, according to Hussein et al. (2022), is its ability to actively involve Foundation Phase learners in the learning process. This active involvement creates an immersive learning environment in which learners can access, explore, and engage with content more effectively.

Visual learning plays a particularly important role in early childhood education. Ndwandwe et al. (2024) emphasize that visual elements capture learners' attention and stimulate interest, resulting in improved comprehension of lesson content. Through the use of images, animations, diagrams, and videos, abstract concepts are transformed into concrete learning experiences that young learners can more easily understand, explain, and remember.

From a cognitive science perspective, research shows that children in the early years' process and retain information more effectively when learning is supported by visual representations rather than text alone (Mayer, 2021). Visual learning reduces cognitive load by organizing information in ways that align with how the brain processes new knowledge. In the Foundation Phase, where learners are still developing reading fluency and language proficiency, visual scaffolding is especially important.

Smartboards technology naturally supports dual coding**,** where information is presented both visually and verbally. Dual coding has been shown to enhance comprehension, memory, and long-term retention in young learners (Clark & Paivio, 2022). When teachers explain a concept while simultaneously displaying images, diagrams, or animated sequences, learners are better able to make connections between words and meanings. This is particularly beneficial in subjects such as mathematics and language, where concepts may otherwise appear abstract (Rahayu, 2024).

These findings align closely with the results of the present study, where teachers reported that learners understood concepts more easily when Smartboards technology was used to provide visual explanations and interactive demonstrations. Visual learning through Smartboards thus plays a central role in enhancing both understanding and retention in Foundation Phase classrooms.

2.5.2 Use of Games in Learning and Teaching in the Foundation Phase

Game-based learning is an important instructional approach in the Foundation Phase, where play and exploration are central to learning. Integrating Smartboards technology enables teachers to introduce educational games that combine learning with enjoyment. Machaba (2019) notes that when concepts are taught through games, learner motivation increases significantly. Smartboards technology makes it easier to integrate games into daily lessons by providing interactive, visually appealing platforms.

Educational games used through Smartboards technology can be broadly categorized according to learning purpose:

- Drill-and-practice games, which support basic skills such as number recognition, counting, spelling, and letter-sound correspondence
- Problem-solving games, which encourage reasoning, pattern recognition, and logical thinking
- Simulation games, which allow learners to explore real-life situations and practise decision-making in safe environments
- Collaborative games, which promote teamwork, communication, and social interaction

Research shows that these different types of games support specific learning outcomes when aligned with curriculum objectives (Alsaied et al., 2025; Bala, 2025). Smartboards technology supports these approaches by enabling learners to interact directly with game content, receive immediate feedback, and participate in group activities.

The use of games through Smartboards technology aligns with learner-centered pedagogical approaches. Chowdhury (2024) argues that Smartboards technology helps bridge the gap between teacher-centered and learner-centered instruction by placing learners at the center of the learning experience. Studies consistently show that game-based learning enhances learner motivation, engagement, and enjoyment while also supporting knowledge retention (Alsaied et al., 2025).

These findings support the results of this study, where teachers reported that the use of games through Smartboards technology increased learner participation, enthusiasm, and enjoyment during lessons. When used purposefully, games function as powerful learning tools rather than distractions.

2.5.3 Evidence from Meta-Analyses

Large-scale studies and meta-analyses provide strong empirical evidence for the effectiveness of interactive technologies, including Smartboards, in improving teaching and learning outcomes. These studies highlight that technology is most effective when combined with sound pedagogy and teacher competence.

Table 2.1: Summary of Key Meta-Analysis Findings on Interactive Technologies

Study	Focus Area	Key Findings
Higgins et al. (2012)	Interactive whiteboards in primary education	Moderate positive impact on learner achievement when supported by effective pedagogy
Cheung & Slavin (2013)	Educational technology in primary schools	Improved learning outcomes when technology is integrated with structured instruction
Schindler et al. (2021)	Digital learning and student engagement	Strong positive effects on engagement and participation
Alzahrani & Woollard (2023)	Interactive classroom technologies	Improved collaboration, feedback, and motivation
Alsaied et al. (2025)	Smartboards technology in education	Significant gains in active learning and learner engagement

These findings reinforce the view that Smartboards technology does not improve learning outcomes automatically. Its impact depends on how effectively it is integrated into teaching practice. This evidence strengthens the interpretation of the present study's findings by demonstrating that teachers' positive experiences with Smartboards technology are consistent with broader research trends.

Smartboards technology enhances learner focus and sustained attention. Multimedia and interactive tools capture learners' interest and support concentration during lessons (Rahayu & Makmur, 2024). By stimulating multiple senses, Smartboards technology promotes deeper cognitive engagement and richer learning experiences.

Smartboards technology also supports individualized and inclusive learning. Learners are more engaged when lessons include opportunities for independent exploration and interaction rather than relying solely on teacher-led instruction (Kong et al., 2021).

Teachers can adjust pacing, provide additional scaffolding, or introduce extension tasks, which aligns with inclusive education principles.

Research indicates that interactive learning environments improve memory retention and long-term understanding (Silva, 2021). By combining visual, auditory, and interactive elements, Smartboards technology strengthens recall and application of knowledge. This supports the findings of the present study, where teachers observed improved learner recall and understanding when Smartboards technology was integrated into lessons.

The use of Smartboards technology to enhance teaching and learning aligns with South African education policy frameworks. The White Paper on e-Education and CAPS emphasize learner-centered teaching, active participation, and meaningful integration of ICT in the Foundation Phase (DoE, 2004; DBE, 2011; DBE, 2020). Smartboards technology supports these goals by promoting engagement, differentiation, and active learning, particularly in rural and under-resourced classrooms.

2.6 TEACHER PERCEPTIONS AND COMPETENCY IN SMARTBOARDS TECHNOLOGY USE

Teacher perceptions play a critical role in the successful implementation and sustained use of Smartboards technology in classrooms. Research consistently indicates that the effectiveness of classroom technology is closely linked to teachers' beliefs about its value, usefulness, and pedagogical relevance. When teachers do not perceive Smartboards technology as beneficial for teaching and learning, they are more likely to experience challenges in integrating it meaningfully into classroom practice. In contrast, teachers who hold positive perceptions and view Smartboards technology as pedagogically valuable tend to integrate it more successfully, aligning their instructional practices with its educational potential (Kaliisa et al., 2023; Ndwandwe et al., 2024).

Positive teacher perceptions are associated with greater willingness to experiment, adapt teaching strategies, and use interactive features of Smartboards technology. Teachers who believe that technology enhances learner engagement and understanding are more likely to design interactive lessons, encourage learner participation, and move away from

purely teacher-centered instruction. These perceptions are particularly important in the Foundation Phase, where teaching approaches must be flexible, engaging, and responsive to learner needs.

Research further indicates that Smartboards technology supports learner-driven and personalized approaches to learning. Learners are able to interact directly with content, receive immediate feedback, and participate actively in lessons. When teachers receive adequate training and institutional support, they gain confidence in using Smartboards technology to design innovative lessons, support diverse learner needs, and prepare learners for future learning in technologically rich environments (Tondeur et al., 2021; Ertmer & Ottenbreit-Leftwich, 2023). Positive teacher perceptions therefore contribute to the creation of dynamic, interactive, and learner-centered classrooms that enhance teaching and learning outcomes.

2.6.1 Factors Shaping Teacher Perceptions

Teacher perceptions of Smartboards technology are shaped by multiple factors, including age, teaching experience, prior exposure to technology, access to training, and school leadership support**.** Studies show that teachers with prior experience and training in educational technology are more likely to adopt positive attitudes towards Smartboards technology and integrate it confidently into their teaching practices (Kaliisa et al., 2023; Alsaied et al., 2025).

Age and years of teaching experience can influence perceptions, although findings are mixed (Ghavifekr & Wong, 2022). Some experienced teachers may feel less confident using new technologies due to limited exposure during their initial training, while younger teachers may be more comfortable with digital tools but lack pedagogical experience (Scherer et al., 2021). However, research suggests that continuous professional development can reduce these differences by supporting teachers at all career stages (DBE, 2021b; Ertmer & Ottenbreit-Leftwich, 2023).

School leadership and institutional support also play a critical role in shaping teacher perceptions. Supportive school leadership that encourages experimentation, provides

time for collaboration, and prioritizes professional development contributes to more positive teacher attitudes towards technology integration (Chai et al., 2023). In South African rural schools, where access to technical assistance may be limited, leadership support becomes even more important in motivating teachers and sustaining Smartboards use (DBE, 2023, Letswalo, 2024).

2.6.2 Teacher Competency and Professional Knowledge

Teacher competency is equally essential for the effective use of Smartboards technology in the Foundation Phase. Teachers must possess not only pedagogical and content knowledge but also the technological skills required to integrate Smartboards meaningfully into lesson design and classroom interaction. Combining Smartboards technology with subject knowledge enables teachers to present content in ways that are visually engaging, age-appropriate, and aligned with curriculum goals.

From a TPACK perspective, teacher competency involves the integration of technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). Teachers need to know how Smartboards tools work, how to use them to support effective teaching strategies, and how to align them with Foundation Phase curriculum content. This integration allows teachers to design interactive lessons, scaffold learning, adapt instruction, and use formative assessment strategies effectively (Tondeur et al., 2021).

The DBE emphasizes that teacher competence in technology use should go beyond operational skills and focus on pedagogical integration that improves learner outcomes (DBE, 2020). In rural contexts, where training opportunities may be limited, ongoing support and context-specific professional development are crucial for building teacher capacity and confidence.

2.6.3 Resistance to Change and Technology Adoption

Despite the availability of Smartboards technology, some teachers demonstrate resistance to its adoption. Resistance to change is a well-documented phenomenon in educational technology research. Teachers may resist new technologies due to fear of

failure, lack of confidence, increased workload, or concerns about losing control of classroom processes (Kaliisa et al., 2023).

In the context of Smartboards technology, resistance may be expressed through minimal use, reliance on basic functions, or avoidance of interactive features. Research indicates that resistance is often linked to insufficient training, lack of technical support, and negative past experiences with technology (Ertmer & Ottenbreit-Leftwich, 2023). In rural schools, infrastructural challenges can further reinforce resistance, as repeated technical disruptions undermine teacher confidence.

Addressing resistance requires supportive leadership, mentorship, and opportunities for collaborative learning. When teachers are provided with practical, classroom-based training and see positive outcomes from technology use, resistance decreases and adoption improves.

2.6.4 Teacher Self-Efficacy and Smartboards Use

Understanding teacher competence in technology integration can be strengthened through Bandura's self-efficacy theory. Self-efficacy refers to an individual's belief in their ability to perform tasks successfully. Applied to education technology, teacher self-efficacy influences willingness to adopt, adapt, and sustain the use of Smartboards technology in the classroom.

Teachers with high self-efficacy are more likely to experiment with new teaching approaches, persist when challenges arise, and use Smartboards technology creatively to support learning. In contrast, teachers with low self-efficacy may avoid technology use or rely on limited functions, reducing its educational impact. Research shows that self-efficacy increases through mastery experiences, peer support, and professional development (Bandura, as applied in Ertmer & Ottenbreit-Leftwich, 2023).

In the Foundation Phase, where teaching requires confidence, flexibility, and responsiveness, teacher self-efficacy is particularly important. Professional development

programs that focus on practical classroom use, peer modelling, and ongoing support can strengthen self-efficacy and improve Smartboards integration.

2.6.5 Interplay between Perceptions, Competency, and Context

The interaction between teacher perceptions, competency, and contextual conditions ultimately determines how Smartboards technology is used in Foundation Phase classrooms. Positive perceptions alone are insufficient without competence, and competence cannot be sustained without supportive conditions. In rural schools, these challenges are often intensified by limited infrastructure and access to support services.

Aligning teacher perceptions with pedagogical goals, strengthening competence through professional development, and addressing contextual constraints are therefore essential for meaningful integration. This aligns with DBE policy directives that emphasize teacher development and context-responsive ICT integration rather than technology provision in isolation (DBE, 2020; DBE, 2023).

Overall, teacher perceptions and competency are central to the successful integration of Smartboards technology in the Foundation Phase. Positive beliefs, strong self-efficacy, and appropriate professional support enable teachers to use Smartboards technology in ways that enhance learner engagement, participation, and understanding. This reinforces the central argument of the study that technology integration is most effective when it is teacher-driven, pedagogically grounded, and supported by conducive school environments.

2.7 BENEFITS OF SMARTBOARDS TECHNOLOGY IN RURAL SCHOOLS

Smartboards technology integration in the Foundation Phase classroom has several benefits and opportunities for both teachers and learners. Within the South African context, the Department of Basic Education (DBE) continues to promote the meaningful integration of digital technologies to strengthen curriculum delivery, improve learner achievement, and cultivate competencies required in the twenty-first century. Policy frameworks such as the Department of Basic Education, together with subsequent digital learning strategies, emphazise that technology should enhance pedagogical quality,

learner participation, inclusion, and equitable access, particularly in historically disadvantaged and rural schools. This policy orientation positions Smartboards technology as especially relevant in Foundation Phase classrooms where early literacy, numeracy, and learner engagement are foundational determinants of later academic success.

Teachers can prepare learners for the real world by integrating Smartboards technology into daily teaching and learning through activities that encourage curiosity, innovation, problem solving, communication, collaboration, documentation, investigation, and demonstration of knowledge gained from experiences in the natural environment. Recent research indicates that technology-supported learning can facilitate inquiry, collaborative participation, and the development of higher-order thinking when digital tools are intentionally integrated with appropriate pedagogical strategies (OECD, 2023; Chen & Chen, 2025). In K–12 classrooms, technology-enhanced collaborative inquiry has been associated with positive outcomes in learners' inquiry processes, content knowledge, and scientific skills, while the effectiveness of such approaches depends on how technological tools are aligned with learning activities and teacher facilitation (Chen & Chen, 2025). This suggests that interactive classroom technologies such as Smartboards can support inquiry-oriented and collaborative learning when their affordances are deliberately incorporated into purposeful teaching activities rather than used simply as presentation tools. From a constructivist perspective, Smartboards function as mediational tools through which learners actively construct meaning rather than passively receive information. In rural schools, these opportunities are particularly significant because learners may have fewer opportunities to engage with digital tools outside the classroom. Smartboards can therefore contribute to narrowing aspects of the digital divide by exposing learners to technology-enhanced learning experiences from an early age.

The emphasis on Environmental Studies in Namibia's Junior Primary curriculum includes social interaction, personal safety, dietary habits, and environmental awareness (NIED, 2024). Learners are therefore encouraged to make connections between people and their surroundings. Similarly, within the South African Foundation Phase curriculum, particularly Department of Basic Education, Smartboards technology can strengthen Life

Skills teaching by presenting visual scenarios, animated safety lessons, nutrition charts, environmental simulations, and role-play activities that make abstract concepts more concrete for young learners (DBE, 2021). This reflects multimodal learning theory, which argues that learners understand concepts more effectively when information is presented through multiple sensory channels.

The use of Smartboards technology in primary schools is consistently associated with improved learner engagement and participation. Jones (2024) notes that primary school learners, who often have shorter attention spans, benefit from the interactive and visually stimulating nature of digital platforms. This is particularly important in Foundation Phase classrooms where concentration levels may fluctuate rapidly. Smartboards can sustain attention through movement, color, sound, touch interaction, and immediate feedback. Learners often become more willing to answer questions, manipulate objects on the board, complete matching activities, trace letters, and participate in collaborative games. Such active participation reflects learner-centered pedagogy in which learners shift from passive recipients of information to active co-constructors of knowledge.

Additionally, technology can support diverse learner needs by providing varied ways of accessing, engaging with, and responding to learning content (Williams et al., 2024). For example, educational games and language-learning applications have been shown to improve vocabulary retention, phonological awareness, and grammar development, making learning both enjoyable and effective. In multilingual South African classrooms, Smartboards may further support language acquisition through pronunciation tools, visual vocabulary displays, bilingual resources, songs, and digital storytelling applications. Learners who struggle with conventional chalkboard instruction may benefit from multimodal engagement where they can see, hear, touch, and manipulate information simultaneously. This aligns with inclusive education principles advanced by the DBE, which encourage differentiated pedagogical approaches responsive to learner diversity.

Smartboards technology has also been developed to provide educators and learners with a more comprehensive understanding of learning states and processes. These technologies improve the ability and efficiency of obtaining and visualizing insights into

learning dynamics, thereby creating opportunities for timely intervention. Through gathering, analyzing, and displaying learner data, contemporary systems offer evidence-based insights into learner progress (Giannakos et al., 2024; Lee & Martin, 2025). In practical terms, teachers can identify learners who are struggling with letter recognition, counting, phonics, or comprehension tasks and intervene early. This is highly significant in the Foundation Phase because learning deficits that emerge in Grades R–3 frequently widen in later schooling if not addressed promptly. From an assessment for learning perspective, Smartboards can therefore strengthen formative assessment and responsive teaching.

Comparative studies from similar developing contexts further illustrate the potential benefits of Smartboards technology in rural schools. In India, Sharma and Gupta (2023) found that Smartboards improved learner motivation, attendance, and mathematics participation in under-resourced rural primary schools when teachers received sustained professional development. Studies from different educational contexts suggest that interactive digital technologies can support learner-centred pedagogy and broaden opportunities for learner participation. However, the extent to which these technologies enhance teaching and learning is influenced by teachers' digital competencies, pedagogical integration, infrastructure, and the availability of ongoing technical and professional support. These international examples are relevant to South Africa because they reflect comparable challenges of inequality, infrastructure constraints, and rural educational marginalization. Collectively, the evidence suggests that when implementation conditions are supportive, Smartboards can become catalysts for pedagogical innovation across diverse rural contexts.

Another significant benefit relates to teacher effectiveness and instructional efficiency. Smartboards can reduce time spent repeatedly drawing diagrams, writing lengthy notes, or locating paper-based resources. Teachers may save prepared lessons, reuse materials, access digital worksheets instantly, and integrate videos or simulations seamlessly. This can increase time on task and enable educators to focus more directly on explanation, questioning, scaffolding, and learner support. In multi-grade or

overcrowded rural classrooms, such efficiencies may be particularly valuable because instructional time is often constrained.

Smartboards technology can also strengthen home-school relationships. Teachers may use connected systems to communicate learning activities, homework tasks, or progress updates more efficiently where infrastructure permits. Learners may become more motivated to share classroom experiences with parents or guardians, thereby increasing family interest in schooling. Although connectivity limitations remain in many rural communities, even modest forms of digital communication can contribute positively to parental involvement and learner accountability.

However, some researchers argue that the benefits of Smartboards in rural schools are sometimes overstated, with limited evidence of sustained long-term learning gains (UNESCO, 2024). Technology alone does not automatically improve educational outcomes. Where electricity supply is unreliable, internet connectivity is weak, maintenance is inadequate, or teachers receive insufficient training, Smartboards may be underutilized or reduced to expensive projection screens. Some studies further note that short-term learner excitement does not always translate into deeper conceptual understanding unless pedagogy itself changes. This critical perspective is important because it demonstrates that educational technology is mediated by context, teacher agency, and institutional capacity rather than by hardware alone.

Therefore, while Smartboards technology offers substantial benefits for rural Foundation Phase schools, including enhanced engagement, differentiated learning, stronger formative assessment, improved teacher efficiency, and expanded digital access these gains are most sustainable when supported by DBE policy implementation, school leadership, ongoing professional development, technical support, and equitable resource provision. The literature therefore suggests that Smartboards are not a standalone solution to rural educational inequality; rather, their greatest value emerges when technological access is integrated with sound pedagogy, teacher competence, and systemic support structures.

2.8 BROADENING THE UNDERSTANDING OF LEARNING THROUGH SMARTBOARDS TECHNOLOGY

Contemporary scholarship on Smartboards technology increasingly conceptualises learning as a multidimensional process involving cognitive, behavioural, social, and motivational engagement rather than merely academic performance outcomes (Giannakos et al., 2024; Giannakos & Sharma, 2021). Within educational technology research, Smartboards have been associated with learner participation, collaborative interaction, classroom dialogue, guided problem solving, and active engagement during teaching and learning processes. These perspectives are conceptually relevant to the present study because they provide a broader understanding of how digitally mediated classroom interaction may support learning in Foundation Phase contexts.

Although some educational technology studies employ learning analytics and automated data systems to examine learner interaction patterns (Blundell et al., 2022), the present study does not utilise such methods. Instead, these broader debates are included only to contextualise the constructs explored qualitatively in this research, namely learner engagement, participation, collaboration, interaction, and teacher scaffolding (Bond, 2021). In this study, such dimensions are interpreted through classroom observations, teacher interviews, and document analysis within naturally occurring rural classroom settings.

This conceptual positioning aligns with interpretivist assumptions that learning is socially constructed through interaction, participation, and mediated classroom activity (Makoelle, 2021; Thanh & Thanh, 2021). It also supports constructivist perspectives which emphasise dialogue, collaborative meaning-making, and learner-centred engagement in early grade classrooms (Chai et al., 2023). Within Foundation Phase environments, indicators such as peer interaction, shared attention, confidence in participation, questioning, and guided learning activities may provide meaningful evidence of learning processes that cannot be reduced to quantitative performance measures alone.

The inclusion of this discussion therefore strengthens the theoretical framing of the study by positioning Smartboards technology not only as instructional equipment, but also as a pedagogical tool that mediates interaction, engagement, participation, and meaning-making in classroom practice (Rahayu, 2024). This perspective further aligns with Department of Basic Education priorities regarding the purposeful integration of educational technologies to enhance teaching quality and learner support, particularly within under-resourced rural schools (DBE, 2021b; Letswalo, 2024).

2.9 SMARTBOARDS TECHNOLOGY IN RURAL PRIMARY SCHOOLS

Research on rural public schools and their educators as centers of innovation and alternative pedagogy remains limited (Tembrevilla, 2020). Consequently, the experiences and perspectives of rural primary school educators may be overlooked, despite their importance for understanding the contextual conditions that shape teaching and learning in rural schools (Nkambule, 2022). Few studies have specifically examined the use of Smartboards technology in rural primary schools, even though some educational research has explored these contexts (Chisango et al., 2022). To address this gap, this section draws on adjacent literature from under-resourced and developing country settings that face comparable infrastructure, resourcing, and capacity constraints, including sub-Saharan Africa, India, and Australia. These studies consistently report that technology adoption hinges on teacher competence, reliable infrastructure, school-level leadership, and sustained support, which are also the core conditions for meaningful Smartboards integration in rural classrooms. Within the South African context, this discussion aligns with the Department of Basic Education (DBE) commitment to equitable access, inclusive education, and the use of digital technologies to improve learning outcomes across diverse schooling contexts (DBE, 2021b).

Unequal educational opportunities remain a concern in rural communities, particularly as digital technologies and educational resources are often unevenly distributed between rural and urban schools (Ramrathan & Moodley, 2024; Mustafa et al., 2024). However, contemporary research cautions against viewing rural schools solely through deficit-oriented lenses of poverty, remoteness, and resource scarcity. Evidence from South

African rural schools highlights the importance of recognising teachers' contextual knowledge, relationships with learners and communities, and locally responsive pedagogical practices alongside the structural challenges they face (Maseko, 2024; Mdodana-Zide, 2023). An asset-based perspective therefore recognizes rural schools not merely as sites of disadvantage, but as spaces of possibility where contextually responsive innovation can emerge. Smartboards technology, when thoughtfully integrated, may support this shift by enabling rural teachers to draw on local knowledge, visual resources, oral traditions, and collaborative learning practices in ways that affirm rather than marginalize rural identities.

Related evidence from rural South African schools indicates that teachers generally recognise the value of digital technology for teaching and learning, while persistent challenges, including inadequate devices, unreliable infrastructure and connectivity, limited technological knowledge, and insufficient professional development, continue to shape the extent and manner of technology use in everyday classroom practice (Ramrathan & Moodley, 2024; Sepadi et al., 2025).The implication for Smartboards technology is that pedagogical value emerges when professional development and infrastructure are addressed together rather than separately. In many schools, teachers' express willingness to adopt digital tools, yet confidence and sustained use are often weakened when support systems are fragmented. This suggests that teacher motivation alone is insufficient; systemic conditions remain decisive.

In Namibian junior primary classrooms, Smartboards Technology has been found to enhance learner attention and make abstract content more teachable in Environmental Studies, while simultaneously highlighting familiar barriers such as device shortages, internet limitations, and inadequate training (Shikalepo, 2022). These are conditions that equally determine what Smartboards can achieve in rural Foundation Phase contexts. Smartboards and other digital technologies have the potential to reduce educational opportunity gaps by expanding access to educational resources, visual representations, and interactive learning experiences in rural and low-resource schools. However, the extent to which technology contributes to more equitable learning opportunities depends on reliable connectivity, infrastructure, teacher competence, and meaningful pedagogical

integration (UNESCO, 2024; Ramrathan & Moodley, 2024; Mustafa et al., 2024). For early-grade learners, interactive and multimodal technologies can provide additional opportunities to engage with visual and digital representations of concepts, although their contribution to vocabulary development, conceptual understanding, and sustained attention depends on how they are integrated into teaching and learning (Williams et al., 2024; Mustafa et al., 2024).In Australia, interactive whiteboards have been used to connect geographically dispersed classrooms, anchor whole-class interaction, and extend subject options where specialist teachers are scarce (Orlando, 2023). These models demonstrate how a shared interactive surface can coordinate participation across sites and sustain engagement in resource-constrained settings. Their relevance to rural South Africa lies in the possibility of using Smartboards to facilitate cluster teaching, virtual mentoring, inter-school collaboration, and professional learning communities across remote areas. Similar technology integration models have also emerged in provinces where schools collaborate through district support centers and shared digital resource hubs (DBE, 2023). Such approaches are compatible with DBE priorities for strengthening district support and reducing inequality between schools.

Teaching with Smartboards reflects a “wisdom of practice,” integrating technology with the practical complexities of classroom teaching, what has been described as technological pedagogical reasoning (TPR) (Shulman, 1987; contemporary application in Koehler et al., 2023). This means effective Smartboards use depends not on technical operation alone, but on teachers’ ability to make sound pedagogical decisions about pacing, questioning, differentiation, learner participation, and curriculum alignment (Scherer et al., 2021). In Foundation Phase classrooms, for example, a Smartboard may be used to model handwriting formation, display phonics animations, support counting games, or guide collaborative storytelling. Its value therefore lies in how teachers transform curriculum content into developmentally appropriate learning experiences.

Beyond improving cognitive skills, Smartboards can foster critical thinking, learner voice, and identity development by encouraging learners to explore and articulate their perspectives within the context of their rural schools. Learners can engage with local environmental issues, family livelihoods, cultural practices, and community events through

pictures, maps, stories, and collaborative activities presented using digital technologies. Such approaches can create opportunities for culturally responsive and contextually relevant pedagogy when teachers intentionally connect digital resources with learners' existing knowledge, experiences, languages, and communities. Recent research in rural South African schools indicates that meaningful technology integration is closely linked to teachers' pedagogical knowledge and their ability to adapt technology to local classroom contexts (Mthethwa, 2023; Ramrathan & Moodley, 2024; Sepadi et al., 2025). However, these opportunities remain dependent on teachers' technological and pedagogical competence, as well as adequate infrastructure and reliable access to digital resources (Sepadi et al., 2025). The role of rural educators in implementing Smartboards is increasingly recognized as crucial. Teachers' use of technology is no longer simply a matter of whether they should use it; the focus has shifted to how they can integrate Smartboards effectively to meet the demands of twenty-first century education, ensuring that learning is relevant, inclusive, and accessible to all learners regardless of location (Fullan & Gallagher, 2022). Rural educators have the potential to innovate and adapt teaching practices to local realities, using Smartboards to enhance learner engagement, interactivity, and curriculum relevance. It is therefore necessary to move away from deficit perspectives that portray rural schools as lacking, and instead recognize rural teachers as knowledgeable professionals capable of shaping educational outcomes within their unique social and cultural contexts (Maphalala et al., 2022).

Current studies from South African rural and township schools reinforce this stance. Leadership support, targeted training, mentoring, and coherent school-level planning enable teachers to translate positive attitudes into sustained classroom integration (Maphalala et al., 2022; DBE, 2023). Where principals prioritize instructional leadership, timetable access, technical maintenance, and collaborative planning, technology use tends to become embedded rather than sporadic (Letswalo, 2024). This finding is significant because it shows that Smartboards implementation is an organizational matter as much as an individual teacher matter.

Evidence further suggests that Smartboards can significantly enhance teaching and learning outcomes in rural schools when combined with effective teacher development

and ongoing support. Findings from under-resourced contexts show that professional development addressing both pedagogical design and tool fluency is the inflection point that moves interactive boards beyond passive presentation towards short, frequent routines such as questioning, modelling, guided practice, immediate feedback, and collaborative problem-solving that suit early grades (OECD, 2023; UNESCO, 2024). Access to interactive, multimedia-rich lessons can help rural learners overcome limitations imposed by scarce print resources and limited exposure opportunities.

Recent evidence from rural-school contexts indicates that digital technologies can support learner engagement and broaden opportunities for technology-mediated teaching and learning, although their effectiveness depends substantially on teachers' digital competence and the availability of reliable infrastructure and support (Ramrathan & Moodley, 2024; Sepadi et al., 2025). In India, recent research also highlights persistent inequalities in access to digital education, demonstrating that the educational benefits of technology cannot be separated from the availability of adequate digital infrastructure and equitable access (Jafar et al., 2023). In South Africa, the Department of Basic Education has continued to monitor ICT provision, connectivity, and teacher-development structures, while recognising resource constraints and the need to strengthen provincial and district support for technology integration (DBE, 2023, 2024). While rural-specific Smartboards research remains limited, adjacent literature from under-resourced contexts offers methodologically and contextually relevant guidance. Smartboards technology can add significant value for Foundation Phase learning through visualization, participation, shared focus, formative feedback, and collaborative interaction when teacher competence, infrastructure, and leadership support are developed together (Tondeur et al., 2021). In the absence of these conditions, effects are likely to be inconsistent or short-lived. This study therefore uses the adjacent evidence base to frame practical conditions for success and to avoid deficit framings of rural schooling. In doing so, it aligns with DBE policy commitments to equity, quality foundational learning, teacher development, and meaningful technology integration across all South African schools (DBE, 2021a; DBE, 2021b).

2.10 SYNTHESIS, IDENTIFIED GAP, AND BRIDGE TO CHAPTER 3

The literature reviewed in this chapter establishes four interrelated insights that frame the present study. First, the value of Smartboards technology in the Foundation Phase is conditional rather than automatic. Gains in early learning tend to arise when teachers design lessons that use the board to visualize ideas, structure interaction, and sustain a shared whole-class focus, and when they receive ongoing professional development to refine such practices. Where Smartboards technology is used primarily for presentation or transmission of content, its potential to support young learners' conceptual understanding, engagement and participation remains limited.

Second, teacher capacity functions as the fulcrum of impact. Teachers' perceptions, confidence and pedagogical choices ultimately determine whether Smartboards technology is used as a passive display or as a tool for formative questioning, modelling, guided practice and responsive feedback appropriate to Foundation Phase learners. The literature consistently shows that technology itself does not transform learning; rather, it is teachers' everyday decisions about lesson sequencing, task design, pacing and interaction that mediate its educational value.

Third, rural context matters. Infrastructure availability, connectivity, and school-level routines and supports shape what is practically feasible in rural classrooms. Recent South African studies and policy reports indicate that although significant progress has been made in providing digital devices and classroom technologies, rural schools continue to experience challenges related to unstable connectivity, limited technical support and uneven leadership capacity. At the same time, the literature also documents adaptive and locally responsive practices in rural and under-resourced schools, suggesting that teachers actively negotiate constraints and find ways to make Smartboards technology meaningful within their contexts.

Finally, the evidence base itself remains uneven. While there is substantial international research on Smartboards and on ICT integration more broadly, relatively little empirical attention has been paid to Foundation Phase classrooms in rural primary schools, particularly within the Limpopo Province context. Existing studies often focus on teacher

perceptions or broad implementation challenges, rather than on the fine-grained enactment of Smartboards technology in everyday classroom practice or the school-level conditions that enable such use to be sustained over time.

2.10.1 Identified Research Gap

Against this backdrop, a clear research gap emerges. Although prior studies demonstrate the conditional benefits of Smartboards technologies and document common barriers to ICT use, the field lacks detailed, practice-focused accounts of Smartboards technology use in rural Foundation Phase settings. In particular, the literature does not adequately explain:

- how Foundation Phase teachers in rural schools' plan, adapt and sequence Smartboards-mediated lessons in ways that align with Foundation Phase learners' developmental needs,
- which teacher-level capacities, such as routine lesson planning, formative questioning, modelling and task design, support sustained interactive use rather than presentation-only use,
- which school-level supports, including leadership practices, timetabling arrangements and technical troubleshooting mechanisms, enable or constrain effective classroom use; and
- under what contextual conditions, including infrastructure, policy alignment and professional learning structures, Smartboards technology contributes to more equitable early learning experiences in rural primary schools.

Importantly, while national policy documents articulate strong commitments to digital learning and foundational skills development, they offer limited insight into how these ambitions are realized in the everyday teaching practices of Foundation Phase educators in rural contexts.

2.10.2 Research Questions Emerging from the Gap

In response to these gaps, the present study is guided by the following research questions:

1. How do Foundation Phase teachers in rural primary schools enact Smartboards technology in their day-to-day classroom practice?
2. How do teachers plan, adapt and sequence Smartboards-mediated lessons to support developmentally appropriate learning in the Foundation Phase?
3. What teacher-level capacities (for example, pedagogical confidence, planning routines, formative questioning and task design) enable meaningful and interactive use of Smartboards technology?
4. What school-level conditions (such as leadership support, timetabling, infrastructure and technical assistance) enable or constrain the sustained use of Smartboards technology in rural schools?

Together, these questions move beyond the question of whether Smartboards technology "works" and instead focus on how, why and under what conditions it becomes educationally meaningful in rural Foundation Phase classrooms.

2.10.3 How this study addresses the gap

This study makes a distinct and original contribution to the literature in several ways. First, it adopts a practice-focused approach, examining Smartboards technology not as an abstract innovation but as it is actually enacted in everyday classroom situations. By foregrounding teachers' planning processes, classroom interactions and use of formative feedback, the study provides detailed insight into the pedagogical work that underpins effective technology integration in the early grades.

Second, the study is contextually grounded in rural primary schools, responding directly to calls in both the literature and national policy for research that reflects the realities of under-resourced educational settings. Rather than treating rurality simply as a deficit, the study attends to both constraints and adaptive practices, recognizing teachers' agency in working within their school environments.

Third, the study deliberately examines classroom practice and school-level conditions together. This dual focus allows for a nuanced understanding of how teacher capacity interacts with organizational factors such as leadership, timetabling and technical support.

In doing so, the study helps to distinguish challenges related to individual pedagogical capacity from those stemming from structural limitations, thereby identifying realistic and context-sensitive levers for improvement.

Finally, by focusing on the Foundation Phase, the study contributes much-needed empirical evidence to an area that is strategically important for South Africa's foundational learning agenda, yet still under-represented in research on educational technology. The findings therefore have the potential to inform both classroom practice and school-level decision-making, as well as ongoing policy discussions around digital learning in the early grades.

Given that Smartboards technology becomes educationally meaningful through task design, interaction and feedback, the study requires a pedagogy-centered lens capable of capturing how teachers plan, mediate and scaffold learning around the board. Such a lens must attend closely to teacher decision-making, classroom talk and learner participation, with sensitivity to developmentally appropriate practice in the Foundation Phase.

At the same time, because Smartboards technology use in rural contexts is shaped by infrastructure, routines and organizational support, the study also requires a context-sensitive lens that foregrounds school-level conditions alongside classroom practice. This combined theoretical stance enables a holistic analysis of Smartboards technology use, providing a coherent foundation for the framework presented in the next chapter.

2.11 THEORETICAL FRAMEWORK

2.11.1 Introduction to the Theoretical Framework

This section presents the theoretical and conceptual framework underpinning the study, which investigated the integration of Smartboards technology in rural Foundation Phase classrooms. The framework provides the analytical lenses through which classroom practice, teacher decision-making and school-level influences were interpreted.

Importantly, all theoretical foundations guiding the study are consolidated here in Chapter 2, while methodological procedures are reserved exclusively for Chapter 3, in line with conventional postgraduate dissertation structure and examiner guidance. This clear separation strengthens conceptual coherence and ensures that theory informs, rather than overlaps with, the methodological design of the study.

The study examined how Smartboards technology was pedagogically integrated into literacy and numeracy instruction, as well as the teacher-level and school-level factors that enabled or constrained such integration in rural contexts. This focus reflects current national and international concerns regarding the effective use of digital technologies in the early grades, particularly in under-resourced school environments. South African (DBE) policy documents emphasise that digital technologies should support curriculum delivery, foundational learning and equitable access, rather than function as isolated or symbolic additions to classrooms (DBE, 2023; DBE, 2024). Within this policy landscape, understanding how Smartboards are actually used in Foundation Phase classrooms becomes essential.

To strengthen conceptual clarity and coherence, the theoretical framework draws on four complementary perspectives: Constructivist learning theory, Connectivist learning theory, the Cognitive Theory of Multimedia Learning (CTML), and the Technological Pedagogical Content Knowledge (TPACK) framework. Each of these perspectives addresses a different dimension of Smartboards technology integration. Constructivist and connectivist theories provide pedagogical and socio-digital foundations for understanding how learning occurs, while CTML offers insight into how young learners process multimodal information presented through Smartboards. The TPACK framework, in turn, provides an organising lens for analysing how teachers integrate content, pedagogy and technology in practice.

Together, these theories allow Smartboards technology integration to be understood as both a pedagogical process and a contextually situated practice, shaped by teacher knowledge, learner characteristics and institutional conditions. This theoretical positioning aligns with recent research highlighting that technology integration is not determined by access alone, but by the quality of pedagogical design, teacher capacity and school-level

support structures (Scherer, Siddiq & Tondeur, 2023; Cabero-Almenara et al., 2024). In rural settings, these factors are often intensified by infrastructural constraints and uneven professional development opportunities, reinforcing the need for a theoretically robust and context-sensitive framework.

While existing literature frequently reports increased learner engagement through digital technologies, recent studies caution that engagement alone does not guarantee sustained learning gains, particularly once novelty effects fade (Scherer et al., 2023; UNESCO, 2024). Evidence from South Africa similarly suggests that improvements in learner motivation and participation do not always translate into consistent gains in literacy and numeracy outcomes, especially where pedagogical use of technology remains superficial (DBE, 2024). This study therefore adopts a critical and integrative theoretical stance, interrogating not only the presence of engagement, but also the depth, quality and durability of learning in rural Foundation Phase classrooms.

By drawing these theoretical strands together, the framework provides a coherent foundation for analysing Smartboards-mediated teaching and learning in ways that are pedagogically grounded, cognitively informed and sensitive to rural school contexts. The sections that follow elaborate on each theoretical perspective in turn, before demonstrating how they are integrated into a unified conceptual framework guiding the study.

2.11.2 Constructivist Theory

Constructivist theory provides the pedagogical foundation for understanding teaching and learning in Foundation Phase classrooms. The theory conceptualises learners as active participants in knowledge construction who develop understanding through interaction, exploration, dialogue, and guided problem solving rather than through passive reception of information (Darling-Hammond et al., 2020; Schunk, 2020). Learning is therefore understood as a socially mediated process shaped by prior knowledge, classroom interaction, and scaffolded support. This perspective is particularly relevant in the

Foundation Phase, where learners are developing foundational literacy and numeracy competencies that require continuous engagement, feedback, and teacher guidance.

In this study, constructivism informed the analysis of how Smartboards technology supported learner participation and collaborative classroom practices. Classroom observations indicated that digitally mediated instruction was most effective when teachers used Smartboards to facilitate discussion, visual modelling, shared reading, phonics activities, guided numeracy tasks, and immediate feedback. Such practices enabled learners to manipulate representations, explain their reasoning, and participate actively in classroom learning processes rather than remain passive observers.

Drawing on Piaget's conception of learners as active constructors of knowledge and Vygotsky's emphasis on social interaction and the Zone of Proximal Development (ZPD), constructivist theory explains how scaffolded Smartboards activities can strengthen conceptual understanding in early grade classrooms. Through guided participation and teacher mediation, learners are supported to progress from what they can accomplish independently to what they can achieve with assistance. In this sense, Smartboards technology functions as a mediating pedagogical tool that supports joint attention, classroom dialogue, and collaborative meaning-making when integrated purposefully into teaching practice.

Constructivist theory also provides a basis for critically evaluating classroom practice. Research indicates that interactive technologies do not automatically transform pedagogy, as teachers may continue to rely on teacher-centred approaches even when digital tools are available (Scherer, Siddiq & Tondeur, 2023; Tondeur et al., 2024). In such instances, Smartboards may merely reproduce traditional instructional routines through projected worksheets or one-directional presentations with limited learner interaction. Constructivism therefore enabled the study to distinguish between pedagogically meaningful Smartboards integration that promoted active learning and superficial use that prioritised presentation over conceptual engagement.

2.11.3 Connectivist Theory

Connectivist theory complements constructivism by emphasising the role of digital technologies, networks, and information access in contemporary learning (Goldie, 2021). The theory conceptualises learning as the ability to access, connect, interpret, and apply information distributed across multiple sources, technologies, and social contexts. Within digitally mediated environments, knowledge is no longer viewed as residing solely within textbooks or teachers, but as distributed across interconnected resources and learning networks.

In this study, connectivism was relevant in understanding how Smartboards technology functioned as an access point to multimodal learning resources within Foundation Phase classrooms. Teachers used Smartboards to present digital stories, phonics videos, numeracy animations, and interactive exercises that expanded learning opportunities beyond conventional print-based materials. In rural schools where access to specialised educational resources may be limited, Smartboards created opportunities for learners to engage with varied representations of concepts and broader digital content within the classroom environment.

The theory further highlights the teacher's role in mediating learners' interaction with digital resources. Teachers were required to select developmentally appropriate content, organise digital learning activities, and guide learners in interpreting multimedia information meaningfully. Connectivist principles were evident where Smartboards supported exposure to multiple representations of literacy and numeracy concepts while enabling learners to make connections across texts, visuals, sounds, and classroom experiences.

Nevertheless, the literature cautions that the potential of digitally networked learning is shaped by structural conditions such as connectivity, infrastructure, technical support, and teacher preparedness (UNESCO, 2023; World Bank, 2024). In many rural schools, limited internet access and unreliable infrastructure may constrain the Smartboard's role as a fully networked learning tool, resulting in reliance on offline or preloaded materials.

Connectivist theory therefore sensitised the study to the broader structural inequalities influencing technology-mediated learning opportunities in rural Foundation Phase contexts.

2.11.4 Cognitive Theory of Multimedia Learning (CTML)

The Cognitive Theory of Multimedia Learning (CTML) provides a cognitive perspective for understanding how multimedia technologies influence learning processes (Mayer, 2021; Mayer & Fiorella, 2022). CTML proposes that learning is enhanced when information is presented through carefully designed combinations of words, visuals, and audio that support meaningful cognitive processing while respecting the limitations of working memory. The theory is grounded in three central assumptions: learners process information through separate visual and verbal channels, each channel has limited processing capacity, and effective learning requires active cognitive engagement.

CTML was particularly relevant for analysing how Smartboards-mediated lessons were designed and presented in Foundation Phase literacy and numeracy instruction. Young learners are especially vulnerable to cognitive overload because attentional regulation, working memory, and metacognitive skills are still developing. Consequently, the effectiveness of multimedia instruction depends not only on the presence of digital resources, but also on how instructional content is organised, paced, and visually presented.

The theory explains why well-structured Smartboards lessons that combine visuals, text, audio, and teacher explanation can strengthen understanding and retention when aligned with principles such as coherence, signaling, and segmenting. In this study, digitally supported lessons were most effective where teachers highlighted key information, reduced unnecessary visual distractions, paced instruction appropriately, and aligned verbal explanations with visual representations. These practices were particularly beneficial during phonics instruction, shared reading activities, and numeracy demonstrations involving counting, grouping, and number representation.

Conversely, excessive animations, dense text, rapid transitions, or irrelevant multimedia elements sometimes distracted learners and contributed to cognitive overload. In such instances, Smartboards use became cognitively demanding rather than instructionally supportive. CTML therefore strengthened the analytical framework by enabling the study to distinguish between visually stimulating Smartboards use and cognitively effective pedagogical design. The theory highlighted that meaningful learning depends not only on learner engagement, but also on the extent to which multimedia instruction supports conceptual clarity and manageable cognitive processing.

2.11.4.1 Integrative Theoretical Positioning

While constructivism, connectivism, and CTML each provide distinct perspectives on technology-enhanced learning, the theories are complementary rather than competing. Constructivism explains how learners actively construct understanding through interaction, participation, and scaffolded support; connectivism highlights how digital technologies extend access to knowledge and multimodal learning resources; and CTML explains how multimedia design influences cognitive processing and learning quality. Together, these perspectives establish the pedagogical, technological, and cognitive foundations through which Smartboards technology may support teaching and learning in Foundation Phase classrooms.

2.11.5 The TPACK Framework

The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) served as the primary analytical framework for examining teachers' integration of Smartboards technology in rural Foundation Phase classrooms. TPACK conceptualises effective technology integration as emerging from the interaction between technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK), rather than from competence in any single domain. This integrative perspective is particularly relevant in Foundation Phase contexts, where effective teaching depends on aligning pedagogy, curriculum content, and learners' developmental needs.

In this study, TPACK provided a systematic lens for analysing how teachers planned, implemented, and adapted Smartboards-mediated instruction. Classroom observations and interviews revealed important differences in how teachers integrated digital tools into pedagogical practice. Teachers with strong pedagogical and content knowledge but limited technological competence often used Smartboards primarily for display purposes, including projecting worksheets, textbook pages, or static presentations. In such cases, technology supplemented existing teaching routines without significantly transforming classroom interaction.

By contrast, teachers demonstrating stronger TPACK integration used Smartboards technology to facilitate questioning, guided practice, visual modelling, collaborative activities, and formative feedback during literacy and numeracy instruction. These teachers viewed the Smartboard not merely as a presentation device, but as a pedagogical resource that supported learner participation, conceptual explanation, and responsive teaching. TPACK therefore enabled the study to evaluate not only whether Smartboards were used, but also the pedagogical quality and instructional coherence underpinning their integration.

The framework further highlighted the influence of contextual conditions on technology integration in rural schools. Factors such as infrastructure reliability, connectivity, technical support, leadership practices, and access to professional development shaped teachers' capacity to implement effective digitally mediated pedagogy. Teachers who reported ongoing training, peer collaboration, and instructional support demonstrated more integrated and confident classroom use of Smartboards technology than those whose training focused primarily on technical operation.

Recent research similarly emphasises that access to technology alone does not guarantee improved learning outcomes unless teachers are supported to integrate digital tools with clear pedagogical intent (Higgins et al., 2023; Cabero-Almenara et al., 2024). South African scholarship highlights the importance of sustained teacher development and institutional support for effective teaching, particularly in contexts where teachers must respond to diverse learner needs and changing educational demands (Adigun et al.,

2022; Maphalala & Adigun, 2024). These perspectives align with Department of Basic Education (DBE) policy, which emphasises that educational technologies should support curriculum delivery, formative assessment, and differentiated instruction within enabling school environments (DBE, 2023; DBE, 2024).

Importantly, TPACK functioned as the operational bridge linking the preceding theoretical perspectives to classroom practice. Constructivism informed understandings of active and scaffolded learning; connectivism explained how digital resources extended learning opportunities; and CTML clarified how multimedia design influenced cognitive processing. TPACK integrated these perspectives by explaining how teachers translated pedagogical, technological, and cognitive principles into instructional decisions during Smartboards-mediated lessons.

The framework therefore enabled a nuanced interpretation of how Smartboards technology functioned within the realities of rural Foundation Phase classrooms. Rather than reducing technology integration to device availability alone, TPACK illuminated the interaction between teacher knowledge, pedagogical practice, and contextual conditions shaping meaningful Smartboards integration. Consequently, the framework provided a comprehensive and contextually responsive foundation for analysing the study's findings and interpreting the quality of technology integration within rural schooling environments.

2.11.6 Integration of Theories

2.11.6.1 Integrative Use of Constructivism and Connectivism with TPACK

The integration of these two theoretical lenses allowed the study to evaluate whether Smartboards technology use fostered deep conceptual understanding and learner engagement rather than serving as a passive presentation tool. The Technological Pedagogical Content Knowledge (TPACK) framework (Fig:1) operationalises how teachers blend technology with pedagogy and content in practice; used alongside constructivist and connectivist criteria, TPACK helps interpret observed classroom moves (e.g., task selection, representation choices, pacing, and feedback) and the conditions that support them.

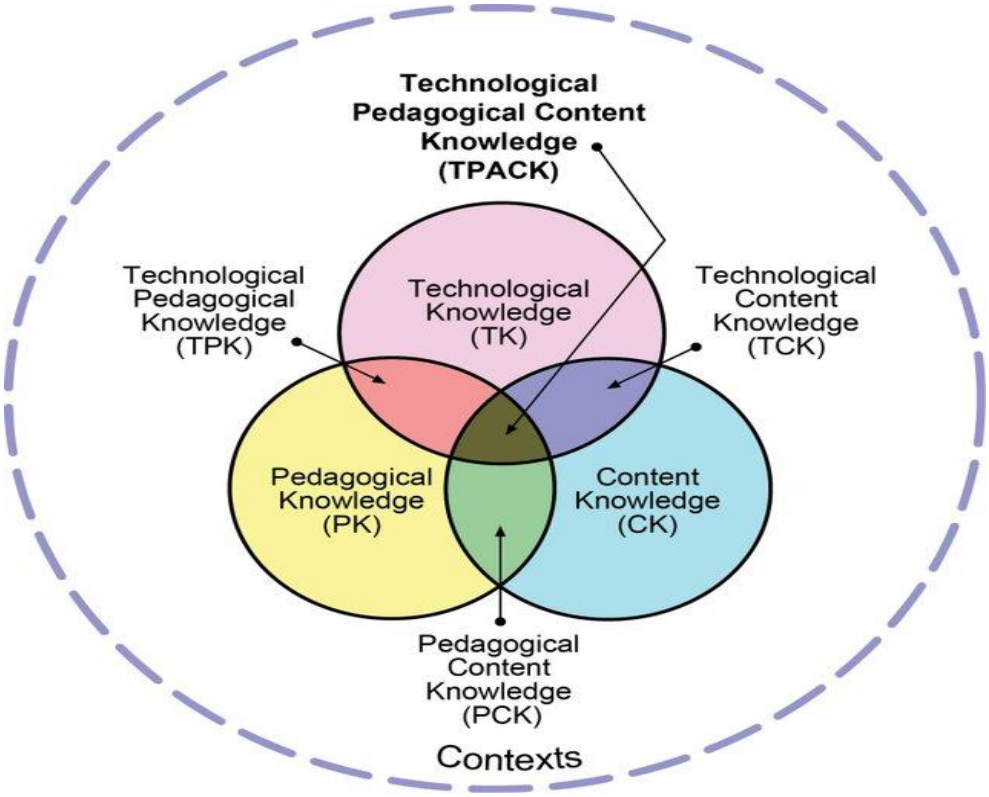


Figure 2.1: *TPACK MODEL* (*Adopted from Koehler et al., (2013)*)

This combined lens maintains coherence with the study's qualitative interpretivist orientation by foregrounding teacher sense-making and local context in explaining Smartboards technology-mediated pedagogy. Importantly, it also allows for a critical interrogation of mismatches between intended pedagogical goals and actual classroom practices, particularly where technology integration remains superficial or procedural rather than transformative (Koehler, Mishra & Cain, 2023).

Rather than operating in isolation, the four theoretical perspectives functioned as an integrated framework. Constructivism explained how learners build understanding through interaction and scaffolding, connectivist explained where learning connects to broader knowledge networks, the Cognitive Theory of Multimedia Learning (CTML) explained how information should be cognitively designed, and the Technological Pedagogical Content Knowledge (TPACK) framework explained how teachers operationalize these principles in practice. Together, the theories enabled a layered

analysis of Smartboards technology integration, capturing pedagogical intent, cognitive impact, technological affordances and contextual constraints.

This integration was particularly important in the Foundation Phase, where effective learning depends on the careful alignment of pedagogy, content, learner development and instructional design. Constructivist theory foregrounded the importance of learner participation, dialogue and scaffolding, highlighting why Smartboards technology is most effective when used to support shared meaning-making rather than passive viewing. Connectivist theory extended this perspective by emphasizing access to digital resources and the role of teachers in mediating learners' engagement with networked knowledge, an issue of heightened significance in rural contexts where access is uneven.

CTML complemented these pedagogical perspectives by introducing a cognitive lens, making it possible to analyze not only what learners were doing, but how Smartboards-mediated information was processed mentally. This theoretical contribution was critical in the early grades, where poorly designed multimedia content can overload learners' cognitive capacities and undermine learning. By incorporating CTML, the framework ensured that Smartboards integration was evaluated in terms of cognitive appropriateness and instructional design quality, not visibility or technological sophistication alone.

TPACK served as the bridging framework that connected these learning theories to observable classroom practice. While constructivism, connectivist and CTML describe principles of learning and cognition, TPACK explains how teachers draw on professional knowledge to translate these principles into instructional decisions. Through TPACK, the study examined how teachers' content knowledge, pedagogical skill and technological competence interacted with school-level conditions to shape Smartboards use in literacy and numeracy lessons.

Together, the theories ensured coherence with the study's qualitative interpretivist orientation, which prioritizes teacher sense-making, contextual understanding and the meanings teachers and learners attach to their practices. The integrated framework made

it possible to interpret Smartboards technology use as a situated pedagogical practice rather than as a technical intervention. This was especially important in rural settings, where infrastructure, leadership support and policy alignment significantly influence what teachers can realistically enact.

The integration of theories also enabled a critical interrogation of superficial or procedural technology use. While connectivist and constructivist perspectives help explain why Smartboards can increase engagement, CTML and TPACK made it possible to question whether such engagement translated into meaningful learning aligned with curriculum goals. This responds directly to concerns in recent literature that technology-driven engagement may be short-lived or novelty-based if not supported by sound pedagogy and cognitive design (Scherer, Siddiq & Tondeur, 2023; Cabero-Almenara et al., 2024).

Importantly, the integrated framework aligns with South African Department of Basic Education (DBE) priorities, which emphasize that digital technologies should support foundational learning, curriculum coverage and equity, rather than exist as stand-alone initiatives (DBE, 2023; DBE, 2024). By combining pedagogical, cognitive and technological perspectives, the framework provides a means of evaluating Smartboards integration in relation to national goals for literacy and numeracy development in the Foundation Phase.

In sum, the integration of constructivist theory, connectivist theory, CTML and TPACK allowed the study to move beyond single-theory explanations and to develop a holistic understanding of Smartboards technology use in rural Foundation Phase classrooms. This integrated theoretical approach underpinned the conceptual framework presented in the next section and guided the analysis of classroom practice, teacher capacity and school-level conditions throughout the study.

2.11.7 Conceptual Framework Diagram

Figure 2 presents the conceptual framework guiding the study. The framework offers a visual synthesis of the theoretical perspectives discussed in Sections 2.11.1–2.11.6 and illustrates how they collectively informed the analysis of Smartboards technology

integration in rural Foundation Phase classrooms. Rather than treating Smartboards technology use as an isolated intervention, the diagram represents Smartboards integration as a dynamic and relational process, shaped by interacting pedagogical, cognitive, technological and contextual factors.

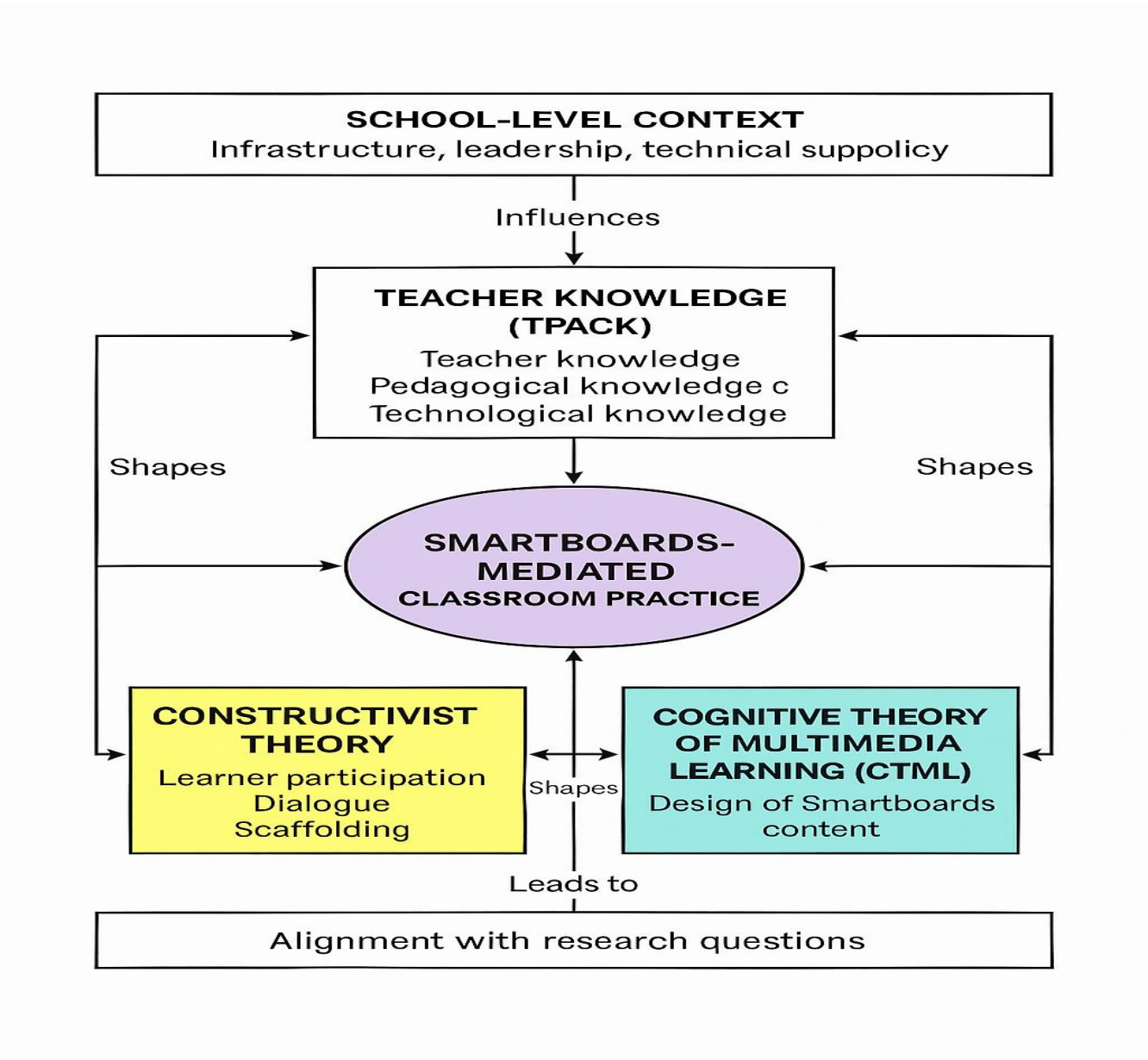


Figure 2.2: Conceptual Framework Diagram (Adopted from Koehler et al., (2013))

Figure 2.2 illustrates how Smartboards technology integration emerges from the interaction between teacher professional knowledge, pedagogical and cognitive learning

theories, and school-level contextual conditions, and how these relationships address the study's research questions.

- Smartboards-mediated classroom practice at the centre
- TPACK mediating teacher practice
- Constructivist Theory and CTML shaping pedagogy and cognitive design
- Connectivist Theory indicating networked access to digital resources
- School-level context (infrastructure, leadership, DBE policy) surrounding practice
- Explicit alignment with the research questions

At the center of the framework is Smartboards-mediated classroom practice, reflecting the study's focus on the everyday enactment of technology during literacy and numeracy instruction. This central positioning highlights that technology integration is realized primarily through classroom interaction, lesson design and pedagogical decision-making, rather than through the mere presence of digital devices.

Surrounding classroom practice are the teacher knowledge domains articulated in the TPACK framework. Content knowledge, pedagogical knowledge and technological knowledge intersect to mediate how Smartboards are used in practice. This positioning reflects the study's analytical emphasis on teacher capacity and professional judgement as key determinants of whether Smartboards technology supports interactive, learner-centred pedagogy or remains limited to presentation-only use.

The framework further incorporates the pedagogical and cognitive foundations that shape instructional design. Constructivist theory is represented as informing learner participation, dialogue, scaffolding and shared meaning-making, while the Cognitive Theory of Multimedia Learning (CTML) informs how Smartboards content is designed, sequenced and presented to support learners' cognitive processing. Together, these perspectives foreground both the social and cognitive dimensions of learning, ensuring that technology use is evaluated in terms of developmental appropriateness and learning quality.

The connectivist dimension of the framework highlights the role of Smartboards as access points to networked and multimodal resources, including digital texts, videos and interactive activities. This component reflects the study's attention to how teachers curate digital content and mediate learners' engagement with broader knowledge networks, particularly in rural classrooms where access to print and specialist resources may be limited.

Encircling these classroom-level processes are school-level contextual factors, including infrastructure availability, leadership practices, technical support and policy alignment. This outer layer acknowledges that Smartboards integration is embedded within institutional conditions that enable or constrain sustained and meaningful use. The inclusion of these factors aligns with Department of Basic Education (DBE) policy, which recognises that digital technology integration depends on both teacher development and enabling school environments, particularly in rural and under-resourced settings (DBE, 2023; DBE, 2024).

Importantly, the conceptual framework also demonstrates alignment with the study's research questions. The central focus on classroom practice addresses the questions concerning how teachers enact Smartboards technology and how lessons are planned and sequenced. The emphasis on TPACK responds to questions about teacher-level capacities enabling meaningful integration. The surrounding contextual layer addresses questions related to school-level conditions that support or constrain sustained Smartboards use. In this way, the framework provides a clear visual link between theory, empirical focus and research design.

Overall, the conceptual framework illustrates that Smartboards technology integration is not a function of technology alone, but the outcome of interacting pedagogical, cognitive, technological and contextual forces. By visually integrating these elements, the framework provides a coherent foundation for the analysis presented in subsequent chapters and clarifies how the study's theoretical perspectives collectively informed the investigation of Smartboards use in rural Foundation Phase classrooms.

2.12 CONCLUSION

This chapter integrated theoretical and empirical insights to provide a comprehensive framework for understanding Smartboards technology use in rural Foundation Phase classrooms. Constructivist and connectivist principles, together with the TPACK framework, guided the analysis of pedagogical integration, teacher competence and school-level influences. By drawing together international and South African literature with established learning theories, the chapter established a coherent foundation for examining how Smartboards technology is enacted in everyday classroom practice rather than assumed to be effective by default.

Importantly, the chapter adopted a critical stance by interrogating assumptions about technology effectiveness, highlighting gaps between learner engagement and sustained learning outcomes, and acknowledging contradictory evidence reported in recent studies. While many sources suggest that digital technologies increase motivation and participation, the literature reviewed demonstrates that such gains are often uneven and context dependent. The inclusion of comparative evidence from developing countries further contextualized these findings, illustrating that Smartboards technology use is shaped by complex socio-economic, infrastructural and institutional conditions that extend beyond the classroom.

The theoretical framework developed in this chapter deepened this analysis by positioning Smartboards integration as a mediated pedagogical process rather than a technical intervention. Constructivist theory emphasized learner participation, dialogue and scaffolding; connectivist theory highlighted access to networked resources and teacher-mediated connections; the Cognitive Theory of Multimedia Learning foregrounded cognitive processing and instructional design; and the TPACK framework explained how teachers integrate content, pedagogy and technology in practice. Together, these perspectives made it possible to analyze not only whether Smartboards were used, but how and why they were used in ways that supported or constrained meaningful learning.

The chapter also underscored the central role of teacher agency in technology integration. The literature consistently emphasized that teachers' knowledge, beliefs and confidence influence whether Smartboards function as interactive learning tools or remain limited to presentation-only use. At the same time, school-level factors such as leadership, infrastructure reliability, technical support and alignment with Department of Basic Education (DBE) policies were shown to play a decisive role in enabling or constraining sustained and effective use, particularly in rural contexts.

Overall, the chapter highlights the importance of aligning teacher knowledge, pedagogical practice and institutional conditions to maximize the potential of Smartboards technology for learner engagement, participation and conceptual development in the Foundation Phase. Rather than presenting optimistic or deterministic claims about digital learning, the chapter offers a balanced and evidence-based perspective that recognizes both opportunities and limitations. This integrated review and theoretical synthesis therefore provides a robust foundation for the research design and analysis presented in the following chapters, supporting a nuanced investigation of Smartboards technology use in rural primary schools.

The structure of Chapter 2 was deliberately designed to progress from a broad review of the literature to a focused theoretical synthesis that directly informs the study. The chapter begins by examining empirical research on Smartboards technology, teacher capacity and rural schooling contexts, establishing the current state of knowledge and identifying key gaps. This is followed by a clearly delineated theoretical framework, in which constructivist theory, connectivist theory, the Cognitive Theory of Multimedia Learning and the TPACK framework are presented and then integrated. This sequencing ensures that theory emerges logically from the literature rather than being imposed a priori. The inclusion of an integrated conceptual framework diagram further clarifies the relationships between theories, research questions and classroom practice. Overall, the chapter structure supports conceptual coherence, aligns with postgraduate research conventions, and provides a robust foundation for the research design and analysis presented in subsequent chapters.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter outlines the methodological processes adopted to investigate how Smartboards technology is integrated into Foundation Phase teaching and learning in rural South African primary schools. Guided by a qualitative interpretivist paradigm, the study sought to understand the lived classroom experiences of teachers and the meanings they attribute to Smartboards technology use in literacy and numeracy instruction. Interpretivism assumes that social reality is constructed through human experiences, interactions, and contextual conditions; hence the research aimed to capture teachers' situated practices rather than impose predetermined categories. The theoretical assumptions outlined in Chapter 2, including constructivist theory (Piaget; Vygotsky), connectivism (Siemens), and the TPACK framework, informed the design of the data-generation tools and provided sensitising concepts for interpreting classroom practice. This chapter therefore explains how the research was conducted, describing the research design, setting, sampling procedures, data-generation methods, ethical considerations, data-analysis processes, and strategies used to ensure trustworthiness.

3.2 RESEARCH DESIGN AND THEORETICAL ALIGNMENT

A qualitative interpretivist research design was employed because the research questions required deep understanding of teacher perceptions, classroom interactions, and school-level influences rather than numerical measurement. The interpretivist stance was appropriate because Smartboards technology integration is shaped by teachers' beliefs, pedagogical orientations, personal histories, and the contextual constraints of rural schooling. Qualitative design enabled the researcher to explore these complex realities in natural classroom settings where Smartboards were used. It further allowed for observation of spontaneous behaviour, real-time interaction with technology, and authentic accounts of teacher experience.

The design aligns with the study's theoretical foundations. Constructivist theory stresses the importance of interaction, scaffolding, and learner engagement, elements that could only be captured through close observation and conversation with teachers. Connectivism informed attention to how teachers accessed digital content, drew on networks, and navigated digital resources during lessons. The TPACK framework sensitised the study to the intersections of teachers' technological, pedagogical, and content knowledge, making qualitative inquiry the most suitable approach.

3.3 PARADIGM

The study is grounded in an interpretivist paradigm, which assumes that reality is socially constructed and best understood through the meanings individuals assign to their experiences. Within the context of rural Foundation Phase classrooms, this paradigm is appropriate as it allows for an in-depth exploration of how teachers perceive and integrate Smartboards technology into their pedagogical practices. Interpretivism prioritises participants' subjective realities, recognising that teaching and learning are shaped by contextual, cultural, and institutional factors rather than fixed, objective truths (Creswell & Poth, 2023; Merriam & Tisdell, 2022). In this study, the interpretivist stance aligns with the constructivist and connectivist theoretical foundations, as both emphasise active meaning-making, social interaction, and the co-construction of knowledge within specific learning environments. Consequently, the paradigm supports an inquiry into how teachers' beliefs, experiences, and professional identities influence the pedagogical use of Smartboards in resource-constrained rural settings.

Furthermore, the interpretivist paradigm enables a nuanced understanding of the complex interplay between technology, pedagogy, and context, as conceptualised through the TPACK framework. Rather than seeking generalisable cause-and-effect relationships, the study aims to generate rich, contextualised insights into classroom practices and teacher decision-making processes. This approach is particularly relevant given recent critiques that question the assumption that increased technological engagement necessarily leads to improved learning outcomes, highlighting the importance of examining how technology is meaningfully enacted in practice (Scherer, Siddiq & Tondeur, 2023; UNESCO, 2024).

By employing qualitative methods such as interviews and classroom observations, the study captures multiple perspectives and lived experiences, thereby producing a holistic understanding of Smartboards technology integration. In doing so, the interpretivist paradigm not only complements the study's theoretical framework but also strengthens its ability to critically interrogate the realities of digital teaching and learning in rural education contexts.

In doing so, the interpretivist paradigm not only compliments the study's theoretical framework but also strengthens its ability to critically examine the realities of digital

3.4 RESEARCH SETTING AND SAMPLING PROCEDURES

The study was conducted in three rural primary schools located within the Mopani District of Limpopo Province, South Africa. The schools were purposively selected on the basis that they had functional Smartboards installed in Foundation Phase classrooms and had been actively using the technology for at least one school term. This criterion ensured that the study focused on sustained pedagogical use rather than initial exposure or experimental implementation.

The Mopani District is predominantly rural and characterised by socio-economic challenges, including high unemployment rates, limited access to basic services in some communities, and uneven distribution of educational resources. Schools in the district frequently experience infrastructural constraints such as overcrowded classrooms, intermittent electricity supply, and inconsistent internet connectivity. Although the Department of Basic Education has promoted the integration of digital technologies such as Smartboards, the level of infrastructure support varies significantly between schools, resulting in uneven patterns of technology adoption and use. This variability provided a contextually rich environment for examining how Smartboards are enacted in real classroom conditions.

Rurality was therefore not treated merely as a geographic descriptor but as a pedagogical context shaping technology integration. Variations in leadership support, infrastructure reliability, and teacher digital readiness influenced which schools met the inclusion criteria.

Schools with non-functional Smartboards, minimal usage of the technology, or severe infrastructural disruptions were excluded to ensure that the study examined authentic and sustained integration practices rather than occasional or symbolic use.

Purposive sampling was used to select eight (n = 8) Foundation Phase teachers who were directly involved in teaching literacy and numeracy using Smartboards. Participants were drawn from Grades 1 to 3 and were required to have at least one term of continuous experience using Smartboards in classroom instruction. In addition, participants had to demonstrate willingness to engage in both semi-structured interviews and classroom observations. Two to three teachers were selected per school, allowing for both cross-school comparison and within-school depth of insight.

Although the sample size was relatively small, it was appropriate for the qualitative and interpretive nature of the study. The aim was not statistical generalisation but rather analytic depth and contextual understanding of pedagogical practices. Data saturation was reached during the iterative process of data collection and analysis, as later interviews and observations began to yield no substantially new codes or themes. This confirmed that the sample size was sufficient to address the research questions comprehensively within the bounded rural context.

Clear inclusion and exclusion criteria guided the sampling process. Schools were included if they were located in a rural area within Mopani District, had fully functional Smartboards installed in Foundation Phase classrooms, and demonstrated consistent use of the technology for at least one school term. Schools were also required to grant access for classroom observations and teacher participation. Teachers were included if they were currently teaching Foundation Phase learners, had practical experience using Smartboards, and were actively involved in literacy and numeracy instruction.

Schools were excluded if Smartboards were non-functional, minimally used, or inconsistently integrated into teaching due to infrastructural or technical constraints. Teachers without direct classroom experience using Smartboards, or those not involved

in Foundation Phase teaching, were also excluded to preserve the relevance and depth of the dataset.

To enhance trustworthiness, member checking was conducted as part of the validation process. Preliminary thematic summaries derived from interviews and observations were shared with participants after initial transcription and coding. This was done through follow-up face-to-face discussions and, where necessary, WhatsApp communication. Participants were invited to confirm the accuracy of interpretations, clarify meanings, and correct any misrepresentations. Feedback received was generally affirming, with minor clarifications related to classroom examples and terminology, which were subsequently incorporated into the final analysis. This process strengthened the credibility of the findings by ensuring alignment between participant experiences and researcher interpretations.

Table 3.1: A summary of the participating schools

School (Pseudonym)	Enrolment	Quintile	Number of Smartboards	Years of Smartboard Use	Connectivity Status
School A	±650 learners	Quintile 2	3 Smartboards	2 years	Limited internet, stable electricity
School B	±480 learners	Quintile 1	2 Smartboards	1.5 years	Intermittent internet, unstable electricity
School C	±720 learners	Quintile 2	4 Smartboards	3 years	Limited internet, mostly stable electricity

The table shows that while all three schools had access to Smartboards, there were differences in terms of resources, years of use, and connectivity. These variations provided a broader understanding of how Smartboards technology is implemented across different rural school contexts.

The final number of eight participants was determined through purposive sampling guided by both practical and theoretical considerations. Practically, the inclusion of two to three teachers per school ensured balanced representation across the three sites while remaining feasible within the time and resource constraints of the study. Theoretically, the sample size was sufficient to enable cross-school comparison while allowing for analytic depth within each school context. In qualitative interpretivist research, adequacy of sample size is judged not by statistical representativeness but by the richness and credibility of the data generated (Creswell & Poth, 2023; Merriam & Tisdell, 2022). The combination of purposive selection, iterative data collection, and the achievement of saturation after eight participants confirmed that this number was sufficient to comprehensively address the research questions within the bounded rural context.

3.5 DATA COLLECTION

Data were collected through semi-structured interviews, classroom observations, and document analysis in order to generate a comprehensive and triangulated understanding of Smartboards technology integration in Foundation Phase classrooms. The use of multiple data sources enhanced methodological precision by allowing for convergence and cross-validation of findings across different forms of evidence.

Semi-structured interviews constituted the primary data collection method. This approach was selected due to its flexibility in allowing participants to articulate their experiences while still maintaining alignment with the research objectives. An interview guide was developed in line with the study's research questions, focusing on teachers' pedagogical use of Smartboards, perceived benefits, challenges encountered, and institutional support structures. Interviews were conducted in English and, where necessary, supplemented with code-switching to local languages to ensure clarity and participant comfort.

Each interview lasted approximately 40 to 60 minutes and was conducted at the participants' respective schools in a quiet and private space to minimise disruption and encourage open dialogue. All interviews were audio-recorded with participants' informed consent and subsequently transcribed verbatim to preserve the authenticity of responses. Field notes were also taken during and immediately after each interview to capture non-verbal cues and contextual observations.

Classroom observations were conducted to complement interview data and to directly examine how Smartboards were enacted in real instructional settings. An observation schedule was used to guide attention to key aspects such as teacher–learner interaction, instructional strategies, learner engagement, integration of multimedia resources, and the extent to which Smartboards were used to support literacy and numeracy instruction. Observations were non-participant in nature, allowing the researcher to remain unobtrusive and minimise disruption to normal teaching activities.

Each teacher was observed at least once during a teaching session involving Smartboard use. Where possible, follow-up observations were conducted to capture variation in instructional practice across different lessons. Detailed descriptive field notes were recorded during and immediately after each observation to ensure accuracy and depth of contextual detail.

Document analysis was used as a supplementary method to strengthen data triangulation. Relevant documents included lesson plans, teaching preparation notes, and any available school-level ICT integration guidelines. These documents were examined to establish the extent to which Smartboards were formally embedded in instructional planning and to compare planned versus enacted pedagogical practices.

Data collection followed a staged and iterative process. Initial entry into schools involved obtaining permission from school leadership and briefing participants on the purpose and scope of the study. Interviews and observations were then conducted concurrently across the three selected schools to allow for emerging insights to inform subsequent data

collection. This iterative approach enabled preliminary patterns to be identified early and explored further in later engagements.

To ensure consistency and credibility, data collection procedures were implemented across all sites. The same interview guide, observation framework, and document analysis criteria were applied uniformly. All data were securely stored, with audio recordings and transcripts saved on a password-protected device accessible only to the researcher.

The data collection process also incorporated ongoing reflexive practice. The researcher maintained a reflective journal throughout fieldwork to document personal observations, assumptions, and potential biases. This supported methodological transparency and contributed to the dependability of the study by making the research process auditable.

Overall, the integration of interviews, observations, and document analysis provided a rich, layered dataset that enabled a nuanced understanding of Smartboards technology integration in rural Foundation Phase classrooms.

The coherence of the data collection process was strengthened through the interplay of purposive sampling, systematic monitoring of saturation, and methodological triangulation. The purposive selection of eight Foundation Phase teachers across three rural schools ensured balanced representation while remaining feasible within the study's practical constraints. Saturation was reached after six interviews and corresponding observations, with the final two participants confirming the stability of emergent themes, thereby validating the adequacy of the sample size. Triangulation across semi-structured interviews, classroom observations, and document analysis further enhanced credibility by allowing convergence of evidence from multiple sources. Together, these strategies ensured that the dataset was both sufficiently rich and analytically robust to address the research questions comprehensively within the bounded rural context.

3.5.1 Classroom observation

Non-participant classroom observations were conducted to capture the real-time use of Smartboards technology in literacy and numeracy instruction. Each participating teacher was observed twice, with each observation lasting approximately 45–60 minutes. The observations were scheduled in consultation with the teachers and took place during normal lesson times over a period of several weeks. In most cases, observations were conducted in the morning sessions when literacy and numeracy lessons were taught. Conducting multiple observations enhanced the credibility of the data by allowing the researcher to capture variations in instructional practices and reducing the likelihood of recording a typical teaching behaviours, as noted by Sharan B. Merriam and Elizabeth J. Tisdell (2022).

The observations focused on pedagogical strategies, teacher–learner interactions, learner engagement, scaffolding practices, content representation, and the nature of Smartboard use, including any technical challenges encountered during lessons. A structured observation guide, informed by constructivist, connectivist, and TPACK principles, was used to ensure consistency across classrooms. The guide incorporated key indicators such as the extent of learner interaction, the use of multimodal representations, teacher facilitation techniques, and the integration of content, pedagogy, and technology. Field notes were maintained to document both descriptive accounts of classroom activities and reflective insights.

The researcher adopted a non-participant observer role throughout the study. This meant that the researcher did not take part in teaching activities and remained seated at the back or side of the classroom to avoid disrupting the lesson. Interaction with teachers and learners during the lesson was kept to a minimum, except in cases where clarification was needed after the lesson had ended. This helped to ensure that the natural classroom environment and teaching practices were maintained as much as possible.

An observation protocol was followed before, during, and after each session. Before the observation, permission was confirmed with the teacher, and the observation guide was

reviewed to ensure readiness. During the observation, detailed field notes were recorded, focusing on both what was happening in the classroom and how Smartboards technology was being used. Attention was also given to learner responses and any challenges that arose. After the observation, the researcher expanded the field notes by adding further details and reflective comments while the lesson was still fresh in memory.

Field notes were maintained to document both descriptive accounts of classroom activities and reflective insights. For example, a typical observation note included entries such as: *"Teacher used the Smartboard to display a counting activity. Learners came to the front to drag numbers into correct positions. Most learners appeared engaged, although a few struggled to interact with the board. The teacher provided guidance and encouraged participation."* Such notes were anonymized and are included as sample observation records in the appendix.

Overall, the use of structured observations, a consistent observation protocol, and detailed field notes contributed to a deeper understanding of how Smartboards technology was used in practice within the classroom context.

To further standardise the observation process, specific focus areas were identified, as presented in Table 3.2 below.

Table 3.2: Observation Focus Areas and Descriptions

Observation Focus Area	Description
Teacher–Learner Interaction	Nature of questioning, feedback, scaffolding, classroom dialogue, and learner participation during Smartboards-mediated instruction.
Learner–Board Interaction	Frequency and forms of learner engagement with the Smartboard, including touch interaction, responses to activities, and participation in digital tasks.

Observation Focus Area	Description
Instructional Strategies	Use of multimedia resources, collaborative learning activities, differentiation strategies, and guided instructional practices.
Technological Integration	Extent to which Smartboards use aligned with lesson objectives, curriculum content, and pedagogical goals.
Learner Engagement	Learners' attention, responsiveness, participation levels, and involvement during classroom activities.
Technical Incidents	Connectivity challenges, device malfunctions, technical interruptions, and teacher troubleshooting responses during lessons.
Classroom Management	Organisation of learners, management of transitions, classroom flow, and maintenance of instructional focus during Smartboards use.

The structured observation framework enhanced consistency across classroom observations and enabled systematic comparison of instructional practices, learner participation, and Smartboards integration across participating schools.

3.5.2 Semi-Structured Interviews

Semi-structured interviews were conducted with eight Foundation Phase teachers across three rural primary schools, with prior permission obtained from all participants. Ethical principles were adhered to throughout the process, including informed consent, confidentiality, and voluntary participation.

The interviews took place in quiet and familiar settings within the school environment, such as empty classrooms and staffrooms. These locations were deliberately selected to

minimise interruptions and create a comfortable atmosphere that encouraged open and honest responses. In some instances, interviews were conducted after school hours to accommodate teachers' availability. This flexible arrangement ensured that participants were relaxed and able to engage fully in the discussion.

Each interview lasted between 45 and 60 minutes, with an average duration of approximately 50 minutes. This range allowed sufficient time for in-depth exploration of participants' experiences while remaining sensitive to their professional commitments.

The interviews were guided by a structured yet flexible interview guide consisting of open-ended questions. These questions were designed to explore teachers' experiences with Smartboard technology, their beliefs about its use in teaching and learning, perceived benefits and challenges, exposure to professional development, and the role of school-level support structures. The semi-structured design enabled participants to express their views freely while allowing the researcher to probe for clarity, depth, and emerging themes. This approach ensured both consistency across interviews and richness of data.

The development of the interview guide was informed by the study's research questions and theoretical frameworks, particularly the Technological Pedagogical Content Knowledge (TPACK) framework, as well as constructivist and connectivist perspectives. Questions were carefully sequenced, beginning with general teaching experiences before moving towards more specific issues relating to Smartboard integration. This progression allowed participants to feel at ease and encouraged more reflective and meaningful responses.

To strengthen the reliability and validity of the instrument, the interview guide was piloted with one Foundation Phase teacher from a non-participating school. The pilot interview was conducted under conditions similar to those of the main study. During this process, attention was given to the clarity, wording, and sequencing of questions, as well as the overall duration of the interview. Feedback from the pilot resulted in minor revisions, including the refinement of question wording, removal of repetitive items, and improved flow of the interview structure. Additionally, ambiguous and leading questions were

identified and eliminated. As noted by Creswell and Poth (2023) and Braun and Clarke (2022), pilot testing enhances the credibility and effectiveness of qualitative data collection instruments by ensuring alignment with research objectives and contextual appropriateness.

All interviews were audio-recorded with participants' consent to ensure accurate capture of their responses. The recordings were transcribed verbatim by the researcher using Microsoft Word. The transcription process involved listening carefully to each recording multiple times and typing responses word-for-word, including pauses and emphasis where relevant to preserve meaning. Thereafter, each transcript was reviewed and cross-checked against the original audio recordings by the researcher to correct any inaccuracies or omissions. This rigorous process ensured a high level of accuracy and trustworthiness of the data.

It is important to note that classroom observations in this study were limited to observing teachers' instructional practices during lessons. Therefore, the interviews played a critical role in providing insights into aspects that were not directly observable. These included teachers' emotional responses to technology use, their pedagogical reasoning, and their perceptions of institutional and contextual factors influencing Smartboard integration.

In addition to the interviews, participants completed handwritten questionnaires, which were later typed by the researcher to improve clarity and facilitate analysis. These questionnaire responses complemented the interview data by providing additional reflections and allowing participants to express views they may not have articulated verbally.

Data saturation was systematically monitored throughout the iterative process of data collection and analysis. After the sixth interview and corresponding classroom observations, preliminary coding revealed recurring themes with no substantially new categories emerging. The final two interviews and observations confirmed this pattern, serving to validate rather than extend the coding framework. Saturation was therefore determined not only by the absence of new codes but also by the stability of existing

themes across multiple data sources. This process was documented in analytic memos and cross-checked during peer consultation to ensure that the determination of saturation was transparent, auditable, and methodologically rigorous.

The integration of interview data, questionnaire responses, and classroom observations enhanced the overall depth, credibility, and interpretive richness of the study. This methodological triangulation allowed for a more comprehensive understanding of the phenomenon under investigation and strengthened the validity of the findings.

3.6 DATA ANALYSIS AND THEMATIC INTERPRETATION

The collected data, which consisted of verbatim interview transcripts, observation field notes, and lesson materials were analysed using thematic analysis following the six-phase framework developed by Braun and Clarke (2022). This approach provided a systematic yet flexible process for identifying, analysing, and interpreting patterns within the qualitative data while remaining closely aligned with participants' lived experiences and the study's research objectives.

The analysis began with familiarisation through repeated reading of interview transcripts and observation notes. During this phase, the researcher immersed herself in the data by reading and re-reading transcripts while recording preliminary analytical notes and reflections. For example, when participants described learners "touching, dragging, and matching objects on the Smartboard," early observations such as "active learning" and "hands-on engagement" were noted. This process assisted in identifying recurring patterns and emerging meanings across participant responses.

The second phase involved generating initial codes. Coding was conducted inductively to allow patterns to emerge directly from participants' experiences and classroom observations, while deductive insights derived from the research questions and theoretical frameworks also informed interpretation. Codes such as "technology confidence" and "content explanation" reflected dimensions of the Technological Pedagogical Content Knowledge framework, whereas codes relating to learner interaction and participation were informed by constructivist and connectivist perspectives.

Table 3.3: Illustrates how raw qualitative data were systematically coded and organised into broader analytical categories during the coding process.

Data Extract	Initial Code	Category
Learners come to the board and move pictures to match answers.	Hands-on activity	Learner engagement practices
I feel more confident using the Smartboard now.	Teacher confidence	Teacher professional development
Some lessons are difficult when the system is not working.	Technical challenge	Institutional and infrastructural constraints
Learners understand better when they see and interact.	Improved conceptual understanding	Pedagogical benefits of Smartboards use

Coding and theme development were supported through NVivo software, which facilitated systematic organisation, retrieval, and management of qualitative data. To strengthen analytic rigour and minimise subjective interpretation bias, approximately 20% of the interview transcripts were independently double-coded with a peer researcher. Coding discrepancies were discussed and resolved collaboratively, resulting in refinement of the codebook and clearer operational definitions of categories and themes. This process enhanced consistency, dependability, and credibility within the analysis.

The third phase involved identifying relationships between codes and clustering conceptually related codes into preliminary themes. For example, codes such as “hands-on activity,” “learner participation,” and “visual learning” were grouped under the category learner engagement practices, which contributed to the broader theme interactive learner engagement. The fourth phase involved reviewing and refining themes against the complete dataset to ensure coherence, internal consistency, and alignment with the research questions. During this stage, certain themes were merged, refined, or renamed to improve analytical clarity and conceptual alignment.

The fifth phase focused on defining and naming the final themes in relation to Smartboards technology integration within rural Foundation Phase classrooms. The final themes

included interactive learner engagement, teacher technological confidence, enhancing conceptual understanding, and institutional support and constraints. These themes reflected both the pedagogical opportunities and contextual challenges associated with Smartboards integration in rural educational settings.

The sixth and final phase involved producing the analytical narrative. Themes were synthesised and interpreted in relation to the study's objectives and theoretical frameworks to generate a coherent understanding of participants' experiences. The analysis was guided by the TPACK framework together with constructivist and connectivist perspectives, enabling interpretation of how teachers integrated technological, pedagogical, and content knowledge in classroom practice. These theoretical lenses further supported understanding of how teacher beliefs, institutional conditions, learner interaction, and pedagogical decisions shaped the effective integration of Smartboards technology.

To enhance analytical transparency, a thematic mapping process was used to demonstrate the progression from raw data to final themes, as illustrated below:

- Codes: hands-on activity, learner participation, visual learning
- Category: learner engagement practices
- Theme: interactive learner engagement

This mapping process strengthened the audit trail of the study by clearly demonstrating the relationship between participant responses, intermediate analytical categories, and final thematic interpretations.

Data storage and management adhered to established ethical and data-protection requirements. Hard-copy research materials were securely stored in a locked location, while electronic files were encrypted and password-protected to prevent unauthorised access, loss, or disclosure. These measures were consistent with contemporary research data-management practices and the requirements of the Protection of Personal Information Act (POPIA), which requires appropriate safeguards when personal information is collected, processed, and stored in South Africa (Academy of Science of

South Africa [ASSAf], 2021; Staunton et al., 2021; UK Data Service, 2025). Overall, the thematic analysis generated a coherent and theoretically grounded understanding of Smartboards integration practices, pedagogical benefits, teacher experiences, and institutional constraints within rural Foundation Phase classrooms. Although full inter-coder reliability across the entire dataset was not undertaken, the use of peer checking, systematic coding procedures, reflexive interpretation, and transparent analytical processes strengthened the trustworthiness, dependability, and credibility of the findings.

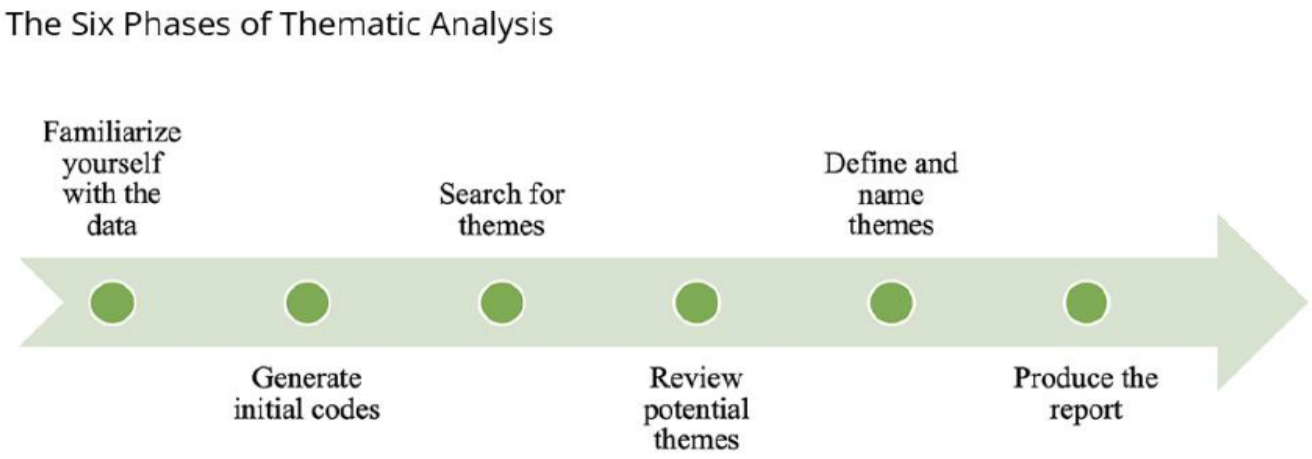


***Figure 3.1*: The six phases of thematic analysis (adapted from Braun & Clarke, 2006, 2012)**

3.7 TRUSTWORTHINESS

Trustworthiness was established through the criteria of credibility, transferability, dependability, and confirmability (Lincoln & Guba). Each criterion was operationalised in a distinct manner to ensure methodological rigour.

Credibility was ensured through methodological triangulation involving interviews, classroom observations, and document analysis. This multi-source approach allowed for convergence and cross-validation of findings related to Smartboards integration in Foundation Phase classrooms. Member checking was conducted to verify the accuracy of interpretations, while prolonged engagement in the field enabled a deeper contextual understanding of classroom practices and instructional routines.

Transferability was achieved through thick, contextual description of the rural school environment, including classroom conditions, resource availability, pedagogical practices, and patterns of Smartboards use. This allows readers to assess the applicability of findings to comparable educational contexts.

Dependability was supported through an audit trail documenting all stages of the research process, including data collection procedures, coding decisions, theme development, and methodological adjustments. Supporting materials such as transcripts, field notes, and analytic memos were systematically organised to ensure procedural transparency.

Confirmability was ensured through systematic reflexive practice and peer consultation. Interpretations were continuously checked against raw data to minimise researcher bias, and analytical decisions were reviewed to ensure they were grounded in participants' accounts rather than personal assumptions.

Together, these strategies ensured that the findings are consistent, traceable, and grounded in empirical evidence.

Positionality

In qualitative interpretivist research, the positionality of the researcher is central to the credibility and trustworthiness of the study. Positionality refers to the researcher's own social, cultural, and professional location, and how these influence the research process, from the framing of questions to the interpretation of findings. Acknowledging positionality is therefore essential in ensuring reflexivity and transparency in the study.

As the researcher, I occupy a dual role: both as an academic committed to advancing scholarly debates on digital pedagogy, and as a practitioner with lived familiarity of the South African schooling context. My professional background in education provided me with insight into the systemic challenges faced by rural schools, including infrastructural instability, resource scarcity, and uneven access to professional development. This insider awareness sensitised me to the realities of teachers' work and enabled empathetic

engagement during interviews and classroom observations. At the same time, my academic training required me to maintain critical distance, ensuring that interpretations were grounded in participants' voices rather than my own assumptions.

My linguistic and cultural proximity to the Mopani District context further shaped the research process. Sharing cultural and linguistic affinities with participants facilitated rapport, trust, and openness during data generation. Teachers were more willing to articulate their experiences in ways that reflected their authentic realities, knowing that the researcher understood the nuances of rural schooling. However, this proximity also carried the risk of over-identification, which I mitigated through reflexive journaling, peer debriefing, and member checking to ensure that interpretations remained faithful to participants' meanings rather than filtered through personal bias.

Importantly, my positionality as a researcher situated within broader debates on digital equity influenced the framing of Smartboards technology not merely as a pedagogical tool but as a lens through which issues of inclusion, access, and systemic support could be interrogated. This orientation aligned with the interpretivist paradigm, which values contextualised meaning-making and recognises that knowledge is co-constructed between researcher and participants. By explicitly acknowledging my positionality, I sought to enhance the transparency of the research process and strengthen the trustworthiness of the findings.

Thus, positionality in this study is not treated as a limitation but as an integral dimension of qualitative inquiry. It underscores the reflexive awareness that the researcher's identity, experiences, and commitments inevitably shape the research journey. By critically engaging with my own positionality, I ensured that the study remained ethically grounded, contextually sensitive, and academically rigorous in its exploration of Smartboards technology integration in rural Foundation Phase classrooms.

3.8 REFLEXIVITY

The researcher acknowledges that qualitative research is shaped by positionality and interpretive perspective. As an education specialist involved in ICT integration within the

district, the researcher brought contextual familiarity with Smartboards implementation, teacher support structures, and rural schooling constraints. This insider positioning provided analytical depth but also introduced the potential for interpretive bias, particularly the tendency to assume pedagogical effectiveness in instances of technology use.

To address this, reflexivity was maintained as a continuous analytical practice rather than a retrospective reflection. The researcher maintained structured field notes capturing observations, initial interpretations, and evolving assumptions during data collection. These reflections were used to distinguish between descriptive evidence and interpretive inference during analysis.

During coding and theme development, deliberate efforts were made to bracket prior expectations regarding Smartboards effectiveness. Interpretations were consistently validated against raw participant data to ensure that findings remained grounded in actual classroom experiences.

Peer consultation further supported reflexive integrity by enabling critical interrogation of emerging interpretations, particularly where professional experience may have influenced analytic assumptions.

Rather than eliminating subjectivity, the study treated it as an acknowledged component of knowledge production. This reflexive positioning enhanced transparency by explicitly accounting for how the researcher's professional background shaped engagement with the data while maintaining analytical discipline grounded in participant evidence.

In summary, the methodological coherence of this study rests on the alignment between its qualitative interpretivist design, theoretical paradigm, and the researcher's positionality and reflexive practice. The interpretivist stance provided the foundation for exploring teachers' lived experiences of Smartboards integration, while constructivist, connectivist, and TPACK frameworks sensitised the inquiry to the interplay of pedagogy, technology, and content. Positionality acknowledged the researcher's insider status and professional expertise, and reflexivity ensured that these influences were critically managed through structured field notes, peer consultation, and attention to power dynamics. Data collection

strategies, including purposive sampling, systematic monitoring of saturation, and triangulation across interviews, observations, and document analysis, further reinforced methodological rigor by ensuring that the dataset was both contextually rich and analytically robust. Together, these elements demonstrate an integrated and transparent research process, enhancing the credibility, trustworthiness, and scholarly contribution of the study to understanding Smartboards technology integration in rural Foundation Phase classrooms. The following section turns to the ethical considerations that guided the study, ensuring that methodological rigor was matched by adherence to principles of respect, beneficence, and non-maleficence.

3.9 ETHICAL CONSIDERATIONS

Building on this methodological foundation, ethical approval for the study was obtained prior to data collection, and all procedures were conducted in accordance with institutional research ethics requirements. Participation was voluntary, and informed consent was obtained from all participants prior to engagement in the study. Participants were informed of the purpose of the research, their right to withdraw at any stage without penalty, and the measures in place to ensure confidentiality and anonymity.

To protect participant identities, all names and identifying features of schools and individuals were removed and replaced with pseudonyms during transcription and reporting. The three primary schools are referred to as *School A*, *School B*, and *School C*, while the participants are labeled *FPT 1* through *FPT 8*. Data were securely stored in password-protected digital files, with hard-copy materials kept in a locked and controlled environment accessible only to the researcher.

Particular attention was given to the sensitivity of classroom-based research involving Foundation Phase learners. The study was designed to avoid disruption of teaching and learning processes, and observations were conducted in a non-intrusive manner. No learner-level identifying data were collected, and the focus remained on pedagogical practices rather than individual learner performance.

The study adhered to principles of beneficence, non-maleficence, and respect for persons, ensuring that no harm, psychological, professional, or institutional, was caused to participants or the school community.

3.10 CONCLUSION

Having outlined the ethical safeguards that guided the study, this chapter concludes by synthesising the methodological framework underpinning the study. It explained the qualitative interpretivist research design, the purposive sampling strategy, and the data generation methods used to investigate Smartboards technology integration in rural Foundation Phase classrooms. The chapter also outlined the ethical procedures followed, the thematic analysis process employed, and the measures applied to ensure trustworthiness and strengthen the integrity of the study.

By detailing the research design, context, participants, data generation methods and analytical procedures, the chapter demonstrated how the study was systematically and ethically conducted within authentic rural school settings. Each methodological decision was guided by the need to capture rich, contextually grounded insights into teachers' everyday practices and perceptions, rather than surface-level measures of technology use. The qualitative interpretivist approach was particularly well suited to exploring how Smartboards technology is enacted, understood and constrained within the realities of Foundation Phase classrooms.

Grounding the methodology within a qualitative, interpretivist approach ensured strong alignment with the theoretical framework and research questions established in Chapter 2. The use of classroom observations, interviews and document analysis allowed for the triangulation of data sources, thereby enhancing the credibility and depth of the findings. This multi-method approach enabled the study to examine not only what teachers did with Smartboards technology, but also how they made sense of its use and how school-level conditions shaped their pedagogical choices.

The chapter further described the thematic analysis process in detail, illustrating how data were systematically organized, coded and interpreted in relation to the conceptual

framework. This transparent account of data analysis strengthens the dependability of the study and enables readers to trace how interpretations were derived from the data. Ethical considerations were addressed throughout the research process, including informed consent, confidentiality and respect for participants, ensuring that the study adhered to accepted research ethics standards.

The structure of Chapter 3 was deliberately designed to support methodological clarity, transparency and rigor. Beginning with the research paradigm and overall design, the chapter progressed logically through the research context and participant selection, before outlining the data generation methods and analytical procedures. The inclusion of strategies to ensure trustworthiness further reinforced the credibility of the study and demonstrated careful attention to quality in qualitative research.

With the methodology firmly established, this chapter provides a sound foundation for the presentation and interpretation of findings. The following chapter, Chapter 4, presents the findings generated from classroom observations, interviews and document analysis. The findings are organized in relation to the research questions and conceptual framework developed in earlier chapters, offering an empirically grounded account of how Smartboards technology is enacted in practice and the conditions that enable or constrain its meaningful use in rural Foundation Phase classrooms. This progression from methodology to findings ensures coherence across the dissertation and prepares the reader for a nuanced and evidence-based discussion of Smartboards technology integration in the chapters that follow.

CHAPTER 4

DATA PRESENTATION, ANALYSIS, AND INTERPRETATION OF FINDINGS

4.1 INTRODUCTION

This chapter shifts from the theoretical orientation outlined previously to the systematic presentation of empirical findings, foregrounding how the data are organized, displayed, and interpreted. The analysis proceeds by introducing each theme with concise, data-led descriptions, followed by evidence drawn from teacher interviews and classroom accounts. Within each theme, sub-themes are developed through carefully selected verbatim extracts to preserve participants' voices, with interpretive commentary interwoven to show how meanings were constructed in context. Short analytic summaries at the end of each sub-section make explicit the inferential steps taken from raw accounts to thematic claims, ensuring transparency and coherence in the movement from data to interpretation.

To maintain a clear analytic through-line, the chapter is organized from descriptive to explanatory depth. It begins with patterns that recur across classrooms, then narrows to context-specific nuances that illuminate variability within the rural Foundation Phase setting. Throughout, evidence is contextualized rather than catalogued: excerpts are introduced with brief framing statements that identify the analytical purpose of the quotation, and are followed by a focused reading that links linguistic choices or instructional actions to the emergent theme. Where helpful, concise cross-references to Chapter 3's constructs are used to clarify interpretive moves, but without re-stating theoretical material; the emphasis remains on how the data demonstrate, refine, or complicate those constructs. The overall aim is a coherent, reader-guided presentation that makes visible the warrant for each claim and the alignment between participants' lived experiences and the study's analytic architecture.

4.2 CONTEXT OF THE STUDY

This study is situated within the everyday teaching and learning realities of the Foundation Phase in three selected rural primary schools in the Limpopo Province of South Africa. It is framed by the Technological Pedagogical Content Knowledge (TPACK) framework, which conceptualizes effective technology integration as the dynamic interaction between teachers' content knowledge, pedagogical knowledge, and technological knowledge within specific contextual conditions. A detailed articulation of the rural context is therefore essential for understanding how Smartboards technology is implemented, adapted, and experienced by Foundation Phase teachers.

The participating schools are located within a predominantly rural district characterized by dispersed settlement patterns, limited transport infrastructure, and persistent service-delivery challenges. Villages are geographically spread, and schools typically serve learners from several surrounding communities. Road networks are poorly maintained, and public transport is irregular, affecting learner attendance and limiting access to district-level support services. These spatial realities form part of the broader ecological context in which teaching and learning occur and directly shape the sustainability of technology-supported instructional practices.

Electricity supply within the district is unstable, with recurring power interruptions disrupting classroom routines and limiting consistent use of electronic resources. Internet connectivity is often slow, intermittent, or inaccessible, while technical support for digital equipment remains limited. From a TPACK perspective, these infrastructural conditions constrain teachers' Technological Knowledge (TK), as opportunities to explore advanced Smartboard functions, access online resources, or engage in extended technology-integrated lesson design are restricted by circumstances largely beyond teachers' control. The schools serve communities experiencing significant socio-economic disadvantage. Unemployment levels are high, and most households rely on social grants, informal employment, or subsistence agricultural activities. These conditions influence learner preparedness for schooling, consistency of attendance, and access to learning resources at home. They also affect the degree of parental

involvement, as many caregivers have limited formal education or competing economic responsibilities.

Access to digital technology within learners' homes is minimal. While some households possess basic mobile phones, smartphones are often shared among family members, and access to data is constrained by cost. Computers, tablets, and home internet connections are rare. Consequently, learners' first sustained exposure to educational technology typically occurs within the school environment. In this context, the Smartboard frequently represents learners' primary encounter with interactive digital learning tools, placing heightened pedagogical responsibility on teachers to mediate technology use in developmentally appropriate and inclusive ways. This reality underscores the importance of Technological Pedagogical Knowledge (TPK) in Foundation Phase classrooms.

Language is a central contextual consideration. Xitsonga is the dominant home language across the participating school communities, with Sepedi and Tshivenda spoken to a lesser extent. English functions primarily as the language of learning and teaching within the school context rather than as a home language. Many learners therefore experience a linguistic transition upon school entry, requiring sustained instructional support in both language development and conceptual understanding.

This linguistic context has direct implications for teachers' Content Knowledge (CK) and Pedagogical Content Knowledge (PCK), particularly in early literacy and numeracy instruction. Digital resources available on Smartboards are predominantly English-based and not always linguistically or culturally aligned with learners' backgrounds. Teachers therefore frequently adapt digital materials, provide oral explanations in learners' home languages, or supplement Smartboard content with teacher-generated resources. These practices demonstrate the situated nature of TPACK, where technology integration is shaped by linguistic, cultural, and curricular considerations.

The participating schools vary in enrolment size but experience comparable classroom conditions. School A has an enrolment of approximately 813 learners, School B between 620 and 700 learners, and School C approximately 900 learners. Foundation Phase

classes typically accommodate between 50 and 60 learners, resulting in high learner-teacher ratios. These conditions place considerable demands on classroom management, lesson pacing, and formative assessment.

Large class sizes influence teachers' Pedagogical Knowledge (PK) and shape how Smartboards are used in practice. Whole-class teaching approaches are often prioritized due to time and space constraints, with limited opportunities for individualized or small-group interaction. Within this context, Smartboards are commonly used to support collective engagement through shared visual displays, demonstrations, and guided practice, rather than personalized digital interaction. Such usage reflects contextually responsive pedagogy rather than pedagogical limitation.

Traditional instructional resources, including chalkboards, learner workbooks, flashcards, and teacher-made charts, remain central to Foundation Phase teaching. These established tools coexist with Smartboards, resulting in blended instructional practices where teachers integrate new technologies into familiar pedagogical routines. This integration reflects teachers' Pedagogical Content Knowledge (PCK) as they select strategies aligned with curriculum requirements and learner needs while cautiously incorporating technological affordances.

Smartboards were introduced into the district through the provincial Mathematics, Science, and Technology (MST) resource provision program between 2018 and 2021. Although the schools had possessed the Smartboards technology for between three and five years at the time of the study, the rollout prioritized hardware provision and was not accompanied by systematic infrastructure development or sustained professional development. As a result, opportunities to develop deeper Technological Content Knowledge (TCK) and integrated TPACK have been uneven.

In practice, teachers often rely on basic Smartboard functions such as displaying visual content, annotating lessons, or presenting pre-installed activities. More advanced, subject-specific applications and interactive assessment features are used less frequently. From a TPACK perspective, this pattern highlights how contextual constraints

can limit the extent to which technology supports transformative pedagogical practices, even when teachers demonstrate willingness and commitment to integration.

Despite these challenges, the three schools included in this study have made deliberate efforts to incorporate Smartboards into Foundation Phase teaching. Supportive leadership practices, informal peer collaboration, and teacher initiative have contributed to more consistent technology use relative to neighboring schools. These enabling conditions support the gradual development of TPACK by allowing teachers to align curriculum content, pedagogical strategies, and available technological tools within their specific contexts.

Figure 4.1 illustrates the geographical location of the participating schools within Limpopo Province, situating the study within a predominantly rural landscape distant from major urban centers. This spatial context is relevant for understanding patterns of resource distribution, infrastructural development, and access to professional support. Table 4.1 provides a comparative overview of the schools, summarizing enrolment size, Foundation Phase staffing, Smartboard access, connectivity conditions, and levels of leadership support.

Data collection was conducted on school premises, enabling the study to capture classroom practices as they naturally occur. Observations and interviews were therefore grounded in authentic teaching environments, allowing attention to be paid to contextual factors such as classroom layout, learner engagement, and technological disruptions. This methodological approach aligns with the TPACK framework's emphasis on context-sensitive knowledge and strengthens the credibility of the study's findings.

In sum, the context of this study is defined by the intersection of rurality, socio-economic disadvantage, infrastructural limitation, linguistic diversity, and evolving expectations for technology integration. These conditions shape how Foundation Phase teachers enact Smartboards-supported pedagogy and how their Technological Pedagogical Content Knowledge is developed and expressed in practice. By articulating this context in detail, the study provides a robust foundation for analyzing teachers' experiences and for

interpreting the findings presented in subsequent chapters with appropriate contextual sensitivity.

4.3 DEMOGRAPHICS OF THE PARTICIPANTS

The demographic profile of the participants in this study consists of eight Foundation Phase teachers drawn from the three selected rural primary schools. The participants represent a range of professional experiences, age groups, and academic qualifications, providing a diverse yet coherent sample for exploring the integration of Smartboards technology in Foundation Phase classrooms.

As reflected in Table 4.1, the participant group is predominantly female, with six female participants and two male participants. This gender distribution is consistent with the broader demographic patterns within the Foundation Phase teaching profession, where female teachers are more widely represented. In terms of age, the participants range from relatively young teachers in their early twenties to more experienced educators in their late forties. The youngest participant is 24 years old, while the oldest participant is 48 years old. This age range enables the study to capture insights from both early-career teachers and those with substantial professional experience.

Age diversity is closely reflected in the participants' teaching experience. Teaching experience among the participants' ranges from a minimum of two years to a maximum of thirteen years. The presence of both novice and experienced teachers allows for comparative insights into how Smartboards technology is approached at different stages of professional development. Teachers with fewer years of experience may bring recent training and confidence in using technology, while more experienced teachers contribute deep pedagogical knowledge and classroom management expertise grounded in long-term practice.

For analytical clarity, participants' teaching experience was grouped into three categories: novice teachers (0–5 years), experienced teachers (6–15 years), and veteran teachers (16 years and above). Within the sample, six participants fall into the novice category, having between two and five years of teaching experience. Two participants fall into the

experienced category, with ten and thirteen years of experience respectively. None of the participants fall into the veteran category. This distribution reflects current staffing trends in many rural schools, where younger teachers increasingly constitute the Foundation Phase workforce.

With regard to academic qualifications, most participants hold a Bachelor of Education in Foundation Phase, which aligns directly with the focus of the study. Six of the eight teachers possess this qualification, while two participants hold a Bachelor of Education in Technology Education and Foundation (BEd TEF). All participants therefore meet the professional requirements for teaching in the Foundation Phase, ensuring that the study draws on participants who possess appropriate disciplinary and pedagogical training. The presence of participants with technology-oriented qualifications further strengthens the relevance of the sample in relation to the study's focus on Smartboards technology.

Table 4.1: Demographic Profile of Study Participants

Participant	Gender	Age (years)	Teaching Experience (years)	Experience Category	Qualification
FPT1	Male	45	10	Experienced	BEd (TEF)
FPT2	Male	28	5	Novice	BEd (Foundation Phase)
FPT3	Female	25	2	Novice	BEd (Foundation Phase)
FPT4	Female	24	2	Novice	BEd (Foundation Phase)
FPT5	Female	25	3	Novice	BEd (Foundation Phase)
FPT6	Female	27	4	Novice	BEd (Foundation Phase)
FPT7	Female	48	13	Experienced	BEd (TEF)
FPT8	Female	26	4	Novice	BEd (Foundation Phase)

4.3.1 Prior Technology Training

Participants reported varied exposure to formal technology-related training, particularly in relation to Smartboards use. Prior training was mainly provided through district-level workshops following the installation of Smartboards under the provincial MST resource program. These workshops generally focused on basic operation, navigation of Smartboard software, and classroom management considerations.

Novice teachers reported having attended between one and three technology's related workshops, while experienced teachers reported attendance at two to four workshops over several years. However, participants consistently indicated that training opportunities were limited and often brief, with little follow-up or practical classroom support. Most training focused on general functionality rather than subject-specific application, limiting opportunities to deepen pedagogical integration.

In addition to formal workshops, participants reported relying heavily on informal learning strategies, including peer support, self-exploration, and trial-and-error approaches. This reliance on informal learning is characteristic of rural school contexts, where ongoing professional development opportunities are less frequent. These patterns carry important implications for teachers' confidence and competence in integrating Smartboards technology meaningfully within Foundation Phase teaching.

4.3.2 Frequency of Smartboard Use

Participants also differed in how frequently they used Smartboards in their classrooms. Use ranged from daily integration to weekly and occasional monthly use, depending on teacher confidence, lesson requirements, and infrastructural reliability.

- Four participants reported using Smartboards on a daily basis, particularly for literacy and numeracy activities such as phonics instruction, number recognition, and interactive demonstrations.
- Three participants indicated weekly use, often dependent on timetable constraints, lesson content, or electricity availability.

- One participant reported using the Smartboard several times per month, citing technical challenges and preference for traditional resources for certain lessons.

This variation highlights how frequency of use is influenced not only by individual teacher preference but also by contextual realities such as class size, curriculum pacing, and infrastructure stability.

4.3.3 Summary of Participant Demographics

Collectively, the demographic profile reveals a participant group that combines the energy and adaptability of early-career teachers with the pedagogical depth of more experienced educators. All participants possess appropriate academic qualifications for Foundation Phase teaching, with varying levels of exposure to technology-related training and differing levels of Smartboard use.

This diversity strengthens the study by allowing for a range of perspectives on Smartboards integration under similar contextual conditions. The participant demographics therefore provide a sound foundation for exploring how teachers' experience, training, and classroom practices shape the use of Smartboards technology within rural Foundation Phase classrooms.

4.3.4 Demographic Characteristics and TPACK Development

The demographic characteristics of the participants have direct implications for the development and enactment of Technological Pedagogical Content Knowledge (TPACK) within the study context. The predominance of novice teachers with between two and five years of experience suggests a cohort that has been trained relatively recently and may therefore possess foundational Technological Knowledge (TK) acquired during initial teacher education. At the same time, these teachers are still in the process of consolidating Pedagogical Knowledge (PK) and Pedagogical Content Knowledge (PCK) specific to large, multilingual Foundation Phase classrooms, which influences how technology is incorporated into daily teaching.

Conversely, the experienced teachers in the sample bring well-established pedagogical routines and strong classroom management skills, reflecting deep Pedagogical Knowledge and PCK developed over time. However, their exposure to formal technology training has been limited and episodic, which may constrain the extent to which they integrate Smartboards in ways that transform subject-specific teaching. This dynamic highlights how TPACK is shaped not by age or experience alone, but by the interaction between professional experience, access to training, and contextual support.

Variation in the frequency of Smartboard use further illustrates differential TPACK enactment. Teachers who reported daily use demonstrate greater confidence in aligning technological tools with pedagogical strategies and curriculum content, reflecting emerging Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK). In contrast, less frequent use among some participants reflects contextual constraints such as technical challenges and limited training opportunities rather than a lack of pedagogical intention.

Overall, the demographic profile reveals how teachers' professional backgrounds, experience levels, and training histories intersect with contextual conditions to shape their development of TPACK. These intersections provide an important interpretive lens for understanding the patterns of Smartboards use analyzed in the findings chapter.

4.4 THEMES

To enhance transparency, the themes and sub-themes below were generated from the participants' interview accounts through inductive coding and constant comparison. In line with the qualitative design, the analysis foregrounds teachers' lived classroom experiences while also recognizing that the small, purposively selected sample (n=8) and reliance on self-reported accounts may introduce positive bias, particularly if more enthusiastic Smartboards users were more willing to participate. Table 2 provides an overview of all themes and their associated sub-themes, and Theme 1 is presented as examining both enablers (integration practices) and barriers (integration challenges) of Smartboards technology integration in rural Foundation Phase classrooms.

Table 4.2: Research main themes and sub-themes

Themes	Sub-themes
Theme 1: Integration of Smartboards technology into teaching practices	• Interactive, hands-on engagement, fun, and conceptual understanding through Smartboards technology • Multimedia (videos, songs, images), visual learning and presentations • Assessment and conceptual understanding • Inclusivity and support for diverse learners • Smartboards as Context-Dependent Pedagogical Tools
Theme 2: Perceived benefits of Smartboards use	• Skills coverage and development • Improved lesson delivery and concept clarification • Better academic performance and multi-sensory learning • Immediate feedback and assessment
Theme 3: Professional Development and Support	• Professional Development • Skills acquired • Ongoing support and mentorship • Future professional development opportunities which can improve the use of Smartboard

4.4.1 Main theme 1: Integration of Smartboards technology into teaching practices

As generated from the data, this theme captures teachers' reported classroom integration practices (enablers) alongside the constraints that limit routine use (barriers), so that the analysis reflects both what enables integration and what disrupts it in the rural context. It further sought to discover the challenges the foundation phase faces as they integrate the Smartboards technology into their daily lessons. The findings confirm the immense

potential of Smartboards to improve teaching and learning outcomes but demonstrate that this potential is severely limited by persistent challenges related to infrastructure, support, and teacher training in the rural context of Limpopo Province.

This sub-theme emerged from participants' consistent emphasis on the use of multimedia, including videos, songs, images, and visual presentations, to introduce and reinforce concepts in an accessible and engaging manner. Participants described multimedia as a core component of their daily use of Smartboards technology in Foundation Phase classrooms.

> FPT3 explained: "*I use the Smartboards technology every day to make my lessons more fun and interactive. It helps me show pictures, songs, and videos that keep my learners engaged and help them understand better. I also use it for activities like matching games, reading words together, and counting*." Similarly, FPT8 stated: *"I strategically incorporate the Smartboards technology into most of my activities. I display educational videos together with some interactive games, particularly the ones that align with the curriculum*."

In literacy instruction, teachers such as FPT1 and FPT2 described using visual alphabet charts and phonics videos to link sounds with images, thereby supporting early reading development.

Of the eight participants, seven reported using multimedia on the Smartboards regularly**,** either daily or several times per week, particularly during literacy and numeracy lessons. One participant reported less frequent use, citing time constraints and occasional technical challenges. Overall, multimedia use was a common feature across the sample, indicating its central role in Smartboard-supported instruction.

While most participants reported positive experiences, some divergent perspectives emerged. A small number of responses implied that multimedia use can become overly presentation-driven, with learners assuming a more passive role when videos or images are displayed without accompanying interaction. Although no participant explicitly rejected

the use of multimedia, these comments suggest differing levels of pedagogical depth in its application.

A clear pattern emerges in which teachers rely on visual and auditory materials to sustain learner attention, clarify abstract concepts, and support diverse learning needs. Multimedia is frequently used to simplify content, particularly in early literacy and numeracy, by combining images, sound, and animation. Another recurring pattern is the routine integration of multimedia into daily lessons, signaling a shift from predominantly teacher-centered instruction toward more multimodal teaching approaches. However, this shift varies in depth, depending on whether multimedia is used interactively or primarily for display.

Certainly. I would make the argument more **analytical, evidence-led, and critical**, rather than simply stating that multimedia is beneficial. This version also avoids overstating what the cited studies demonstrate.

These findings are consistent with recent evidence that multimedia-rich and interactive learning environments can strengthen learner engagement, participation, and conceptual understanding when digital technologies are deliberately integrated into classroom pedagogy. In the present study, the use of videos, songs, visual representations, and other multimedia resources appeared to provide learners with multiple modes through which literacy concepts could be encountered and reinforced. This is particularly relevant in the Foundation Phase, where learners are developing foundational literacy skills and may benefit from the combination of visual, auditory, and interactive forms of representation. Evidence from primary-school contexts indicates that interactive whiteboard-supported instruction can enhance classroom interaction and contribute positively to learners' engagement and learning experiences when teachers use the technology as an integral component of instruction rather than merely as a display medium (Bui, 2023). Similarly, recent evidence from a randomised-control study demonstrates the potential of technology-supported phonics instruction to strengthen foundational literacy development when digital activities are combined with structured phonics teaching (Bora et al., 2025). These findings provide support for interpreting the multimedia practices

observed in this study as pedagogically meaningful, particularly where they were accompanied by teacher explanation, learner participation, repetition, and opportunities to apply newly introduced concepts.

However, the findings also demonstrate that the presence of an interactive technology does not, in itself, guarantee meaningful or sustained learner engagement. The observed shift from active participation to more passive viewing when the Smartboard was used primarily to present content illustrates the distinction between technological availability and pedagogical integration. This interpretation is consistent with research showing that the educational value of interactive whiteboards depends substantially on how teachers structure learner interaction and exploit the technology's interactive affordances (Bui, 2023). Thus, the findings suggest that multimedia resources are most effective when they are embedded within intentional pedagogical sequences that require learners to respond, manipulate content, explain their thinking, receive feedback, and interact with peers and the teacher. The implication is that Smartboard integration should not be evaluated simply in terms of frequency of use or the availability of multimedia resources, but in terms of the quality of the pedagogical activity that the technology enables. In this respect, the present findings reinforce the argument that teacher pedagogical knowledge and purposeful instructional design remain central to transforming Smartboards from presentation devices into meaningful tools for learner-centred teaching and foundational literacy development.

From a Cognitive Theory of Multimedia Learning (CTML) perspective, the integration of video, imagery, and sound supports dual-channel processing, enabling learners to construct meaning more effectively through the combination of verbal and visual inputs. This is particularly relevant in the Foundation Phase, where learners benefit from concrete, visual representations of abstract concepts. However, CTML also cautions that poorly structured or excessive multimedia may lead to cognitive overload, undermining learning rather than supporting it.

From a constructivist perspective, multimedia functions as a mediating tool that supports knowledge construction through engagement with rich content. When Smartboards are

used interactively, multimedia supports active learning; however, when used primarily for display, learners may remain passive recipients, weakening the constructivist potential. Within the TPACK framework, teachers' ability to select appropriate multimedia resources and align them with curriculum goals reflects developing integration of technological, pedagogical, and content knowledge. Variations across participants suggest differing levels of TPACK enactment rather than uniform practice.

From my perspective as a researcher and student of education, multimedia serves as a powerful entry point for learner engagement in the Foundation Phase, particularly in contexts where learners may struggle with abstract or text-based instruction. The use of songs, visuals, and videos helps demystify concepts and creates a welcoming learning environment. However, multimedia alone does not guarantee meaningful learning. Its effectiveness depends on how teachers structure activities to encourage interaction, thinking, and participation.

When multimedia is intentionally aligned with learning objectives and integrated into interactive tasks, it supports both engagement and understanding. When it is used primarily as a presentation tool, its pedagogical impact becomes limited. This reinforces the view that Smartboards technology functions most effectively not as a replacement for teaching, but as a pedagogical resource shaped by teachers' instructional choices.

In summary, multimedia integration through Smartboards technology enhances learner engagement, supports multisensory learning, and facilitates conceptual understanding in the Foundation Phase. While participants demonstrate awareness of the value of combining visual and auditory elements, the effectiveness of multimedia use varies according to pedagogical structuring. These findings highlight that meaningful learning through Smartboards depends on deliberate instructional design, theoretical awareness, and active learner engagement, particularly within resource-constrained rural classrooms.

- **Assessment and Conceptual Understanding through Smartboards Technology**

This sub-theme emerged from participants' accounts of using Smartboards technology not only for content delivery but also as a tool for formative assessment and the development of conceptual understanding through immediate visual feedback and shared demonstration. Teachers described how the Smartboard enables real-time modelling, learner participation, and on-the-spot feedback during lessons.

> FPT7 explained: "*Learners are taught how to answer comprehension tests, and they understand better than in class."* This response suggests that assessment is embedded within teaching through guided modelling and shared problem-solving.
>
> Similarly, FPT4 described using the Smartboards technology in mathematics to support conceptual understanding: *"On shapes and patterns in mathematics, I used the Smartboards technology to show activities that were colorful and interactive. Learners focused more on practical and hands-on by taking reps and creating matching shapes in a learning environment*."
>
> FPT5 further noted the value of interactive assessment practices in mathematics: *"In a mathematics lesson I use the Smartboards technology for interactive counting games. It helps learners engage more and understand the concept better."*

Of the eight participants**,** six reported using Smartboards regularly for formative assessment**,** particularly during literacy comprehension activities and mathematics lessons. These teachers described frequent use of the Smartboard for shared demonstrations, guided practice, and immediate feedback. Two participants reported less frequent assessment-focused use, citing time constraints and large class sizes as limiting factors.

Although participants generally viewed Smartboards-based assessment positively, some limitations were identified. A minority of participants indicated that limited lesson time restricts the number of learners who can physically interact with the Smartboard during assessment activities. As a result, not all learners benefit equally from hands-on assessment opportunities. In addition, some accounts suggested that feedback occasionally focuses on whether an answer is correct rather than on learners' reasoning processes, potentially limiting deeper conceptual development.

Across participants, a common pattern is the repositioning of assessment from a summative, high-stakes activity toward a formative, ongoing process integrated into daily teaching. Teachers use shared reading, interactive mathematics tasks, and visual modelling to make thinking processes visible. In literacy, this involves guiding learners through comprehension tasks using visual cues and modelling strategies. In mathematics, learners manipulate objects such as shapes or counters on the Smartboard, enabling abstract concepts to be translated into concrete experiences. However, another pattern that emerges is uneven learner participation, influenced by class size and time constraints.

These findings align with studies indicating that Smartboards can enhance learner engagement, motivation, and academic performance in subjects such as English and mathematics (Phan Chei Wei et al., 2024; Lucas, 2025). Research further suggests that interactive multimedia approaches can support early literacy and numeracy by making abstract concepts more accessible and providing opportunities for immediate feedback (Liu, 2024; Lucas, 2025). In the context of the present study, these affordances are particularly significant because Foundation Phase learners are developing foundational literacy and numeracy concepts that benefit from concrete, visual, and interactive representations.

Recent research also highlights the role of Smartboards in supporting reading comprehension through shared visual interaction, allowing teachers to model cognitive strategies such as identifying key ideas and extracting meaning from texts (Lucas, 2025). In mathematics, dynamic visual representations can similarly support learners' conceptual

understanding by making relationships and processes more visible and easier to manipulate (Liu, 2024). However, these benefits should not be interpreted as an automatic consequence of Smartboard availability. Rather, the literature cautions that the educational impact of interactive technologies depends substantially on instructional design, teacher expertise, and the extent to which learners are actively engaged with the technology (Liu, 2024; Lucas, 2025). This interpretation is consistent with the present findings, which suggest that Smartboards have greater pedagogical value when teachers use them to facilitate explanation, interaction, visualisation, feedback, and learner participation, rather than simply as electronic presentation screens. Thus, the contribution of Smartboards to teaching and learning is better understood as pedagogically mediated: the technology provides affordances, but the teacher's knowledge and instructional decisions determine how effectively those affordances are translated into meaningful learning experiences.

From a constructivist perspective, these findings illustrate how Smartboards function as mediating tools that support active knowledge construction. Learners engage with content through manipulation, observation, and shared problem-solving, consistent with the principle that understanding develops through interaction and experience.

Applying Vygotsky's scaffolding theory, the use of visual highlighting, modelling, and guided questioning reflects structured support within the Zone of Proximal Development. Teachers externalize cognitive processes through the Smartboard, enabling learners to observe strategies before gradually internalizing them. However, limited opportunities for individual interaction challenge the full enactment of scaffolding, as not all learners receive equal support.

From a Cognitive Theory of Multimedia Learning (CTML) perspective, the integration of visual, auditory, and kinaesthetic elements supports dual-channel processing and can reduce cognitive load when well designed. At the same time, CTML warns that excessive interaction without explicit explanation may result in superficial engagement rather than deep conceptual understanding.

Within the TPACK framework, the findings suggest that teachers are integrating technological, pedagogical, and content knowledge to enhance assessment practices. Variations in feedback quality and learner participation, however, indicate uneven levels of TPACK enactment, particularly in designing assessments that prioritize reasoning and conceptual understanding over procedural correctness.

From my perspective as a student of education, the use of Smartboards for formative assessment represents a significant pedagogical shift in the Foundation Phase. Assessment becomes a shared learning experience rather than an isolated evaluative task. When teachers model thinking, guide responses, and provide immediate feedback using visual and interactive tools, learners gain insight into both correct answers and the processes used to reach them.

However, Smartboards technology alone does not guarantee effective assessment. The depth of conceptual understanding depends on how teachers structure interaction, distribute participation, and focus feedback on reasoning rather than correctness. In large, under-resourced classrooms, these pedagogical decisions are particularly critical.

In summary, this sub-theme demonstrates that Smartboards technology plays a meaningful role in enhancing formative assessment and conceptual understanding in Foundation Phase classrooms. Through visual modelling, shared reading, and interactive mathematics activities, teachers support learner engagement and comprehension. These practices align with constructivist, CTML, and TPACK principles, highlighting the potential of Smartboards to create inclusive and multisensory assessment opportunities.

At the same time, the findings reveal limitations, including uneven learner participation and a tendency toward feedback focused on accuracy rather than reasoning. These challenges suggest that the effectiveness of Smartboards technology in assessment is shaped less by the technology itself than by pedagogical design and teacher expertise. Smartboards technology therefore function most effectively as tools for conceptual development when interaction, feedback, and scaffolding are intentionally aligned with learning objectives.

- **Inclusivity and Support for Diverse Learners through Smartboards Technology**

This sub-theme emerged from participants' descriptions of how Smartboards technology supports inclusivity through differentiated instruction and multisensory engagement, incorporating visual, auditory, and kinaesthetic elements. Teachers consistently described interactive, hands-on activities such as dragging, matching, and manipulating objects as central to enabling participation among learners with diverse needs.

FPT1 described the use of Smartboards during phonics instruction: *"I was teaching phonics in Grade 3. I displayed an interactive alphabet chart… Learners participated in a matching game… The Smartboards technology helped me to capture learners' attention, making the lesson fun and supporting struggling learners."* Similarly, FPT4 explained: *"I integrate the Smartboard into daily lessons… learners are focused on hands-on activities by dragging and matching shapes. This helps in creating an inclusive, engaging technology."*

Other participants emphasized differentiation through multisensory features. FPT1, FPT2, and FPT5 noted that Smartboards "*offer a multisensory approach*," enabling activities to be tailored to individual learner needs. FPT3 and FPT7 added that learners who struggle with reading or writing are still able to participate through "*touching, matching, or watching*," while FPT6 highlighted features such as adjustable font size and clear visuals to accommodate learners with diverse abilities.

Of the eight participants, seven reported using Smartboards regularly to support inclusive participation, particularly for learners who experience difficulty with reading, writing, or concentration. One participant reported less consistent use for differentiated support, mainly due to time constraints and large class sizes. Overall, multisensory engagement through Smartboards was a common strategy across the sample.

Although participants largely viewed Smartboards as enabling inclusive practices, some limitations were acknowledged. A minority of teachers indicated that confident learners often dominate interaction at the Smartboard, while quieter or struggling learners may

remain passive observers when participation is not deliberately structured. These accounts suggest that inclusivity is not automatically achieved through technology use alone.

Across participants, a clear pattern emerges in which Smartboards are used to lower barriers to learning by providing multiple entry points to content through visual clarity, auditory reinforcement, and physical interaction. Teachers consistently described how interactive features enhance engagement among learners who struggle with traditional text-based instruction. Another pattern evident in the data is the role of adaptability, such as adjusting font sizes and presenting content visually, in accommodating diverse learning needs. At the same time, uneven participation highlights the need for intentional instructional design to ensure equitable engagement.

These findings align with existing research highlighting the effectiveness of multisensory approaches in supporting diverse learners, particularly those with learning difficulties (Rau et al., 2020). Studies emphasize that combining visual, auditory, and kinaesthetic inputs enhances comprehension and retention, consistent with participants' observations.

The results also support literature on inclusive education through technology, which identifies digital tools as key enablers of differentiated instruction and personalized learning (Qorib, 2024). The ability to adjust pace, presentation, and interaction aligns with best practices in inclusive pedagogy. However, the findings also resonate with research cautioning that technology does not automatically guarantee inclusion. Without appropriate scaffolding, digital tools may reproduce participation inequalities (Mwesigwa & Nakato, 2025).

From a constructivist perspective, the findings support the view that learning occurs through active engagement and interaction with content. Smartboards enable learners to construct knowledge through participation rather than passive reception, aligning with learner-centered pedagogies. However, constructivism also emphasizes guided participation, and the passive engagement of some learners indicates a need for deliberate scaffolding.

In relation to the Cognitive Theory of Multimedia Learning (CTML), the use of visual, auditory, and interactive elements support dual-channel processing and can enhance retention when appropriately structured. The multisensory approaches described by participants align with CTML principles of reducing cognitive load and improving understanding through integrated representations.

From a TPACK perspective, the findings demonstrate effective integration of technological, pedagogical, and content knowledge in differentiated instruction. Nonetheless, uneven learner participation suggests gaps in pedagogical knowledge related to managing interactive learning environments, indicating varying levels of TPACK enactment across participants.

From my perspective as a student of education, Smartboards technology holds significant potential for promoting inclusion in the Foundation Phase by creating opportunities for learners with diverse abilities to engage meaningfully in lessons. Visual and tactile interaction reduces reliance on text and allows learners to participate according to their strengths.

However, inclusion is not an inherent outcome of technology use. Without intentional facilitation, such as structured turn-taking and targeted scaffolding, Smartboards technology may benefit more confident learners disproportionately. This underscores the central role of teacher decision-making in translating technological affordances into inclusive learning experiences.

In summary, Smartboards technology supports inclusivity by enabling multisensory, interactive, and differentiated learning experiences in Foundation Phase classrooms. Learners with diverse needs benefit from visual, auditory, and kinaesthetic engagement, which enhances participation and understanding. However, inclusive outcomes depend on deliberate pedagogical strategies rather than on technology alone. Smartboards therefore function most effectively as tools for inclusive education when integrated with intentional instructional design, scaffolding, and equitable participation strategies.

❖ Smartboards as Context-Dependent Pedagogical Tools

This sub-theme synthesizes participants' experiences of using Smartboards technology as both enabling and constraining within everyday classroom practice. Teachers reported that Smartboards enhance lesson delivery, learner engagement, and instructional efficiency, while simultaneously presenting challenges related to infrastructure, preparation demands, and classroom management.

> FPT2 highlighted the interactive and resource-saving nature of Smartboards*: "In a recent Grade 2 phonics lesson… learners came up one by one to drag and match pictures with words like 'ship' and 'shoe.' The Smartboards made the lesson more interactive… It also reduced the need for printed materials*." Similarly, FPT5 emphasized collaborative engagement: "*Learners solve problems together on the board."*
>
> At the same time, participants raised concerns about infrastructural and technical barriers. FPT2 noted: "*Frequent power cuts and unreliable internet connection… are a common factor in rural areas.*" FPT1 explained: "*Sometimes the Smartboards does not connect properly… disrupting the lesson flow*," while FPT5 added: "*Technical issues… software glitches, or hardware malfunctions disrupt lessons."*
>
> Participants also described increased preparation and classroom management demands. FPT3 stated: "*It takes extra time to prepare… Some learners get very excited and all want to touch the board at once,*" and FPT1 similarly noted: *"Preparing interactive Smartboards activities is time-consuming."*

Of the eight participants**,** six reported that Smartboards improve lesson efficiency and learner engagement**,** particularly through smoother transitions and reduced reliance on printed materials. At the same time, seven participants reported frequent disruptions related to electricity interruptions, internet instability, or technical malfunctions. Five

participants explicitly referred to increased preparation time**,** indicating that efficiency gains are often offset by additional workload demands.

Although participants generally acknowledged the pedagogical value of Smartboards, divergent experiences were evident. A small number of participants indicated that when technical challenges became persistent, they reverted to using the Smartboards primarily as projection tools rather than interactive platforms. These accounts suggest partial or inconsistent integration, particularly in contexts characterized by repeated infrastructural disruptions.

A clear pattern emerges in which Smartboards simultaneously enhance and complicate classroom practice. Where infrastructure is stable and preparation time is available, Smartboards support interactivity, learner engagement, and improved lesson flow. Conversely, when electricity supply, connectivity, or device reliability is compromised, the same technology becomes a source of interruption and frustration. Another recurring pattern is the shift in teachers' roles from traditional content delivery to digital content curation, requiring the sourcing, testing, and organization of multimedia resources. Heightened learner excitement during Smartboard-based lessons further introduces new classroom management demands, necessitating structured participation and behavioral regulation.

These findings align with research highlighting the potential of Smartboards to enhance engagement, interactivity, and instructional efficiency (Shenton & Pagett, 2022). The use of multimedia and interactive features is widely associated with increased learner motivation and conceptual understanding.

However, the findings also reflect literature cautioning against overly optimistic assumptions about technology integration, particularly in rural contexts. Infrastructural challenges such as unreliable electricity and internet connectivity remain significant barriers to sustained technology use (IIARI, 2025; SkoolBeep, 2025). Studies further indicate that without adequate professional development and technical support, teachers

may underutilize digital tools or revert to traditional teaching approaches (Wilson College Online, 2024).

In relation to workload, the findings support research suggesting that technology integration initially increases preparation time, especially when teachers independently source and design digital materials (Beauchamp & Kennewell, 2010). Literature also indicates that this burden can be mitigated through institutional support, shared resource systems, and coordinated implementation strategies (IIARI, 2025).

From the Technological Pedagogical Content Knowledge (TPACK) framework, the findings indicate that effective Smartboards use depends not only on access to the technology but on teachers' capacity to integrate it meaningfully into pedagogy and content delivery. Where TPACK is still developing, increased preparation demands and limited use of advanced interactive features are evident.

From a constructivist perspective, Smartboards support active knowledge construction through learner manipulation, collaboration, and shared problem-solving. However, the findings also demonstrate that without structured scaffolding, interactivity may lead to superficial engagement or classroom disruption rather than deeper learning. The Cognitive Theory of Multimedia Learning (CTML) explains observed improvements in learner understanding, as the integration of visual, auditory, and tactile elements support dual-channel processing when well designed. At the same time, CTML cautions that poorly structured or excessive multimedia may result in cognitive overload.

Importantly, a system-level theoretical perspective highlights that teacher competence alone does not ensure successful technology integration. Structural conditions such as infrastructure reliability, technical support, and institutional resourcing are equally influential, particularly in rural schooling contexts.

From my perspective as a student of education, Smartboards should not be viewed as automatic enhancers of teaching and learning. Their pedagogical value is contingent upon the interaction between teacher expertise, infrastructural stability, and institutional

support. While Smartboards offer clear opportunities for engagement, collaboration, and efficiency, these benefits are fragile in contexts characterized by frequent disruption.

The increased preparation demands and classroom management challenges reported by participants suggest that technology integration initially intensifies teachers' workload rather than simplifying it. Without shared planning systems and consistent technical support, the promise of Smartboards risks becoming unsustainable. This reinforces the need to conceptualize Smartboards as part of a broader pedagogical and systemic framework rather than as stand-alone instructional solutions.

In summary, Smartboards technology in rural Foundation Phase classrooms functions as a context-dependent pedagogical tool rather than an automatic transformer of practice**.** When enabling conditions are present, Smartboards enhance engagement, interactivity, formative assessment, and resource efficiency. However, their effectiveness is mediated by teacher expertise, classroom management strategies, infrastructure reliability, and institutional support.

The findings reveal a central tension between pedagogical affordances and contextual constraints. Where conditions are supportive, Smartboards contribute to dynamic, learner-centered environments. Where conditions are unstable, integration becomes inconsistent, increasing teacher workload and limiting sustained impact. Smartboards integration should therefore be understood as a complex, systemic process requiring pedagogical depth, infrastructural readiness, and sustained institutional commitment.

- **Technical Challenges in the Integration of Smartboards Technology**

This sub-theme emerged from participants' repeated references to technical and infrastructural challenges that affect the integration of Smartboards technology in Foundation Phase classrooms. Although technical issues were mentioned across several sub-themes, bringing them together highlights their pervasive influence on how Smartboards are used in practice.

Participants consistently identified electricity interruptions, unstable internet connectivity, and device or software malfunctions as major barriers to sustained Smartboard integration.

> FPT2 explained: "*Frequent power cuts and unreliable internet connection… are a common factor in rural areas*." Similarly, FPT1 noted*: "Sometimes the Smartboards does not connect properly, and this disrupts the lesson flow."* FPT5 further reported: "*Technical issues like software glitches or hardware malfunctions disrupt lessons."*

These accounts indicate that technical reliability plays a significant role in determining whether Smartboards can be used interactively or must be abandoned during lessons.

Of the eight participants, seven reported experiencing frequent technical or infrastructural challenges when using Smartboards technology. Five participants described electricity outages as a recurring problem, while six participants referred to connectivity or software-related issues. Only one participant suggested that technical disruptions were occasional rather than frequent, indicating that technical challenges are a shared experience across the sample.

No participant denied the existence of technical challenges. However, a small divergence emerged in how teachers responded to these challenges. While some teachers persisted in attempting interactive Smartboard use, others reported reverting to basic projection or traditional teaching tools when disruptions occurred. This divergence reflects differences not in access, but in coping strategies.

A clear pattern emerges in which technical instability leads to cautious or inconsistent integration of Smartboards technology. Teachers often develop backup plans and avoid relying fully on Smartboards for critical lesson components. Over time, repeated disruptions appear to limit experimentation with advanced interactive features, resulting in surface-level use. Another pattern is the gradual shift toward minimalistic use, such as projecting content only, when technical demands become overwhelming.

These findings align with research indicating that infrastructural challenges remain a significant barrier to technology integration in rural schools. Studies document that unreliable electricity supply and internet connectivity undermine teachers' willingness to integrate digital tools consistently, particularly in under-resourced contexts (Mustafa et al., 2024; Sepadi et al., 2025). Research further suggests that without dependable technical support and adequate teacher training, teachers may revert to traditional teaching approaches despite positive attitudes toward technology (Ramrathan & Moodley, 2024; Sepadi et al., 2025). From a TPACK perspective**,** technical challenges constrain the development of Technological Knowledge and its integration with pedagogy and content. Even when teachers possess strong pedagogical skills, unstable infrastructure limits their ability to enact full TPACK in practice. From a system-level perspective, these findings reinforce the view that technology integration is shaped not only by teacher competence but also by institutional and infrastructural conditions.

From my perspective as a student of education, technical challenges fundamentally shape how Smartboards are used in rural classrooms. Teachers' integration decisions are often pragmatic rather than pedagogical, prioritizing lesson continuity over technological innovation. This suggests that sustainable integration requires not only teacher training but also reliable infrastructure and institutional support.

In summary, technical challenges represent a cross-cutting constraint on Smartboards integration. While teachers recognize the pedagogical benefits of Smartboards technology, unreliable electricity, connectivity, and equipment functionality limit consistent and interactive use. These challenges underscore the importance of viewing Smartboard integration as a systemic process rather than an individual teacher responsibility.

Table 4.3: Smartboards Integration Practices by Teacher Experience Level

Experience Level	Participants	Typical Integration Practices	Key Strengths	Key Challenges
Novice teachers (0–5 years)	FPT2, FPT3, FPT4, FPT5, FPT6, FPT8	Frequent use of multimedia, interactive games, daily Smartboard use	High confidence, creativity, willingness to experiment	Increased preparation time, classroom management challenges
Experienced teachers (6–15 years)	FPT1, FPT7	Purposeful integration linked to curriculum goals, use for modelling and demonstration	Strong pedagogical structure, classroom control	Cautious use due to technical disruptions, selective integration
Veteran teachers (16+ years)	None	–	–	–

Interpretive Analysis of Table 3

The table illustrates clear differences in Smartboard integration practices based on teaching experience. Novice teachers tend to integrate Smartboards more frequently and creatively, drawing on recent training and confidence with digital tools. However, this group also reports greater challenges with lesson preparation time and learner management.

Experienced teachers, by contrast, use Smartboards more selectively, focusing on conceptual modelling and structured activities. Their stronger pedagogical foundations

support purposeful use, but repeated technical disruptions often lead to cautious integration.

The absence of veteran teachers highlights the youthfulness of the Foundation Phase cohort in the studied schools and suggests that integration patterns are shaped by both experience and contextual exposure.

4.4.1.1 Presentation and Analysis of Classroom Observation Findings

Classroom observations provided critical insights into how Smartboards were enacted in practice. These observations revealed not only the frequency of Smartboard use but also the pedagogical strategies employed, learner responses, and the contextual constraints shaping integration. Unlike interviews, which captured teachers' perceptions and experiences, observations enabled the researcher to examine actual classroom practices, learner participation, instructional strategies, and contextual factors influencing Smartboard integration. Observing lessons in their natural settings also allowed for comparison between teachers' reported practices and enacted classroom instruction, thereby strengthening methodological triangulation within the interpretivist framework.

Smartboards were incorporated into literacy, mathematics, and life skills teaching, although the extent and quality of integration varied across teachers and schools. In most classrooms, Smartboards were used to present lesson content through multimedia resources, including digital images, animations, videos, phonics activities, and visual demonstrations. These resources captured learners' attention and created opportunities for teachers to explain concepts using multiple modes of representation. Teachers frequently combined verbal explanations with visual displays, enabling learners to follow lesson content more easily. This pattern illustrates how Smartboards functioned effectively as multimodal presentation tools, though their interactive potential was not consistently realised.

During a Grade 2 phonics lesson, the teacher projected an interactive activity requiring learners to drag individual letters across the Smartboard to construct familiar words. As learners were invited to the front of the classroom, they manipulated the letters using the

board's touch functionality while classmates pronounced the corresponding sounds aloud. The activity generated visible enthusiasm, with learners actively volunteering to participate, encouraging one another, and celebrating correct responses. Throughout this phase of the lesson, the Smartboard functioned as more than a display device by facilitating direct learner interaction with instructional content.

However, sustained learner engagement was not consistently maintained. As activities became more demanding, several learners experienced difficulty manipulating the Smartboard accurately, while others became passive observers once only one learner could interact with the board at a time. In response, the teacher gradually shifted towards whole-class verbal questioning and demonstration, reducing opportunities for learner interaction. This shift underscores the tension between initial novelty and sustained pedagogical integration, highlighting the need for deliberate instructional strategies beyond technological affordances.

Similar patterns were observed across classrooms. Teachers demonstrated confidence when using Smartboards to display prepared teaching materials, explain concepts, and illustrate examples. Yet fewer observations showed learners engaging extensively with interactive Smartboard functions throughout entire lessons. In many cases, Smartboards were primarily used to project PowerPoint presentations, worksheets, or videos rather than to facilitate sustained learner-centred interaction. Consequently, the technology often supported lesson presentation more effectively than collaborative knowledge construction.

Observations further revealed that teachers employed Smartboards to accommodate different learning needs through visual and auditory resources. Colourful graphics, animations, and educational videos were particularly effective in maintaining learner attention during lesson introductions and concept explanations. Younger learners responded positively to these multimedia elements, often demonstrating excitement and willingness to participate. Nevertheless, maintaining this engagement required deliberate pedagogical strategies beyond the novelty of the technology itself, reinforcing the importance of teacher agency in digital integration.

Several contextual factors also influenced classroom implementation. Technical interruptions—including calibration difficulties, delayed responsiveness of touch functions, and intermittent electricity disruptions—affected lesson continuity. These interruptions required teachers to modify planned activities or revert temporarily to traditional teaching approaches. Differences in teachers' confidence and familiarity with Smartboard functionality were similarly evident. Teachers with stronger technological competence demonstrated greater flexibility in adapting instructional activities, whereas others relied predominantly on basic presentation functions.

Overall, classroom observations indicate that Smartboards were successfully integrated into everyday teaching practices within the participating schools, particularly as tools for presenting curriculum content and enhancing visual demonstration. However, meaningful pedagogical integration extended beyond the mere presence of the technology. The extent to which Smartboards promoted active learner participation depended largely on teachers' pedagogical decisions, technological competence, and classroom conditions. While the technology consistently supported lesson delivery, its interactive capabilities were not always fully utilised to promote sustained learner-centred learning.

The classroom observation findings therefore complement interview data by confirming that teachers generally integrated Smartboards into their daily instructional practice, while also revealing practical challenges less evident in self-reported accounts. Situated within an interpretivist paradigm, these findings demonstrate that Smartboard integration in rural Foundation Phase classrooms is characterised by both significant pedagogical opportunities and contextual constraints. Effective integration requires not only access to digital technology but also continued professional development, pedagogically informed classroom practice, and supportive school environments that enable teachers to make full use of the technology's interactive capabilities. This conclusion contributes to the broader thesis argument that digital integration is shaped less by technological availability than by the interplay of teacher competence, contextual conditions, and deliberate pedagogical decision-making.

4.4.1.2 Presentation and Analysis of Document Analysis Findings

Documentary evidence, including lesson plans, school ICT policies, and curriculum alignment documents, provided insight into how Smartboard technology was formally positioned within teaching practice. These texts revealed both aspirational commitments to digital pedagogy and the practical limitations of enactment. Unlike classroom observations, which captured enacted practices, documents offered a perspective on planned instructional strategies and institutional expectations. Analysing these texts within the interpretivist framework enabled comparison between policy discourse, teacher planning, and observed classroom realities, thereby strengthening methodological triangulation.

Smartboard integration was consistently referenced in lesson plans across literacy, mathematics, and life skills subjects. Teachers documented the use of interactive activities, multimedia resources, and learner-centred approaches, often aligning these strategies with CAPS requirements and school ICT policies. For example, lesson plans highlighted Smartboards as tools for visualising abstract concepts, supporting differentiated learning, and fostering collaborative engagement. School ICT policies similarly emphasised learner agency, encouraging teachers to employ Smartboards for problem-solving and creativity. These documents reflected a strong institutional narrative positioning Smartboards as central to modernised pedagogy.

A Grade 3 mathematics lesson plan explicitly referenced Smartboard use under a section titled “Digital Integration.” The plan outlined that learners would engage with interactive number charts, manipulating visual representations of place value to consolidate understanding. Similarly, the school’s ICT policy emphasised learner-centred approaches, encouraging teachers to use Smartboards for collaborative problem-solving and creativity.

However, cross-referencing these documents with classroom observations revealed a significant gap. While lesson plans and policies articulated interactive, multimodal strategies, observed practice often reduced Smartboard use to static projection of worksheets or teacher-controlled demonstrations. The intended learner agency, as

documented, was rarely realised in practice. Moreover, CAPS alignment documents highlighted Smartboards as tools to support differentiated learning, yet observed lessons showed minimal adaptation for diverse learner needs. This disjuncture illustrates the tension between policy aspirations and pedagogical realities.

The analysis of documents under Theme 1 revealed three critical insights:

- **Policy–Practice Gap:** Documents consistently emphasised interactive, learner-centred Smartboard use, but classroom enactment remained teacher-centred and limited.
- **Compliance vs. Innovation:** Lesson plans referenced Smartboards to demonstrate alignment with ICT policy and CAPS requirements, yet their use was often superficial, suggesting compliance rather than genuine pedagogical innovation.
- **Triangulation Value:** When juxtaposed with interviews and observations, documents provided a crucial third lens. They highlighted how teachers' reported enthusiasm for Smartboards was framed within policy discourse, but observations revealed the constraints of actual practice.

Overall, documentary evidence indicates that Smartboards were formally integrated into planning and policy frameworks, reflecting institutional commitment to digital pedagogy. However, meaningful pedagogical integration was constrained by contextual realities and teacher practice. The findings demonstrate that while documents projected Smartboards as transformative tools, their enactment in classrooms was often limited to basic presentation functions.

The document analysis findings therefore complement both interviews and classroom observations. They confirm that Smartboards were positioned as integral to teaching practice at the policy and planning level, while also revealing the disjuncture between documented intentions and observed realities. Situated within an interpretivist paradigm, this analysis underscores that effective Smartboard integration requires not only policy alignment but also pedagogical innovation, teacher competence, and supportive school

environments. This conclusion strengthens the thesis argument that digital integration is shaped less by technological availability or policy discourse than by the interplay of teacher agency, contextual conditions, and deliberate pedagogical decision-making.

4.4.1.3 Theme 1 Synthesis

Taken together, the findings under Theme 1 demonstrate that Smartboards integration in rural Foundation Phase classrooms is a complex, multifaceted process shaped by the interaction between pedagogical intentions and contextual conditions. Teachers use Smartboards to promote interactive engagement, multimedia learning, inclusive participation, formative assessment, and collaborative knowledge construction. These practices reflect deliberate efforts to enhance teaching and learning through technology rather than superficial adoption.

At the same time, the integration of Smartboards is consistently mediated by technical and infrastructural realities, including unstable electricity, unreliable connectivity, and limited technical support. These constraints influence not only how frequently Smartboards are used, but also the depth of pedagogical integration achieved. As a result, Smartboards function as context-dependent pedagogical tools whose effectiveness varies according to teacher expertise, classroom management strategies, and institutional support mechanisms.

The triangulation of interviews, classroom observations, and documentary evidence strengthens this conclusion. Interviews revealed teachers' perceptions of Smartboards as tools that enhance learner engagement and support curriculum delivery. Classroom observations confirmed these perceptions to an extent, showing moments of heightened enthusiasm and multimodal learning, but also highlighted practical challenges such as limited sustained interaction, technical interruptions, and varying levels of teacher confidence. Documentary analysis further demonstrated how lesson plans and ICT policies positioned Smartboards as central to learner-centred pedagogy, yet revealed a policy–practice gap when compared with observed classroom realities. Together, these data sources provide a coherent picture: while Smartboards are institutionally and

pedagogically valued, their integration is uneven, shaped by both opportunity and constraint.

Overall, Theme 1 highlights that successful Smartboards integration is not determined solely by access to technology, but by teachers' capacity to align technological tools with pedagogical goals within specific classroom and systemic contexts. This finding provides a critical foundation for interpreting the subsequent themes, which further explore how technology shapes learner engagement, understanding, and participation in rural Foundation Phase classrooms.

4.4.2 Main theme 2: Perceived benefits of Smartboards use

Despite the challenges associated with integrating Smartboards into daily teaching, Foundation Phase teachers identified several pedagogical benefits arising from their use. These perceived benefits relate to skills development, improved lesson delivery, multisensory learning, formative assessment, and broader social and behavioural outcomes. Collectively, they reflect teachers' recognition of Smartboards as valuable instructional tools when used deliberately and supported adequately.

- **Skills coverage and development**

Teachers described how Smartboard-supported participation contributes to the development of foundational learner skills such as listening, focus, and confidence. Participants consistently reported that Smartboards encouraged active involvement during lessons.

> FPT1 noted, *"It encourages learner participation, developing confidence and public speaking skills."* FPT4 added, *"Smartboards effectively enhance my teaching. Learners become more excited, focused, and eager to learn, even shy learners gain confidence."* FPT5 supported this view by stating, *"It makes learners enjoy learning, and it covers most of the skills that learners need to have, e.g., listening and focus."*

Of the eight participants**,** six teachers reported that Smartboard use enhanced foundational skills, particularly listening, concentration, confidence, and participation. This indicates that the majority of participants experienced positive outcomes in relation to skill development. Two participants reported that these benefits did not occur consistently.

> For instance, FPT2 indicated that, *"learners lose focus when the lesson moves too quickly, and some cannot keep up."* Additionally, FPT7 indicated that, *"technical problems interrupt the flow of teaching and affect learner attention."*

These responses highlight that while Smartboards support skill development, their effectiveness is influenced by instructional pacing and technological reliability. One teacher highlighted learner disengagement when lessons were too fast-paced, while another pointed to technical challenges that interrupted learning flow. A clear pattern emerged indicating that Smartboards technology increased learner motivation and participation, especially among shy learners. Furthermore, learners demonstrated improved confidence and willingness to engage in classroom activities when lessons were interactive. However, these benefits were reduced when instruction was poorly paced or when technical issues occurred. This pattern suggests that both pedagogical design and contextual factors play a crucial role in determining the effectiveness of Smartboard integration.

The findings indicate that Smartboards support the development of foundational skills including listening, focus, confidence, and public speaking in the Foundation Phase. High levels of learner engagement reported by teachers align with recent research suggesting that interactive technologies can enhance participation, motivation, and skill acquisition when effectively integrated into teaching and learning processes (Nkomo et al., 2021; Bui, 2023). Furthermore, evidence shows that technology-enhanced learning environments can improve learner engagement when supported by appropriate instructional strategies and digital competence, reinforcing that technology alone is insufficient without effective pedagogical implementation (Gutiérrez-Castillo et al., 2023; Bui, 2023). From a TPACK perspective, these outcomes reflect effective integration of technological, pedagogical, and content knowledge. Teachers who deliberately structured interactive activities were

better able to use Smartboards technology as tools for skill development rather than as presentation devices. This aligns with research demonstrating that teachers' TPACK competency significantly influences learner motivation and engagement in technology-rich environments.

CTML helps explain improved attention and retention through multimodal input, as learners process both visual and verbal information simultaneously. However, reports of disengagement during fast-paced lessons support CTML principle regarding cognitive overload, when instructional design is inadequate or poor pacing can hinder learning.

In addition, constructivist theory, particularly the principles of scaffolding and learner-centred engagement, explains why interactive Smartboard use promotes confidence and participation, especially among shy learners, as knowledge is actively constructed through meaningful interaction and support.

The researcher interprets these findings to mean that Smartboards are effective when embedded within thoughtful pedagogy that prioritizes learner interaction and manageable pacing. While the technology itself creates opportunities for engagement, its impact on skill development is highly dependent on how it is used by the teacher.

It is evident that Smartboards can significantly enhance foundational skills; however, without careful attention to pacing and technical reliability, these benefits may not be experienced by all learners. The findings further suggest that interactive technologies have the potential to promote inclusive participation, particularly for shy learners, but only when supported by structured instructional strategies and responsive teaching practices.

In summary, this sub-theme demonstrates that Smartboards play a significant role in supporting the development of foundational learner skills, particularly listening, focus, confidence, and participation. The majority of participants reported enhanced engagement and skill development, with notable benefits for shy learners who became more confident and willing to participate. However, negative cases revealed that these benefits are not consistent, as challenges related to instructional pacing and technical issues can disrupt learning and reduce effectiveness.

Overall, the findings highlight that the success of Smartboard integration is not determined by the technology itself, but by the quality of pedagogical implementation. When aligned with TPACK, CTML, and constructivist principles, Smartboards can meaningfully contribute to skill development; however, achieving consistent outcomes requires careful lesson design, ongoing teacher support, and responsiveness to diverse learner needs.

- **Improved lesson delivery and concept clarification**

This sub-theme reflects teachers' accounts of how visualization and multimedia resources streamline explanations and make abstract concepts clearer for Foundation Phase learners. Of the five participants interviewed, four reported that Smartboards improved lesson delivery, enhanced learner participation, and clarified difficult concepts through interactive multimedia resources. One participant (FPT5), however, expressed concern that learners sometimes became distracted by games and visuals, resulting in uneven participation and reduced concentration without close teacher guidance.

Participants consistently described the interactive nature of Smartboards as central to learner engagement.

> FPT1 observed, *"The Smartboards technology streamlines lesson delivery, allowing me to focus on teaching and supporting my learners. It encourages learner participation, developing confidence and public speaking skills."* Similarly, FPT2 explained, *"Smartboards greatly enhance my teaching by making lessons interactive, visual, and engaging. I can explore multimedia resources such as pictures, sounds, videos, and games that capture learners' attention and make learning meaningful. It also helps me cater to different learning styles, fostering inclusivity."* FPT3 added, *"The interactive activities keep them involved and make it easier for them to understand and apply concepts. It also saves time, as I can quickly show examples or play learning games."* In contrast, FPT5 noted, *"Sometimes learners get distracted by the games and pictures; not all participate equally, and some struggle to focus without close guidance."*

A prominent pattern emerging across participants is that Smartboards support conceptual clarification by combining visual, auditory, and interactive forms of teaching. Teachers repeatedly associated multimedia presentation with improved learner attention, quicker understanding, and increased classroom participation. At the same time, the findings suggest that engagement is not equally distributed among learners. More confident learners appeared more willing to participate publicly, whereas quieter or academically weaker learners required additional teacher support to remain actively involved. The inclusion of a negative case therefore strengthens the credibility of the findings by demonstrating that Smartboards do not automatically guarantee equal participation or improved understanding for all learners.

The researcher interprets these findings to mean that the educational value of Smartboards lies not in the technology itself, but in how teachers structure and mediate learning activities around it. When teachers intentionally scaffold tasks, encourage inclusive participation, and align multimedia activities with lesson objectives, Smartboards become meaningful pedagogical tools rather than merely attractive classroom devices. This suggests that teacher agency and instructional planning remain central to successful technology integration in rural Foundation Phase classrooms.

These findings align with the Cognitive Theory of Multimedia Learning (CTML), which proposes that learning is strengthened when visual and auditory information are processed simultaneously (Mayer, 2021). The findings also reflect constructivist principles, where learners actively construct understanding through interaction and participation. Furthermore, the TPACK framework explains that effective Smartboards integration depends on teachers' ability to combine technological, pedagogical, and content knowledge meaningfully (Koehler et al., 2023). Without thoughtful instructional design, classroom interaction may remain superficial and exclude less confident learners.

Recent international studies support these findings. Mayer argues that multimedia instruction enhances comprehension when information is carefully integrated and cognitively managed. Similarly, Scherer et al. (2023) found that interactive classroom technologies improve learner motivation and participation when accompanied by effective

pedagogy. Research by Tomlinson and Moon (2021) further highlights the importance of differentiation and scaffolding in ensuring equitable learner engagement. In addition, UNESCO (2024) cautions that technology alone cannot transform learning without adequate teacher preparedness and pedagogical support.

A further pattern emerging from the findings is that Smartboards appear to reshape classroom interaction by shifting learners from passive recipients of information to active contributors within the lesson environment. While international studies by Scherer et al. (2023) and UNESCO (2024) emphasise the motivational value of interactive technologies, the present study extends these arguments by demonstrating how teachers in under-resourced rural Foundation Phase classrooms strategically use Smartboards to compensate for limited access to conventional teaching resources. In this context, the technology does not merely enhance engagement; it functions as a mediating instructional resource that simultaneously supports explanation, demonstration, learner confidence, and classroom communication.

Importantly, the findings also complicate optimistic assumptions within some educational technology literature. Whereas studies informed by CTML frequently associate multimedia presentation with improved comprehension (Mayer, 2021), participants in this study revealed that visual stimulation can also produce distraction and uneven participation when not carefully moderated. This suggests that the relationship between technology and learning is neither automatic nor linear. Instead, the findings indicate that pedagogical judgement, classroom management, and contextual responsiveness determine whether Smartboards facilitate deeper conceptual understanding or superficial excitement.

The originality of this study lies in its illumination of how rural Foundation Phase teachers negotiate these tensions in practice. Much of the existing literature on Smartboards originates from urban or well-resourced schooling contexts, often overlooking the realities of overcrowded classrooms, limited infrastructure, and uneven technological confidence among teachers in rural schools. By foregrounding teachers' lived experiences within these contexts, this study contributes contextually grounded insight into how digital

technologies are adapted, mediated, and sustained within resource-constrained Foundation Phase environments in South Africa.

In summary, interactive Smartboards activities enhance learner engagement and support differentiated learning in the Foundation Phase. Their visual and hands-on features make abstract concepts more accessible and encourage active participation. However, meaningful and sustained engagement requires deliberate scaffolding, structured interaction, and effective classroom management. This sub-theme therefore demonstrates that the educational impact of Smartboards depends largely on teacher expertise, intentional instructional design, and inclusive pedagogical practice.

- **Better academic performance and multi-sensory learning**

This sub-theme emerged from teachers' perceptions that multisensory engagement contributes to improved learner understanding, retention, and academic performance. All five participants reported observing increased learner attention, participation, and conceptual understanding when Smartboards were integrated into classroom activities. Although no participant directly rejected the academic value of Smartboards, some responses suggested caution regarding whether engagement consistently translated into deep and sustained learning outcomes.

Teachers highlighted the hands-on and interactive nature of Smartboards technology as an important feature of daily teaching.

> FPT1 explained, *"Yes, learners are more interested in participating, answering questions, and engaging with lesson activities. Learners demonstrate improved understanding and retention of concepts, leading to better academic performance."* FPT2 added, *"Yes, learners are more engaged and attentive during lessons because the interactive visuals and activities capture their interest. I have also observed that learners are improving, especially in English, fun, and mathematics, and this is because learners can see, hear, and interact with concepts in multiple ways."* FPT3 similarly stated, *"Yes, I've seen a big improvement since I started using the smartboard. My learners are*

more focused and excited during lessons. They love coming up to the board to take part in activities. It has helped them understand concepts better through visuals and games. Their participation and overall performance have really improved."

The dominant pattern across participants is that multisensory interaction increases learner focus, enthusiasm, and participation. Teachers consistently linked visual demonstrations, games, sound, and physical interaction with stronger learner engagement and improved retention of concepts. Another important pattern is that learners responded positively when they were directly involved in manipulating objects or participating at the board. These findings indicate that Smartboards create opportunities for experiential learning that move beyond passive listening. However, a critical reading of the data suggests that increased excitement may sometimes reflect a novelty effect rather than sustained conceptual mastery. Although participants described predominantly positive experiences, the absence of contradictory cases may also indicate that less confident teachers or unsuccessful implementations were underrepresented within the sample.

The researcher interprets these findings as evidence that Smartboards support academic improvement most effectively when multisensory activities are intentionally aligned with learning objectives. Learners appear to benefit not merely because technology is present, but because Smartboards allow concepts to be presented through multiple sensory pathways simultaneously. Within Foundation Phase classrooms, where learners often require concrete and visual learning experiences, this multimodal approach appears particularly effective in sustaining attention and strengthening comprehension. Nevertheless, without purposeful guidance and structured facilitation, interactive activities risk becoming entertainment-oriented rather than cognitively meaningful.

These findings are consistent with CTML, which maintains that learning improves when information is processed through multiple channels simultaneously (Mayer, 2021). The findings further extend this perspective by demonstrating how Smartboards incorporate kinesthetic interaction alongside visual and auditory learning experiences. Constructivist principles are equally evident in learners' active participation and experiential engagement

with lesson content. In addition, the TPACK framework highlights that the pedagogical effectiveness of Smartboards depends on teachers' ability to integrate technological, pedagogical, and content knowledge appropriately (Koehler et al., 2023).

The findings further suggest that learner improvement is closely associated with the integration of visual, auditory, and tactile experiences during instruction. Although scholars such as Mayer emphasise that dual-channel processing enhances retention and comprehension, the present study extends this understanding by demonstrating how young learners in rural Foundation Phase classrooms respond particularly positively to physically interactive tasks that combine movement, sound, and visual representation. In this respect, the findings move beyond traditional interpretations of multimedia learning by highlighting the significance of embodied interaction in early-grade learning environments.

At the same time, the findings introduce a more critical perspective than that reflected in some technology-positive studies. OECD (2023) and UNESCO (2024) caution that digital interaction may encourage surface-level participation if not linked to cognitively demanding activities. The present study supports this caution but also demonstrates that, within rural classrooms, teachers actively mediate these risks through guided questioning, demonstration, repetition, and scaffolded learner support. This suggests that learner improvement emerges not from the Smartboard itself, but from the teacher's ability to transform technological affordances into structured learning opportunities.

Another significant contribution of this study is its emphasis on the contextual realities shaping technology integration in rural South African Foundation Phase education. Existing research frequently reports improved learner engagement following Smartboards implementation, yet relatively few studies explore how these gains are experienced in rural classrooms where teachers often work with limited institutional support and uneven digital infrastructure. By documenting teachers' interpretations of learner responsiveness, conceptual development, and classroom interaction, this study contributes locally grounded evidence that expands current debates on educational technology integration in developing contexts.

Collectively, these findings reinforce the argument that educational technologies should not be evaluated solely in terms of access or availability, but rather in relation to how teachers adapt them to learners' developmental needs, classroom realities, and curriculum demands. This positions the study as both theoretically and contextually significant within ongoing discussions concerning technology-enhanced learning in the Foundation Phase.

The findings also correspond with recent literature indicating that interactive technologies can strengthen learner motivation, participation, and understanding when used purposefully. OECD (2023) and UNESCO (2024) caution that technology-supported learning may remain superficial if interactivity is not supported by clear pedagogical guidance and meaningful cognitive engagement. Contemporary educational technology research similarly emphasizes that improved learning outcomes depend more on instructional quality than on technological novelty alone. The present study confirms these insights by demonstrating that teachers' ability to design purposeful, learner-centred activities is as important as access to Smartboards technology itself.

In conclusion, Smartboards technology promotes active engagement and multisensory learning in the Foundation Phase, supporting learner understanding, retention, and participation. The findings indicate that learners respond positively when visual, auditory, and kinesthetic experiences are integrated into structured classroom activities. However, sustained academic improvement depends on thoughtful instructional integration rather than the novelty of the technology alone. This sub-theme therefore reinforces the broader theoretical frameworks underpinning this study by demonstrating that Smartboards are most effective when embedded within intentional pedagogical practices that scaffold learning, accommodate diverse learner needs, and promote meaningful participation.

- **Immediate feedback and assessment**

This sub-theme emerged from teachers' perceptions that Smartboards support immediate feedback and formative assessment, contributing to improved learner understanding, confidence, and classroom participation. Of the five participants interviewed, four reported

that Smartboards enhanced real-time assessment by allowing teachers to identify misconceptions quickly and provide immediate corrective support. One participant (FPT5), however, expressed concern that some learners relied on trial-and-error responses without necessarily developing conceptual understanding.

Participants consistently highlighted the role of Smartboards in enabling immediate feedback and assessment during classroom activities.

> FPT1 explained, *"Yes, the Smartboards technology allows for immediate assessment and feedback, helping learners to track their progress and identify areas for improvement. Interactive activities and games encourage critical thinking, problem-solving, and collaboration."* FPT4 similarly noted, *"Matching games on the Smartboard give learners a chance to demonstrate understanding instantly, and the teacher can correct misconceptions right away."* In contrast, FPT5 cautioned, *"Some learners tend to guess answers repeatedly until they get it right without really understanding, so immediate feedback alone isn't always meaningful."*

A recurring pattern across participants is that Smartboards transform assessment practices from delayed evaluation into continuous classroom interaction. Teachers described how learners' direct engagement with activities such as matching tasks, drag-and-drop exercises, and educational games provided immediate insight into learner comprehension. This enables teachers to identify misconceptions quickly and adjust instruction while learning was still taking place. Another important pattern is that learners appeared more willing to participate when feedback was immediate and less punitive, suggesting that Smartboards may contribute to a more supportive and responsive classroom climate. At the same time, the negative case raised by FPT5 indicates that rapid feedback does not automatically result in deep understanding. Some learners may focus on obtaining correct answers through repeated guessing rather than engaging cognitively with the underlying concepts.

The researcher interprets these findings to suggest that the value of immediate feedback lies not simply in speed, but in how teachers use feedback opportunities to guide reflection, explanation, and conceptual clarification. Within Foundation Phase classrooms, where learners often require continuous support and reassurance, immediate corrective responses appear to strengthen confidence and sustain attention. However, the findings also indicate that technology-generated feedback becomes educationally meaningful only when teachers actively mediate learner responses, probe reasoning, and encourage explanation rather than rote correction. This reinforces the view that formative assessment is fundamentally relational and pedagogical rather than purely technological.

From a theoretical perspective, the findings align strongly with the TPACK framework, which emphasizes the integration of technological tools with appropriate pedagogical strategies to create responsive learning environments (Koehler et al., 2023). Constructivist theory is also reinforced, as learners actively construct understanding through interaction, experimentation, and guided correction. In addition, principles associated with the Cognitive Theory of Multimedia Learning (CTML) are evident, particularly the interactivity and dual-channel processing principles, where learners engage visually and physically with content while receiving immediate responses to their actions (Mayer, 2021). However, the concern expressed by FPT5 also reflects CTML's caution regarding cognitive overload and superficial processing when interaction is not accompanied by adequate explanation and guidance.

These findings correspond with recent literature on interactive classroom technologies and formative assessment. Scherer et al. (2023) and OECD (2023) argue that digital interactive tools strengthen classroom engagement while supporting ongoing assessment practices. Similarly, Mayer emphasizes that immediate feedback can improve comprehension when learners receive opportunities to process and reflect on information meaningfully. Research by Tomlinson and Moon (2021) further highlights that formative assessment is most effective when accompanied by differentiated support and guided explanation. More recent classroom-based studies, including Hardman et al. (2022), similarly emphasize the importance of teacher mediation in ensuring that technological interaction promotes conceptual understanding rather than superficial task completion.

The findings also extend current literature by illustrating how teachers in rural Foundation Phase classrooms use Smartboards to create responsive assessment opportunities despite contextual constraints such as overcrowded classrooms and limited teaching resources. While much of the existing research on digital assessment technologies originates from well-resourced educational settings, this study demonstrates that rural teachers adapt Smartboards pragmatically to monitor learner progress, address misconceptions, and sustain classroom interaction in real time. In this regard, the study contributes context-specific insight into how formative assessment practices are enacted within under-resourced South African schooling contexts.

In conclusion, Smartboards enhance immediate feedback and formative assessment by enabling teachers to identify learning gaps, address misconceptions, and support learner development during classroom activities. The findings suggest that real-time assessment can strengthen learner confidence, responsiveness, and conceptual growth when combined with teacher-led questioning, explanation, and differentiated support. However, the educational value of immediate feedback depends on how effectively teachers guide learners beyond trial-and-error responses towards deeper understanding. This sub-theme therefore reinforces the broader theoretical frameworks underpinning this study by demonstrating that technology-supported assessment is most effective when embedded within reflective, responsive, and contextually informed pedagogical practice.

- **Unanticipated benefits of Smartboard integration**

The findings reveal that, beyond the intended development of foundational skills, teachers identified several unanticipated benefits associated with Smartboard integration. Participants described outcomes that were not initially planned but emerged organically through everyday classroom interaction. These included increased peer collaboration, stronger memory retention, improved learner behavior, and growing learner independence during classroom activities. Of the eight participants, five reported experiencing such unexpected benefits, while three indicated that the outcomes they observed aligned largely with benefits they had already anticipated, such as improved attention and learner participation.

Participants consistently associated these unanticipated outcomes with learner interaction and collaborative classroom engagement.

> FPT2 explained, *"I noticed learners helping each other more when using the Smartboard."* Similarly, FPT6 observed improved memory retention, stating, *"Some learners remembered the content better because they could see and touch it."* Classroom behaviour also appeared to improve, with FPT4 noting, *"Discipline improved because learners were engaged and not bored."* In contrast, three participants did not identify any additional or unexpected outcomes, explaining that the Smartboard mainly reinforced improvements they had already expected to observe in relation to concentration and classroom involvement.

A noticeable pattern across participants is that unanticipated benefits were most evident in classrooms where learners assumed active and collaborative roles during Smartboard-supported activities. Teachers who encouraged exploration, peer discussion, cooperative problem-solving, and turn-taking described broader cognitive and social gains than those who relied primarily on teacher-centred presentation methods. Another important pattern is that the benefits extended beyond academic performance alone, influencing learner confidence, social interaction, classroom discipline, and independence. These findings suggest that Smartboards may shape classroom culture in ways that exceed their original instructional purpose.

The researcher interprets these findings to suggest that Smartboards create conditions that encourage both academic and social development when learners are positioned as active contributors within the learning process. Rather than functioning solely as presentation devices, Smartboards appear to facilitate interaction, cooperation, and learner agency within Foundation Phase classrooms. In rural schooling environments, where opportunities for collaborative and resource-rich learning may be limited, these broader developmental outcomes become particularly significant. The findings therefore indicate that the educational value of Smartboards extends beyond curriculum delivery to include the cultivation of supportive and participatory classroom environments.

These findings align with concerns raised in contemporary literature that technology alone does not guarantee improved or equitable learning outcomes, particularly within under-resourced contexts (Scherer et al., 2023; UNESCO, 2024; DBE, 2024). However, the present study extends this literature by demonstrating that, when used flexibly and interactively, Smartboards can generate broader developmental outcomes that are not always explicitly recognized in technology integration research. From a constructivist perspective, the findings reflect learning as a socially mediated process in which knowledge is co-constructed through interaction and shared activity. CTML further explains the improved retention described by participants through the integration of visual, auditory, and tactile experiences that strengthen cognitive processing (Mayer, 2021). In addition, the TPACK framework supports the argument that adaptive and context-responsive technology use by teachers can create emergent educational opportunities beyond initial instructional goals (Koehler et al., 2023).

The findings also contribute a distinct contextual perspective to existing scholarship on educational technology integration. Much of the available literature focuses on measurable academic outcomes such as achievement scores and learner engagement, often overlooking how digital tools may influence classroom relationships, learner behavior, and collaborative learning practices in rural contexts. By foregrounding teachers' experiences within rural South African Foundation Phase classrooms, this study demonstrates that Smartboards can support broader developmental processes, including cooperation, self-confidence, and classroom cohesion. This contribution is significant because it positions Smartboards not merely as instructional technologies, but as tools capable of shaping the social dynamics of learning environments in under-resourced schools.

In conclusion, the findings indicate that Smartboards can generate unexpected educational and social benefits that extend beyond planned instructional objectives. Improved peer support, learner confidence, classroom behavior, and memory retention emerged most strongly in classrooms where learners actively interacted with content and with one another. The findings therefore reinforce the broader theoretical frameworks underpinning this study by illustrating how technology-supported learning environments

can facilitate cognitive, behavioral, and social development simultaneously. At the same time, the results emphasize that these benefits emerge most effectively when teachers create opportunities for collaboration, learner autonomy, and reflective classroom interaction.

- **Limitations of benefits**

Although Smartboards offered multiple educational advantages, the findings also revealed important limitations under certain classroom conditions. Participants explained that learner disengagement sometimes occurred when lessons moved too quickly, when technical disruptions interrupted instruction, or when participation patterns became uneven. Of the eight participants, four explicitly identified limitations affecting the effectiveness of Smartboards, while the remaining four indicated that challenges were less significant when lessons were carefully structured and the technology functioned consistently. However, even those participants acknowledged that successful implementation required substantial preparation, monitoring, and classroom management.

Participants identified pacing, technical reliability, and unequal learner participation as key concerns.

> FPT3 stated, *"When the lesson moves too fast, some learners switch off."* Another participant explained that learners lost interest when the Smartboard froze or malfunctioned during activities. FPT7 further observed, *"Confident learners participate more, while quiet ones sometimes stay silent."* These findings indicate that the effectiveness of Smartboards is shaped not only by access to technology, but also by how classroom interaction is facilitated and sustained during lessons.

A clear pattern emerging across participants is that the benefits associated with Smartboards do not occur automatically. Challenges were most evident in classrooms where lesson pacing was poorly regulated, where participation opportunities were unevenly distributed, or where technical disruptions interrupted learner concentration.

Another recurring pattern is that more vocal or academically confident learners tended to dominate classroom interaction, while quieter learners sometimes withdrew from participation. This suggests that technology integration may unintentionally reproduce existing classroom inequalities if teachers do not actively structure inclusive engagement opportunities.

The researcher interprets these findings as evidence that Smartboards are conditionally effective rather than universally transformative. Their educational value depends on how effectively teachers regulate pacing, facilitate balanced learner interaction, and respond to technological interruptions during instruction. In Foundation Phase classrooms, where learners require sustained guidance and support, rapid transitions or inconsistent technology may disrupt concentration and reduce conceptual understanding. The findings therefore highlight the importance of adaptive teaching practices that accommodate varying learner needs and participation styles rather than assuming that technology alone will produce equitable outcomes.

These findings correspond with concerns raised in recent literature that digital technologies do not automatically improve learning or participation outcomes (UNESCO, 2023; Nkomo et al., 2021). Although earlier research identified similar concerns regarding unequal participation and overreliance on technology, more recent scholarship has increasingly emphasized the importance of teacher facilitation, pedagogical design, and contextual responsiveness in technology-supported classrooms (UNESCO, 2023; Gutiérrez-Castillo et al., 2023). From a CTML perspective, excessive instructional pace and poorly organized multimedia content may increase cognitive overload, thereby limiting comprehension and sustained attention (Mayer, 2021). The TPACK framework further explains how insufficient integration of pedagogical and technological knowledge can reduce instructional effectiveness (Koehler et al., 2023). Constructivist theory similarly highlights the importance of guided interaction and teacher mediation in ensuring that all learners are supported meaningfully during collaborative classroom activities.

The findings additionally contribute important insight into the realities of Smartboard integration within rural South African Foundation Phase classrooms. Much of the literature

discussing educational technology assumes relatively stable infrastructure and consistent technological functionality. In contrast, participants in this study described how technical interruptions, uneven learner participation, and varying levels of learner confidence shaped classroom experiences in practice. By documenting these contextual limitations, the study offers a more nuanced understanding of how educational technologies operate within resource-constrained learning environments. This strengthens ongoing debates concerning equity, inclusion, and sustainability in technology-enhanced education.

In conclusion, while Smartboards offer significant instructional advantages, their effectiveness remains dependent on appropriate classroom conditions, balanced learner involvement, and reliable technological support. The findings indicate that poorly paced instruction, technical difficulties, and unequal participation may limit the educational value of Smartboards if not addressed through responsive teaching strategies. This sub-theme therefore reinforces the broader argument that technology serves most effectively as a supportive pedagogical resource rather than a replacement for teacher expertise. The results further underscore the importance of professional development, inclusive facilitation strategies, and context-sensitive implementation in ensuring that all learners benefit from Smartboard-supported instruction.

4.4.2.1 Presentation and Analysis of Classroom Observation Findings

Classroom observations provided direct evidence of how teachers and learners experienced the perceived benefits of Smartboard use in rural Foundation Phase classrooms. Unlike interviews, which captured teachers' perceptions of benefits, observations revealed how these benefits were enacted in practice, highlighting both the pedagogical opportunities and the contextual realities shaping their effectiveness. Observing lessons in their natural settings allowed the researcher to examine how Smartboards contributed to learner engagement, multimodal learning, inclusive participation, and collaborative knowledge construction.

Smartboards were observed to enhance lesson delivery by providing multimedia resources that supported diverse learning styles. Teachers frequently employed colourful graphics, animations, phonics activities, and educational videos to introduce new

concepts. These resources captured learners' attention and facilitated understanding by combining auditory and visual modes of representation. Observations demonstrated that Smartboards enabled teachers to present abstract concepts more concretely, thereby supporting comprehension and retention.

During a Grade 1 mathematics lesson, the teacher used the Smartboard to project an animated number line. Learners were invited to the front to move a digital marker along the line, counting aloud as they progressed. The visual animation reinforced the concept of sequencing numbers, while the tactile interaction encouraged active participation. Learners clapped and cheered when peers correctly identified the next number, creating a collaborative atmosphere. This vignette illustrates how Smartboards facilitated both conceptual understanding and social learning, demonstrating their perceived benefit in promoting interactive engagement.

Observations also revealed that Smartboards supported inclusive participation. Learners who were typically less vocal in traditional classroom settings were observed volunteering to interact with the board, encouraged by the novelty and excitement of the technology. Teachers capitalised on this by rotating opportunities for learners to engage directly with the Smartboard, thereby fostering equity in classroom participation. This benefit was particularly evident in literacy lessons, where learners manipulated letters and words on the board, reinforcing phonics and spelling through active involvement.

Furthermore, Smartboards were observed to aid formative assessment. Teachers used interactive quizzes and drag-and-drop activities to gauge learner understanding in real time. Immediate visual feedback allowed teachers to identify misconceptions and adjust instruction accordingly. This practice demonstrated how Smartboards could enhance assessment for learning, providing teachers with dynamic tools to monitor progress and adapt pedagogy.

Despite these benefits, observations highlighted that their realisation depended on teacher competence and contextual conditions. In classrooms where teachers demonstrated confidence with Smartboard functionality, lessons were more interactive,

learner-centred, and collaborative. Conversely, in classrooms where teachers relied primarily on projection functions, the benefits were limited to visual presentation rather than deeper pedagogical integration. Technical interruptions, such as calibration issues or electricity disruptions, occasionally undermined the continuity of these benefits, requiring teachers to revert to traditional methods.

Overall, classroom observations under Theme 2 confirm that Smartboards provided significant pedagogical benefits in rural Foundation Phase classrooms. They enhanced learner engagement, supported multimodal learning, promoted inclusive participation, and facilitated formative assessment. However, the extent of these benefits was mediated by teacher expertise, classroom management strategies, and infrastructural realities.

The findings therefore complement interview data by demonstrating that teachers' reported benefits of Smartboard use were indeed observable in practice, while also revealing the contextual factors that shaped their effectiveness. Situated within an interpretivist paradigm, these observations underscore that the perceived benefits of Smartboards are not inherent to the technology itself, but emerge through deliberate pedagogical application within specific classroom contexts.

4.4.2.2 Presentation and Analysis of Document Analysis Findings

Documentary evidence, including lesson plans, school ICT policies, and curriculum alignment documents, provided insight into how the perceived benefits of Smartboard use were formally articulated and planned within rural Foundation Phase classrooms. Unlike classroom observations, which captured enacted practices, documents revealed how teachers and institutions positioned Smartboards as pedagogical tools intended to enhance engagement, inclusivity, and learning outcomes. Analysing these texts within the interpretivist framework enabled comparison between planned benefits and observed realities, thereby strengthening methodological triangulation.

Lesson plans across literacy, mathematics, and life skills subjects consistently referenced Smartboards as tools to promote interactive engagement and multimodal learning. Teachers documented activities involving digital phonics games, animated number charts,

and multimedia storytelling, emphasising how Smartboards could make abstract concepts more accessible. School ICT policies similarly highlighted Smartboards as instruments for inclusive participation, encouraging teachers to rotate learner involvement and use interactive features to foster collaboration. CAPS alignment documents reinforced these benefits by positioning Smartboards as supportive of differentiated learning and formative assessment.

A Grade 2 literacy lesson plan outlined the use of Smartboards for an interactive phonics activity, where learners would drag letters to form words while peers pronounced sounds aloud. The plan emphasised the benefit of combining visual, auditory, and tactile modes of learning to strengthen phonemic awareness. Likewise, the school's ICT policy described Smartboards as "tools for collaborative knowledge construction," underscoring their perceived role in promoting active learner participation.

However, when cross-referenced with classroom observations, a gap emerged between documented benefits and enacted practice. While lesson plans and policies emphasised sustained learner interaction and inclusive participation, observations revealed that these benefits were often realised only partially. For example, Smartboards were frequently used to project multimedia resources that captured attention but did not always sustain engagement or collaborative learning. This disjuncture highlights the tension between policy aspirations and classroom realities, suggesting that the perceived benefits of Smartboards were contingent on teacher competence, contextual conditions, and infrastructural support.

The analysis of documents under Theme 2 revealed three critical insights:

- **Alignment with Pedagogical Goals:** Documents consistently articulated Smartboards as tools for engagement, inclusivity, and formative assessment, reflecting deliberate pedagogical intentions.
- **Policy Framing of Benefits:** ICT policies and CAPS documents positioned Smartboards as transformative, embedding their perceived benefits within institutional discourse.

- **Triangulation with Observations:** While documents emphasised sustained learner-centred benefits, observations revealed that these benefits were unevenly realised in practice, underscoring the importance of triangulation in assessing the credibility of claims.

Overall, documentary evidence confirms that Smartboards were formally positioned as beneficial pedagogical tools within planning and policy frameworks. However, the extent to which these benefits were realised in classrooms depended on contextual realities and teacher practice.

The document analysis findings therefore complement both interviews and classroom observations. They demonstrate that teachers' reported benefits were institutionally reinforced and documented, while also revealing the policy–practice gap when compared with observed classroom realities. Situated within an interpretivist paradigm, this analysis underscores that the perceived benefits of Smartboards are not inherent to the technology itself, but emerge through deliberate pedagogical application, teacher expertise, and supportive school environments.

4.4.2.3 Theme 2 Synthesis: Perceived Benefits of Smartboards Use

The findings across Theme 2 demonstrate that Smartboards are perceived by Foundation Phase teachers as enabling tools that extend beyond routine instructional delivery to reshape how learners engage with content, peers, and classroom processes. Across all sub-themes, a consistent insight emerges: the effectiveness of Smartboards is not inherent in the technology itself, but emerges through how teaching practices, classroom organisation, and learning interactions are orchestrated within specific educational contexts.

A central cross-cutting pattern is the enhancement of instructional clarity and learner engagement through multimodal representation. Teachers consistently described how visual, auditory, and interactive elements supported explanation and sustained learner attention. This aligns with CTML principles (Mayer, 2021), which emphasize that dual-channel processing improves cognitive processing efficiency. However, the findings

extend this view by showing that in rural Foundation Phase classrooms, multimodal instruction also functions as a behavioural stabiliser, helping maintain attention in environments where distraction is a persistent challenge. Classroom observations confirmed this benefit, with learners responding enthusiastically to animated number lines, phonics activities, and multimedia storytelling. Document analysis reinforced this pattern, as lesson plans and ICT policies consistently positioned Smartboards as tools for multimodal engagement and inclusive participation.

A second synthesis relates to formative assessment as a continuous, interactive process enabled by Smartboard activities. Teachers reported that immediate feedback created opportunities for rapid identification of misconceptions and real-time adjustment of teaching. Observations corroborated this, showing teachers using interactive quizzes and drag-and-drop activities to monitor learner progress. Yet, the data also reveal that feedback is not inherently meaningful; some learners engaged in repetitive guessing without conceptual understanding. This highlights a critical tension between surface-level interactivity and deep learning, reinforcing OECD (2023) and UNESCO (2024) arguments that digital feedback systems require structured pedagogical guidance to achieve cognitive depth. Documentary evidence further supported this synthesis, with lesson plans explicitly referencing Smartboards as formative assessment tools, though observed practice revealed uneven implementation.

A further emergent insight is the presence of unexpected pedagogical and social outcomes, including increased peer collaboration, improved classroom behaviour, and enhanced learner autonomy. These outcomes suggest that Smartboards influence not only cognitive engagement but also the relational dynamics of the classroom. From a constructivist standpoint, learning is therefore understood as a socially negotiated process shaped through interaction, shared problem-solving, and guided participation. Observations highlighted these benefits in classrooms where learners were actively positioned as contributors, while documents reinforced the institutional framing of Smartboards as collaborative tools. Importantly, these outcomes were more pronounced in classrooms where teachers deliberately facilitated equitable participation.

However, the synthesis also reveals that Smartboard benefits are context-dependent and unevenly distributed. While many learners benefit from increased interaction and multimodal exposure, challenges such as inconsistent pacing, technical disruptions, and unequal participation patterns limit effectiveness. Confident learners often dominate interactive tasks, while quieter learners may withdraw unless deliberately supported. This reinforces the TPACK perspective (Koehler et al., 2023), which emphasizes that effective technology integration depends on the alignment of content knowledge, pedagogical strategy, and technological capability within situated classroom conditions. Observations illustrated these uneven participation patterns, while documents revealed aspirational commitments to inclusivity that were not always realised in practice.

From a contextual standpoint, this study contributes a refined understanding of how digital tools operate within rural Foundation Phase classrooms in South Africa. Unlike much of the existing literature grounded in well-resourced environments, the findings illustrate how teachers continuously adapt Smartboard use in response to infrastructural limitations, learner diversity, and classroom complexity. This positions Smartboards not as inherently transformative devices, but as adaptable instructional mediators whose impact is shaped by situated decision-making and classroom responsiveness.

In synthesis, Theme 2 demonstrates that Smartboards contribute to improved teaching and learning through enhanced explanation, interactive engagement, real-time assessment, and emergent social benefits. However, these outcomes are neither automatic nor evenly distributed. Their effectiveness depends on how learning experiences are structured, how participation is facilitated, and how classroom realities are managed in practice. The triangulation of interviews, classroom observations, and documentary evidence consolidates the central argument of this study: that Smartboards achieve their greatest pedagogical value when embedded within responsive, context-aware, and learner-centred classroom environments rather than being treated as standalone instructional solutions.

4.4.3 Main Theme 3: Professional Development and Support

For Foundation Phase teachers to effectively enhance teaching and learning through Smartboards technology, sustained capacity-building, mentoring, and structured support are essential. This theme captures teachers' experiences of professional development (PD) and its influence on classroom integration of Smartboards.

- **Professional Development**

Participants highlighted multiple forms of professional development that supported their use of Smartboards technology, including departmental workshops, partner-led training, online sessions, and school-based collaborative learning.

Of the eight participants, six reported having participated in formal or informal training opportunities, while two indicated that their exposure was limited or insufficient to fully support classroom implementation.

> FPT1 stated: *"I have had the opportunity to attend workshops organized by the Department of Education, and I have also received training from organizations like Azuka and Edit. They provide continuous support…"* Similarly, FPT2 noted: *"I received on-site training on the use of Smartboard. I also attended online workshops,"* while FPT4 referred to *"school-based workshops and peer-sharing sessions."*

In contrast, FPT5 and FPT7 indicated that training was either too brief or not sufficiently practical to support daily classroom application, suggesting uneven access to meaningful capacity-building experiences.

A key pattern emerging across participants is that exposure to sustained and varied professional learning opportunities is associated with greater confidence in integrating Smartboards technology into teaching practice. Teachers who experienced repeated engagement through workshops, peer collaboration, and on-site coaching demonstrated stronger ability to incorporate interactive tools into lessons. However, where training was fragmented or overly theoretical, teachers reported limited translation of skills into

classroom practice. This indicates that access to training alone does not guarantee effective implementation.

A further pattern is that the nature of professional development is often technically focused rather than pedagogically grounded. Many sessions emphasized operational skills, such as navigating Smartboard tools, with less emphasis on designing learner-centered or cognitively engaging activities. As a result, some teachers remained at a procedural level of competence without fully integrating technology into meaningful learning design.

The presence of divergent experiences, particularly among less confident teachers, represents a negative case that strengthens the credibility of the findings. These teachers highlighted that limited exposure to sustained mentoring reduced their ability to confidently apply Smartboards in ways that support deeper learning. This variation underscores that professional development is not uniformly effective across all educators.

From a TPACK perspective, the findings reveal an imbalance between technological knowledge (TK) and its integration with pedagogical (PK) and content knowledge (CK). While workshops may improve operational proficiency, insufficient emphasis on pedagogical adaptation restricts teachers' ability to design interactive, learner-centered lessons. This limits the potential for constructivist learning environments in which learners actively engage, explore, and co-construct knowledge through technology-enhanced tasks.

The findings align with recent research emphasizing that continuous, practice-based professional development is more effective than isolated training sessions in supporting technology integration (Scherer, Siddiq & Tondeur, 2023; OECD, 2023). Similarly, UNESCO (2024) highlights that fragmented training models often lead to surface-level technology use, where digital tools are used for presentation rather than pedagogical transformation. However, this study extends existing literature by demonstrating that the coexistence of multiple training providers, while increasing access, may inadvertently contribute to inconsistency in training focus, resulting in uneven teacher preparedness across schools.

The researcher interprets these findings to suggest that professional development functions as a determining factor in the depth of Smartboard integration. Where training is continuous, collaborative, and classroom-oriented, teachers are more likely to embed technology into meaningful learning experiences. Conversely, where training is episodic or overly technical, Smartboards remain underutilized or used primarily for demonstration purposes rather than learner-centered engagement. This highlights that effective professional learning is not only about access, but about coherence, relevance, and sustained instructional support.

In summary, professional development plays a critical role in enabling Smartboards integration; however, its effectiveness depends on continuity, pedagogical depth, and alignment with classroom realities. While teachers benefit from multiple training avenues, inconsistencies in quality and limited emphasis on instructional application constrain optimal use. Strengthening professional development through sustained, TPACK-aligned coaching and school-based mentoring is therefore essential for promoting meaningful technology integration in rural Foundation Phase classrooms

- **Skills acquired**

Participants reported varied experiences regarding the effectiveness of Smartboards training, particularly in relation to confidence building and skill acquisition. Of the eight participants, five reported improved confidence and basic operational competence following training, while three indicated that training was insufficient for sustained or advanced pedagogical use.

> FPT1 stated: *"Yes, the training has been helpful in enhancing my skills and confidence to use the Smartboard effectively in my teaching practice."* Similarly, FPT3 noted: *"The training was very helpful and made me confident using the smartboard. It taught me practical skills to create interactive and engaging lessons."*

However, other participants highlighted limitations in the training received.

> FPT7 explained: *"The training provided a tangible foundation, but I did not feel entirely confident. I needed time to experiment and practise on my own."* Likewise, FPT4 indicated that *"although the training received was helpful, it was insufficient for me to use all the features,"* while FPT5 added: *"The training was helpful but not enough. I still need more practice and advanced guidance."*

A clear pattern emerges in which training contributes primarily to initial operational competence, but does not consistently lead to deeper instructional mastery or confident pedagogical integration. Teachers with higher confidence levels were those who engaged in continued self-practice beyond formal workshops, whereas others remained dependent on basic functions. This indicates that skill acquisition is not a single training outcome, but a progressive developmental process shaped by repetition, experimentation, and classroom application.

A notable contradiction is evident between teachers who reported readiness after training and those who still felt uncertain in applying advanced features. This divergence highlights that professional learning experiences are uneven in impact, largely depending on individual engagement, prior exposure, and opportunities for practice.

From a TPACK perspective, the findings suggest that training predominantly strengthens technological knowledge (TK), while the integration of pedagogical (PK) and content knowledge (CK) remains underdeveloped. This imbalance limits the transition from functional use to pedagogically meaningful integration. Constructivist theory further supports this interpretation, emphasising that teacher learning, similar to learner learning, develops through active engagement, reflection, and iterative practice in authentic classroom contexts (Koehler et al., 2023).

These findings align with recent research indicating that short-term or once-off professional development has limited long-term impact on classroom practice (Scherer, Siddiq & Tondeur, 2023; OECD, 2023). UNESCO (2024) similarly notes that teachers in developing contexts often plateau at procedural levels of technology use when sustained support is absent. However, this study extends the literature by showing that rural

teachers actively engage in self-directed experimentation to compensate for gaps in formal training.

The researcher interprets these findings to suggest that Smartboard competence develops along a continuum rather than through discrete training events. While workshops initiate awareness and basic functionality, sustained pedagogical integration requires ongoing practice, reflective adaptation, and classroom-based experimentation. Without these conditions, Smartboards risk remaining at a functional rather than transformative level of use.

In summary, while professional development contributes to foundational skills and confidence, its impact is uneven and incomplete. Effective integration requires continuous, practice-oriented learning pathways that support teachers in moving from technical proficiency towards pedagogically intentional use of Smartboards.

- **Ongoing support and mentorship**

This sub-theme captures the extent to which teachers receive structured or informal support from peers, school leadership, ICT coordinators, and district-level systems in their use of Smartboards. Of the eight participants, four reported having consistent support structures within their schools, while four indicated limited or inconsistent mentorship and guidance.

Participants described contrasting experiences of institutional support.

> FPT2 stated: *"The school management and HODs were very helpful since the school is in a rural setting with limited resources. The mentorship and guidance I received on integrating technology with education was beyond helpful."* FPT3 similarly noted: *"I have access to ongoing support and guidance when using the smartboard. Colleagues and mentors are willing to help with questions and lesson ideas."*

> In contrast, FPT5 explained: *"Currently, there is limited ongoing support. Occasionally, colleagues share tips, but there is no structured mentorship or support program."* FPT6 added: *"The school needs to provide internet connectivity, resources, and workshops for teachers to gain more skills on Smartboard use."*

A dominant pattern across responses is the uneven distribution of professional support across schools, resulting in significant variation in teacher confidence and instructional integration. Where collegial collaboration and leadership encouragement are present, teachers demonstrate greater willingness to experiment with interactive lesson design. Conversely, in contexts where structured mentorship is absent, teachers tend to rely on minimal or repetitive use of Smartboards.

A further pattern indicates that informal peer support partially compensates for institutional gaps, although it remains inconsistent and dependent on individual initiative. This suggests that support systems are largely reactive rather than systematically embedded within school improvement structures.

The presence of divergent experiences represents a clear negative case, reinforcing that technology integration outcomes are highly contingent on contextual support structures rather than technology access alone. Without sustained scaffolding, teachers risk remaining at a surface level of integration, limiting the pedagogical potential of Smartboards.

From a TPACK perspective, ongoing mentorship is essential for developing the integration of technological (TK), pedagogical (PK), and content knowledge (CK). Teachers with access to structured support demonstrate stronger alignment between these domains, while those without such support struggle to move beyond operational use. Constructivist theory further frames mentorship as a form of professional scaffolding, enabling gradual knowledge construction through guided practice, reflection, and shared problem-solving (Koehler et al., 2023).

These findings align with recent research emphasising that collaborative professional learning and sustained mentorship are critical for effective technology integration (Tondeur et al., 2021; Scherer et al., 2023). UNESCO (2024) similarly highlights that fragmented institutional support in rural contexts often leads to inconsistent teacher development and uneven classroom implementation. However, this study extends the literature by demonstrating that even informal peer networks can partially mitigate institutional gaps, although they are insufficient without structured systems.

The researcher interprets these findings to indicate that mentorship functions as a critical enabling condition for sustained Smartboard integration. Where structured support is present, teachers are more likely to develop confidence, experiment with pedagogy, and refine instructional strategies. In its absence, implementation remains cautious, inconsistent, and largely technical rather than pedagogical.

In conclusion, ongoing support and mentorship are decisive factors in the successful integration of Smartboards in Foundation Phase classrooms. While some teachers benefit from collaborative and supportive environments, others operate in isolation with limited guidance, resulting in uneven implementation. The findings therefore underscore the need for institutionalised, school-wide, and district-supported mentorship frameworks to ensure equitable development of technological and pedagogical competencies.

- **Future professional development opportunities which can improve the use of Smartboards**

Participants consistently highlighted the need for more advanced, structured, and sustained professional development opportunities to strengthen the pedagogical use of Smartboards. Of the eight participants, seven expressed a need for continued or advanced training, while one participant emphasised self-directed learning as sufficient for improvement.

> One teacher noted: *"The Department of Education should consider offering bursaries to support educators in learning more about multimedia resources and enhancing their skills in using Smartboards and other digital tools"* (FPT1).

Similarly, FPT2 stated: *"I would like to enrol in an ICT course to deepen my knowledge of Smartboard use and technology integration in education."*

Other teachers emphasised collaborative and practical learning approaches, stating: *"I would like more training on using Smartboards creatively, including new tools and games to support all learners, plus opportunities to share ideas with other teachers"* (FPT3, FPT4, FPT8). Additional participants added that *"more workshops, refresher courses, and mentorship on advanced Smartboard use would be helpful"* (FPT5, FPT6). In contrast, FPT7 suggested: *"Self-practice is needed to improve my use of the Smartboard."*

A clear pattern emerges in which most participants prioritise structured, collaborative, and sustained professional learning, while a minority emphasise individual experimentation. This divergence reflects uneven confidence levels and varying access to support structures. Teachers who advocate formal development pathways tend to seek deeper pedagogical integration, whereas those favouring self-practice appear more comfortable with basic functional use.

The findings indicate a shift from basic operational competence towards a demand for pedagogically meaningful and curriculum-aligned technology integration. Teachers are not only requesting technical upskilling but also strategies for designing interactive, learner-centred lessons that support differentiated instruction and cognitive engagement.

From a TPACK perspective, the findings suggest that while technological knowledge (TK) may be partially developed, there is a stronger need to strengthen the integration of pedagogical (PK) and content knowledge (CK). This reflects a gap between knowing how to use Smartboards and knowing how to use them meaningfully for teaching and learning. Constructivist theory further supports this interpretation, emphasising that teachers, like learners, develop understanding through active participation, collaboration, and reflective practice. CTML also underpins teachers' emphasis on multimedia design, highlighting the importance of aligning visual and auditory channels to enhance cognitive processing (Mayer, 2021).

These findings align with recent research indicating that sustained, practice-based professional development is more effective than isolated workshops in supporting technology integration (Scherer, Siddiq & Tondeur, 2023; Koehler et al., 2023). UNESCO (2024) further emphasises that teachers in developing contexts require continuous support and mentoring to translate digital skills into pedagogically meaningful practice. However, this study extends existing literature by revealing a dual tendency: while most teachers depend on structured institutional support, a minority rely on self-directed learning, indicating variability in professional agency and contextual access.

The researcher interprets these findings as evidence that professional development is not a uniform experience but a differentiated process shaped by institutional support, teacher confidence, and contextual opportunity. In rural Foundation Phase settings, sustained professional learning is particularly critical for bridging the gap between technical competence and pedagogical transformation.

In summary, teachers require continuous, structured, and collaborative professional development that moves beyond technical training towards pedagogical innovation. While self-directed learning plays a supplementary role, effective Smartboard integration depends largely on institutionalised support systems that promote sustained, practice-oriented professional growth.

- **Barriers to effective professional development**

Although professional development opportunities exist, participants identified several barriers that limit their effectiveness in improving Smartboard integration. Of the eight participants, six highlighted structural and pedagogical barriers, while two indicated fewer challenges, largely due to stronger institutional support.

Participants pointed to issues such as limited depth of training, lack of follow-up support, and insufficient practical application.

> FPT4 explained that *"although the training received was helpful, it was insufficient for me to use all the features."* FPT5 added: *"The training was helpful but not enough. I still need more practice and advanced guidance."*

Other participants highlighted systemic constraints.

> FPT6 stated: *"The school needs to provide internet connectivity, resources, and workshops for teachers to gain more skills on Smartboard use."*

These responses indicate that barriers extend beyond individual capability to include infrastructural limitations and inconsistencies in training design and delivery.

A key pattern emerging is that professional development is often fragmented, short-term, and overly technical, limiting its long-term impact on classroom practice. Teachers frequently reported that training focuses on operational use rather than pedagogical transformation, resulting in a gap between skill acquisition and instructional application.

Another pattern is the dependence on institutional conditions. Schools with stronger leadership support and resource availability tend to facilitate more effective professional learning, while under-resourced contexts experience reduced impact of training initiatives. This highlights the systemic nature of barriers rather than purely individual limitations.

The presence of divergent experiences also represents a negative case, reinforcing that professional development effectiveness is unevenly distributed across schools and contexts. This variability contributes to inconsistent Smartboard integration across classrooms.

From a TPACK perspective, these barriers indicate a weak integration between technological knowledge (TK) and its pedagogical and content applications. Without sustained scaffolding, teachers struggle to move beyond basic operational use. Constructivist theory further explains this limitation by emphasising that meaningful learning requires ongoing engagement, reflection, and contextual application, conditions not consistently provided through current PD structures.

These findings align with UNESCO (2024) and OECD (2023), which emphasise that fragmented training models and limited institutional support reduce the effectiveness of digital technology integration in schools. However, this study extends the literature by showing that barriers are not only structural but also pedagogical, particularly the overemphasis on technical training at the expense of instructional design.

The researcher interprets these barriers as evidence that current professional development systems are insufficiently aligned with classroom realities in rural schools. Without sustained mentoring, adequate resources, and pedagogical focus, Smartboard training remains underutilised and uneven in impact.

In conclusion, barriers to effective professional development include fragmented training structures, limited practical application, insufficient follow-up support, and infrastructural constraints. These factors collectively hinder the full pedagogical potential of Smartboards in Foundation Phase classrooms.

- **Teacher recommendations for professional development improvement**

Participants provided clear recommendations for improving professional development related to Smartboard integration. Of the eight participants, all expressed the need for more sustained, practical, and collaborative learning opportunities, indicating strong consensus across the sample.

Recommendations included expanded training access, curriculum-linked workshops, mentorship programs, and structured peer-learning opportunities. Teachers emphasized the need for hands-on, classroom-based professional learning that is directly connected to lesson planning, instructional delivery, and learner engagement.

Participants suggested:

- increased workshops and refresher courses,
- ICT-focused qualification opportunities,
- peer collaboration and idea-sharing platforms,

- ongoing mentorship from experienced practitioners,
- integration of multimedia and interactive instructional design training.

A dominant pattern across responses is the strong preference for practice-oriented and collaborative learning models**,** rather than isolated or once-off training sessions. Teachers consistently emphasized that effective professional development must be continuous, context-responsive, and supported by follow-up coaching to ensure classroom transfer of skills.

Another clear pattern is the emphasis on alignment between professional learning content and classroom realities. Teachers indicated that training should reflect Foundation Phase conditions, including learner diversity, limited infrastructural resources, and varying levels of learner readiness and engagement. This suggests a demand for professional development that is not generic, but explicitly grounded in everyday instructional challenges.

The researcher interprets these recommendations as evidence that teachers are not resistant to technology integration; rather, they are actively seeking more meaningful, situated, and responsive forms of professional learning. This reflects growing professional agency, where teachers critically evaluate existing systems and propose contextually relevant improvements to enhance instructional effectiveness.

From a TPACK perspective, these recommendations underscore the need for integrated professional development that simultaneously develops technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). Constructivist theory further supports the emphasis on collaborative, experiential learning, where teachers construct professional understanding through shared practice, reflection, and iterative classroom application.

These findings align with Scherer et al. (2023) and Tondeur et al. (2021), who argue that effective digital integration is dependent on sustained, school-based professional learning communities rather than fragmented training interventions. Similarly, UNESCO (2024) highlights the importance of mentorship-driven and context-sensitive professional

development models, particularly in under-resourced educational settings where teachers require continuous instructional support.

In summary, teachers recommend a shift towards continuous, practical, and collaborative professional development models that prioritize pedagogical application over purely technical training. These recommendations reinforce the need for systemic reform in professional learning structures to ensure meaningful and equitable Smartboards technology integration across Foundation Phase classrooms.

4.4.3.1 Presentation and Analysis of Classroom Observation Findings

Classroom observations provided direct evidence of how teachers' professional development and institutional support influenced the integration of Smartboards into Foundation Phase teaching practices. Unlike interviews, which captured teachers' perceptions of training and support, observations revealed how differences in professional competence and resource provision translated into classroom enactment. Observing lessons in their natural settings allowed the researcher to examine how teacher confidence, pedagogical strategies, and institutional support mechanisms shaped Smartboard use in practice.

Smartboard integration varied significantly depending on teachers' prior exposure to professional development programmes. In classrooms where teachers had received structured training, Smartboards were used more flexibly and interactively. Teachers demonstrated confidence in navigating multiple functions, incorporating multimedia resources, and adapting activities to learner needs. Conversely, in classrooms where professional development was limited, Smartboards were primarily used for basic projection, with minimal learner interaction. This contrast illustrates the critical role of professional development in enabling teachers to move beyond superficial adoption toward meaningful pedagogical integration.

During a Grade 3 life skills lesson, a teacher who had attended district-level ICT workshops used the Smartboard to facilitate a collaborative activity. Learners were invited to match images of healthy foods with their nutritional categories using drag-and-drop

functions. The teacher guided the discussion, encouraged peer collaboration, and used the Smartboard's immediate feedback to reinforce correct answers. The activity demonstrated both technological competence and pedagogical creativity, reflecting the benefits of professional development. In contrast, another classroom observation revealed a teacher projecting a static worksheet on the Smartboard, reading questions aloud while learners responded verbally. The Smartboard functioned only as a display device, with no interactive engagement, highlighting the limitations of insufficient training.

Observations also revealed the influence of institutional support. In schools where technical assistance was available, Smartboard use was more consistent and uninterrupted. Teachers were able to troubleshoot calibration issues or connectivity problems quickly, maintaining lesson flow. In schools with limited support, technical disruptions often led to lesson delays or reversion to traditional methods. This disparity underscores the importance of institutional support structures in sustaining Smartboard integration.

Furthermore, classroom observations highlighted how professional development shaped teachers' ability to differentiate instruction. Trained teachers used Smartboards to provide visual scaffolds, interactive phonics games, and multimedia explanations tailored to diverse learner needs. Untrained teachers, however, relied on uniform presentation methods, limiting opportunities for inclusive participation. These findings demonstrate that professional development not only enhances technological competence but also expands pedagogical repertoire.

Overall, classroom observations under Theme 3 confirm that professional development and institutional support are decisive factors in the effective integration of Smartboards. Teachers with structured training and reliable support demonstrated greater confidence, creativity, and adaptability, while those without such resources relied on basic functions and experienced frequent disruptions.

The findings therefore complement interview data by showing that teachers' reported need for training and support was observable in practice, and they align with documentary

evidence that emphasised professional development in ICT policies and school planning documents. Situated within an interpretivist paradigm, these observations underscore that Smartboard integration is not determined solely by access to technology, but by the professional capacity of teachers and the institutional structures that sustain their practice.

4.4.3.2 Presentation and Analysis of Document Analysis Findings

Documentary evidence, including school ICT policies, district training guidelines, and lesson planning documents, provided insight into how professional development and institutional support for Smartboard use were formally articulated within rural Foundation Phase schools. Unlike classroom observations, which revealed enacted practices, documents offered a perspective on institutional commitments, planned training initiatives, and policy expectations. Analysing these texts within the interpretivist framework enabled comparison between documented provisions and observed classroom realities, thereby strengthening methodological triangulation.

School ICT policies consistently emphasised the importance of professional development in enabling effective Smartboard integration. Policies outlined expectations that teachers should receive ongoing training in both technical and pedagogical aspects of Smartboard use. District guidelines similarly highlighted the need for workshops and mentoring programmes to build teacher competence and confidence. Lesson plans often referenced Smartboard activities that required interactive functions, suggesting that teachers were expected to have sufficient training to implement these strategies.

A school ICT policy document stated: *"Teachers are required to attend quarterly ICT integration workshops to ensure effective use of Smartboards for learner-centred pedagogy."* Similarly, a Grade 2 mathematics lesson plan included instructions for an interactive Smartboard activity involving drag-and-drop number sequencing. The plan assumed teacher familiarity with Smartboard functions, reflecting the institutional expectation that professional development had equipped teachers with the necessary skills.

However, when cross-referenced with classroom observations, a gap emerged between documented expectations and enacted practice. While policies and lesson plans emphasised interactive, learner-centred Smartboard use, observations revealed that teachers without sufficient training often relied on basic projection functions. This disjuncture highlights the tension between institutional commitments to professional development and the uneven provision or uptake of training opportunities.

The analysis of documents under Theme 3 revealed three critical insights:

- **Institutional Commitment:** Policies and guidelines consistently framed professional development as essential for effective Smartboard integration, embedding training within broader ICT strategies.
- **Planned Pedagogical Benefits:** Lesson plans assumed teacher competence with Smartboard functions, reflecting the expectation that training had prepared teachers to implement interactive activities.
- **Triangulation with Observations:** While documents emphasised structured training and support, observations revealed uneven enactment, underscoring the importance of triangulation in assessing the credibility of institutional claims.

Overall, documentary evidence under Theme 3 confirms that professional development and institutional support were formally prioritised within school and district frameworks. However, the extent to which these commitments translated into classroom practice depended on the availability, quality, and accessibility of training and support.

The document analysis findings therefore complement both interviews and classroom observations. They demonstrate that teachers' reported need for training and support was institutionally recognised and documented, while also revealing the gap between policy aspirations and classroom realities. Situated within an interpretivist paradigm, this analysis underscores that Smartboard integration is not determined solely by access to technology, but by the professional capacity of teachers and the institutional structures that sustain their practice.

4.4.3.3 Theme 3 Synthesis: Professional Development and Support

The findings across Theme 3 demonstrate that professional development and institutional support are decisive factors shaping the effective integration of Smartboards in rural Foundation Phase classrooms. Teachers consistently emphasised in interviews that training and ongoing support were essential for building confidence, expanding pedagogical repertoire, and sustaining technology use. This perception was corroborated by classroom observations, which revealed that teachers with structured training employed Smartboards more interactively and flexibly, while those without sufficient preparation relied primarily on basic projection functions. Documentary evidence further reinforced this pattern, with ICT policies and district guidelines explicitly positioning professional development as central to ICT integration strategies.

A cross-cutting insight is that professional development directly influences the depth of pedagogical integration. Observations showed that trained teachers used Smartboards to scaffold learning, differentiate instruction, and facilitate collaborative activities, while untrained teachers struggled to move beyond static display. Lesson plans and policy documents assumed teacher competence with Smartboard functions, embedding interactive activities as planned strategies. Yet, the observed gap between documented expectations and classroom realities highlights the uneven provision and uptake of training opportunities.

Another synthesis relates to the role of institutional support in sustaining Smartboard use. Interviews revealed that teachers valued technical assistance and peer mentoring, noting that support structures reduced anxiety and enabled experimentation. Observations confirmed that classrooms with reliable technical support experienced fewer disruptions and smoother lesson continuity. Documents reinforced this institutional commitment, with policies mandating quarterly ICT workshops and technical support mechanisms. However, triangulation revealed that while support was formally prioritised, its availability was inconsistent across schools, limiting equitable integration.

The synthesis also underscores the relational dimension of professional development. Teachers reported that collaborative workshops and peer sharing fostered confidence and

innovation. Observations illustrated this in practice, with trained teachers facilitating learner-centred activities that promoted engagement and inclusivity. Documents echoed this emphasis, framing professional development not only as technical training but as a vehicle for pedagogical transformation.

Overall, Theme 3 highlights that Smartboard integration is not determined solely by access to technology, but by the professional capacity of teachers and the institutional structures that sustain their practice. The triangulation of interviews, classroom observations, and documentary evidence demonstrates methodological coherence: interviews captured teachers' expressed need for training and support, observations revealed how competence and support translated into classroom practice, and documents articulated institutional commitments to professional development. Together, these findings consolidate the argument that effective Smartboard integration requires sustained investment in teacher training, reliable technical support, and institutional mechanisms that enable teachers to move beyond superficial adoption toward meaningful pedagogical innovation.

4.5 Summary of Findings

This section provides a consolidated synthesis of the study's key findings, organised according to the research questions. Its purpose is to distil the major patterns that emerged from the data before transitioning to Chapter 5, which presents conclusions and recommendations. Overall, the findings reveal that the integration of Smartboards technology in rural Foundation Phase classrooms is a complex, context-dependent process, shaped by pedagogical intentions, teacher capacity, infrastructural conditions, and institutional support.

The findings indicate that Foundation Phase teachers integrate Smartboards technology primarily to promote interactive, hands-on learning, particularly in literacy and numeracy instruction. Teachers commonly used Smartboards for activities such as dragging and matching letters, numbers, and shapes; phonics games; counting activities; shared reading; and multimedia-supported lessons involving songs, videos, and images. These practices reflect a movement away from exclusively teacher-centred approaches towards

more learner-centred, participatory pedagogies. Classroom observations confirmed these practices in action, while document analysis revealed that lesson plans and ICT policies consistently positioned Smartboards as tools for interactive and multimodal learning.

Across the sample, Smartboards technology was most frequently used to enhance learner engagement and motivation through tactile and visual interaction. However, the depth of integration varied considerably. While some teachers consistently designed interactive, learner-driven activities, others relied more heavily on Smartboards as presentation tools, particularly when faced with technical disruptions or time constraints. This variation suggests that Smartboards integration often remained at the level of pedagogical enhancement rather than full transformation. These findings align with existing research indicating that technology use in under-resourced contexts frequently enhances, rather than redefines, instructional practice (Scherer et al., 2023). Observations highlighted this unevenness in practice, while documents revealed aspirational commitments to sustained interactivity that were not always realised in classrooms.

Significantly, Smartboards technology emerged as context-dependent pedagogical tools rather than automatic enhancers of teaching. Their use was strongly mediated by infrastructural reliability, available preparation time, class size, and teachers' confidence in managing interactive learning environments. This reinforces contemporary scholarship emphasising that meaningful Smartboards technology integration is shaped by systemic and contextual conditions, rather than teacher enthusiasm or access alone (OECD, 2023; UNESCO, 2024).

Persistent technical and infrastructural challenges were identified as the most significant barriers to Smartboards technology integration in rural schools. Nearly all participants reported frequent electricity interruptions, unstable internet connectivity, software glitches, and hardware malfunctions, which disrupted lesson flow and reduced teachers' willingness to rely on Smartboards technology for central instructional activities. Observations corroborated these disruptions, while documents revealed institutional recognition of infrastructural limitations in ICT policy frameworks.

In addition to technical constraints, teachers reported increased preparation demands and classroom management challenges. The need to source, design, and test digital learning materials added to teachers' workloads, particularly for novice educators. Furthermore, the heightened excitement generated by Smartboards technology-based lessons often required new classroom management strategies, including structured turn-taking, to prevent disorder and unequal participation. Observations confirmed these challenges in practice, while lesson plans documented teachers' attempts to structure participation to mitigate behavioural issues.

As a consequence of these combined challenges, some teachers reverted to surface-level use, such as basic projection, particularly when technical disruptions became frequent. These findings are consistent with recent research demonstrating that unreliable infrastructure and limited technical support significantly undermine sustained Smartboards technology integration in rural and under-resourced contexts (UNESCO, 2024; Author, 2025). They also highlight that, in the absence of systemic support, Smartboards technology may inadvertently intensify teacher workload rather than streamline instructional practice. Despite the challenges identified, teachers reported multiple pedagogical benefits associated with Smartboards technology use. These included increased learner engagement, improved attention and focus, enhanced participation, and the development of foundational skills such as listening, confidence, and public speaking. Teachers also perceived improvements in conceptual understanding and academic performance, particularly when learners engaged with multisensory activities that combined visual, auditory, and kinaesthetic modalities. Observations confirmed these benefits in practice, while documents reinforced them through planned activities and policy framing.

The findings further demonstrate that Smartboards technology supported formative assessment practices by enabling immediate feedback and shared modelling of cognitive processes. Teachers used interactive games and demonstrations to identify misconceptions in real time, repositioning assessment as an integral component of teaching rather than a separate summative activity. The pedagogical practices under discussion resonate strongly with constructivist learning theory, insofar as they position

learners as active agents in meaning-making processes. At the same time, they are consistent with contemporary scholarship on assessment for learning, which emphasises formative, systemic, and contextually embedded approaches to evaluation rather than narrow accountability measures (Mayer, 2021; Scherer & Nilsen, 2023). This dual alignment underscores the methodological coherence of the study, situating classroom practice within both theoretical and policy-relevant paradigms of educational innovation. Observations illustrated these practices in classrooms, while documents revealed lesson plans embedding Smartboards as formative assessment tools.

In addition to anticipated outcomes, some participants reported unanticipated benefits, including improved peer collaboration, stronger classroom discipline, better memory retention, and increased learner independence. However, the data also indicate that these benefits were conditional. When lessons were poorly paced, participation was not deliberately structured, or technical difficulties interrupted instruction, learner engagement declined and more confident learners tended to dominate interactions. These findings reinforce scholarly cautions that Smartboards technology does not automatically produce equitable or improved learning outcomes without deliberate pedagogical mediation (Akar, 2020). Observations confirmed unequal participation patterns, while documents revealed aspirational commitments to inclusivity that were not always realised in practice.

The findings reveal that while most teachers had access to some form of professional development related to Smartboards technology, the quality, depth, and coherence of this training varied considerably. Professional development was delivered through departmental workshops, external partners, online sessions, and limited school-based initiatives. Teachers who experienced sustained, practice-oriented training reported higher confidence and more purposeful classroom integration. Documentary evidence reinforced this, with ICT policies mandating regular training, while observations revealed that trained teachers demonstrated greater creativity and adaptability in Smartboard use.

However, many participants indicated that training focused predominantly on basic operational skills, with limited emphasis on pedagogical application. Consequently, several teachers relied on self-directed learning and experimentation to build competence,

resulting in uneven skill development across classrooms. The findings highlight a persistent methodological gap between teachers' acquisition of technological knowledge and the full enactment of the TPACK framework. In rural South African contexts, this limitation is compounded by systemic constraints such as infrastructural instability and uneven professional development, which hinder the integration of pedagogy and content knowledge with technology. By foregrounding this enactment gap, the study contributes to contemporary scholarship that reconceptualises TPACK not as a static framework, but as a contextually negotiated practice shaped by local schooling realities (Petko, Mishra, & Koehler, 2025; Koehler et al., 2023). Observations confirmed this unevenness in practice, while documents revealed policy emphasis on training that did not always translate into pedagogical depth.

Ongoing support and mentorship emerged as critical enablers of sustained Smartboards technology integration. Teachers who benefited from collegial collaboration, ICT champions, and supportive school leadership demonstrated greater confidence and experimentation, while those without structured mentorship reported uncertainty and superficial use. This uneven pattern reflects broader systemic challenges in rural education, where institutional support structures are often fragmented or inconsistent (DBE, 2024; UNESCO, 2024). Documentary evidence reinforced this, with policies highlighting mentorship and collaboration, while observations revealed that classrooms with stronger support structures demonstrated more consistent Smartboard use.

Teachers expressed a strong demand for advanced, collaborative, and curriculum-aligned professional development opportunities. The findings suggest a shift from basic technological competence towards a desire for pedagogically meaningful integration, underscoring the need for sustained, context-sensitive professional learning models.

Taken together, the findings demonstrate that Smartboards technology holds considerable potential to enhance teaching and learning in rural Foundation Phase classrooms by promoting interactive engagement, multisensory learning, inclusive participation, and formative assessment. However, this potential is not realised automatically. Smartboards technology function as contingent pedagogical tools, whose

effectiveness is shaped by infrastructure reliability, teacher expertise, classroom management strategies, and institutional support.

Meaningful integration therefore requires more than access to Smartboards technology. It depends on sustained professional development, coherent support systems, intentional instructional design, and systemic investment in rural school infrastructure. These findings provide a strong conceptual and empirical foundation for Chapter 5, which draws conclusions from the study and offers recommendations at classroom, school, and policy levels.

Collectively, these findings contribute to the growing body of research on educational Smartboards technology in rural contexts by demonstrating that meaningful Smartboards technology integration is shaped less by technological access than by pedagogical capacity and systemic support. The triangulation of interviews, classroom observations, and documentary evidence consolidates this conclusion, ensuring methodological coherence and strengthening the credibility of the study's findings.

CHAPTER 5

RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

Chapter 4 presented a detailed thematic analysis of the study's findings, organised around three interrelated dimensions: the enactment of Smartboards technology in Foundation Phase classrooms, the pedagogical affordances and constraints associated with its use, and the professional development and institutional conditions necessary for sustainable integration. Building on these findings, this concluding chapter synthesises the results in relation to the study's objectives and theoretical frameworks, draws overarching conclusions, and advances evidence-informed recommendations for policy, school leadership, classroom practice, and future research.

The overarching aim of the study was to explore how Smartboards technology enhances teaching and learning in Foundation Phase classrooms within rural primary schools. This aim is situated within South Africa's broader national agenda for digital transformation and educational equity, as articulated in the Department of Basic Education's Digital Education Strategy and the White Paper on e-Education (DBE, 2024; 2025). These policy frameworks position digital technologies as key enablers of learner-centred pedagogy, improved educational access, and quality enhancement in historically disadvantaged contexts.

To address this aim, the study was guided by three research questions focusing on: (i) how Smartboards are enacted in classroom practice, (ii) the pedagogical affordances and constraints emerging from their use, and (iii) the professional learning and institutional conditions required for sustainable integration. These questions informed the development of a contextually grounded conceptual framework presented in Section 5.3, which conceptualises technology integration as a mediated and situated pedagogical process shaped by teacher knowledge, instructional practices, and structural conditions rather than as a purely technical intervention.

5.1.1 Restatement of Research Aim and Questions

The aim of this study was to explore how Smartboards technology enhances teaching and learning in Foundation Phase classrooms within rural primary schools. This aim responds to South Africa's ongoing commitment to digital transformation, learner-centred pedagogy, and educational equity as articulated in national policy frameworks, including the DBE's Digital Education Strategy and the White Paper on e-Education (DBE, 2024; 2025).

The study was guided by the following research questions:

1. How are Smartboards technologies enacted in teaching and learning practices in Foundation Phase classrooms in rural primary schools?
2. What pedagogical affordances and constraints emerge from the use of Smartboards technology in Foundation Phase instruction?
3. What forms of professional learning and institutional support are required to enable sustainable digital pedagogy in rural Foundation Phase classrooms?

These questions respond to the persistent disjuncture between national digital education ambitions and the realities of rural schooling contexts, where infrastructural limitations, uneven teacher preparedness, and resource constraints continue to shape technology integration outcomes (DBE, 2024; Mulaudzi, 2024).

5.1.2 Overview of Methodology

This study adopted a qualitative research approach located within an interpretivist paradigm, which enabled an in-depth exploration of teachers' lived experiences, meanings, and pedagogical practices. A multiple case study design was employed across three rural primary schools in Limpopo Province, allowing for a nuanced and context-sensitive understanding of Smartboards integration in real classroom environments (Creswell & Poth, 2024; Merriam & Tisdell, 2024).

Data were generated through semi-structured interviews with Foundation Phase teachers, non-participant classroom observations, and document analysis. The integration of multiple data sources enabled methodological triangulation, thereby strengthening the

credibility and depth of interpretation. Thematic analysis was used to identify recurring patterns across the dataset, which informed the three key themes presented in Chapter 4.

5.1.3 Theoretical and Policy Orientation

The study is underpinned by constructivist learning theory, which emphasises active engagement, social interaction, and knowledge construction as central to meaningful learning. These principles align with South Africa's Curriculum and Assessment Policy Statement (CAPS) for the Foundation Phase, which advocates learner-centred and activity-based pedagogies (Wiyono, 2025; Çibukçiu, 2025). Within this framework, Smartboards are conceptualised as mediating tools that can support scaffolding, collaboration, and differentiated instruction when purposefully integrated into pedagogy.

The Cognitive Theory of Multimedia Learning (CTML) provides an additional explanatory lens for understanding how multimodal instructional representations enhance cognitive processing through the dual channels of visual and verbal input (Mayer, 2024; Fiorella & Mayer, 2025). This is particularly relevant in early-grade classrooms, where foundational literacy and numeracy development benefit from concrete, visual, and interactive learning experiences.

The Technological Pedagogical Content Knowledge (TPACK) framework further informs the analysis by explaining how effective technology integration depends on the dynamic interplay between technological knowledge, pedagogical strategies, and content expertise (Li & Li, 2024; Nzaramyimana & Umugiraneza, 2024). In the South African context, this framework aligns with national priorities on teacher digital competence and equitable access to meaningful technology-enhanced learning (DBE, 2025).

In addition, the study aligns with inclusive education policy, particularly the Screening, Identification, Assessment and Support (SIAS) framework, which emphasises responsive pedagogies that accommodate learner diversity (Pillay & Tlale, 2024). Within this perspective, Smartboards have the potential to enhance inclusion by enabling multimodal representation, differentiated pacing, and increased learner participation.

5.1.4 Thesis Statement

This study argues that while Smartboards technology hold significant potential to enhance interactive, inclusive, and conceptually enriched learning in rural Foundation Phase classrooms, their effectiveness is fundamentally dependent on the alignment between teacher competence, instructional leadership, and infrastructural reliability.

The findings indicate that Smartboards can strengthen learner engagement, deepen conceptual understanding, and support inclusive pedagogical practices. However, these outcomes are unevenly realised due to persistent constraints, including limited teacher preparedness, inconsistent infrastructure, and inadequate institutional support. These challenges reflect broader structural inequalities within rural education systems, which continue to mediate the success of digital transformation initiatives (DBE, 2024; Mnynadu, Terzoli, & Kobo, 2025).

5.1.5 Structure of the Chapter

This chapter is structured as follows:

- **Section 5.2** synthesises the key findings across the three emergent themes.
- **Section 5.3** interprets the findings through the theoretical lenses of constructivism, CTML, and TPACK.
- **Section 5.4** presents evidence-based recommendations for policy, leadership, and classroom practice.
- **Section 5.5** outlines the limitations of the study.
- **Section 5.6** identifies directions for future research.
- **Section 5.7** provides concluding reflections and the overall conclusion of the study.

5.2 SYNTHESIS OF KEY FINDINGS

The findings of this study demonstrate that Smartboards function as mediating artefacts within Foundation Phase pedagogy, enabling varying degrees of digitally supported teaching and learning in rural primary schools. Across the participating schools, a general pedagogical shift was observed from predominantly textbook-dependent instruction

towards more interactive, visually mediated, and learner-centred practices. However, this shift was uneven and context-dependent, reflecting differences in teacher capability, institutional support, and infrastructural reliability. Interviews highlighted teachers' enthusiasm for Smartboards as tools of engagement, classroom observations confirmed moments of interactive practice alongside constraints, and document analysis revealed policy and lesson plan commitments to learner-centred pedagogy.

From a conceptual perspective, the findings indicate that Smartboards integration is not a technical process in isolation but a socially and pedagogically situated practice. The educational value of the technology emerged through teachers' enactment within specific classroom contexts rather than from the device itself. This directly supports the study's conceptual framework, which positions technology use as mediated by the interaction between teacher knowledge, pedagogical intention, and structural conditions. Interviews captured teachers' perceptions of this mediation, observations revealed its enactment in practice, and documents demonstrated how institutional frameworks framed Smartboards as pedagogical tools. This interpretation provides a foundational bridge to the theoretical argument developed in Section 5.3.

A key finding relates to the role of multimedia in supporting conceptual understanding. Teachers consistently reported in interviews that visual and auditory resources, such as animations, images, videos, and songs, enhanced learner comprehension, particularly in Mathematics and Home Language. Classroom observations confirmed these benefits, showing learners' heightened attention and participation during multimedia-supported lessons. Document analysis reinforced this pattern, with lesson plans and ICT policies explicitly embedding multimedia activities as strategies for conceptual scaffolding. These multimodal representations supported attention, sequencing, and meaning-making in ways that traditional instructional modes did not always achieve. This finding aligns directly with CTML and provides empirical grounding for interpreting how dual-channel cognitive processing is activated in Foundation Phase learning contexts.

At the same time, the findings indicate that the pedagogical effectiveness of multimedia was not inherent in the technology itself but depended on how teachers structured and

integrated these resources into instruction. Where teachers demonstrated stronger pedagogical design, multimedia tools supported guided exploration and conceptual scaffolding. Where such alignment was weaker, multimedia use remained largely decorative or passive. Interviews revealed this variability in teacher confidence, observations illustrated contrasting classroom practices, and documents showed aspirational lesson planning that was not always realised in practice. This variability becomes theoretically significant in Section 5.3, where CTML is extended to include contextual and teacher-mediated constraints.

The findings further show that Smartboards contributed to more inclusive classroom participation by enabling multimodal engagement through visual, auditory, and tactile interaction. Learners who struggled with text-based instruction were better supported through visual scaffolding and interactive activities. Classroom observations confirmed that quieter learners often volunteered to participate when Smartboards were used interactively, while documents highlighted inclusivity as a stated policy goal. This enhanced participation, particularly among lower-performing and less confident learners, suggests that digital mediation can reduce barriers to access when appropriately enacted. This directly informs the study's engagement with inclusive education theory and SIAS principles, which are further developed in the theoretical synthesis.

However, the findings also highlight persistent structural constraints that shaped the extent of pedagogical transformation. Infrastructural instability, including power interruptions, limited connectivity, and inadequate technical support, frequently disrupted instruction and constrained sustained use of Smartboards. Interviews revealed teachers' frustration with these challenges, observations documented lesson disruptions and reversion to traditional methods, and documents acknowledged infrastructural limitations in ICT policy frameworks. This reinforces the argument that technology integration is materially conditioned and cannot be separated from broader socio-technical systems, a key extension developed in the TPACK discussion in Section 5.3.

Overall, Smartboards enactment was found to be uneven across classrooms. While some teachers integrated interactive, learner-centred activities into structured pedagogical

designs, others used the technology primarily for content display. This variation reflects differences in technological confidence, pedagogical orientation, and contextual support. Interviews captured these differences in teacher preparedness, observations illustrated them in practice, and documents revealed institutional expectations that were not always met. These patterns provide direct empirical grounding for the TPACK-based argument in Section 5.3, where teacher knowledge integration is shown to be dynamic and contextually constrained rather than uniform.

5.2.1 Research Question 1: Integration of Smartboards in Classroom Practice

The findings indicate that Smartboards were primarily used as tools for enhancing lesson delivery, learner engagement, and classroom interaction. Teachers increasingly moved from traditional chalk-and-talk methods towards more visually mediated and interactive instructional approaches, although the depth of integration varied significantly. Interviews emphasised this pedagogical shift, observations confirmed interactive practices such as phonics and numeracy activities, and documents revealed lesson plans embedding Smartboard use in curriculum delivery.

In practice, Smartboards were used to present phonics activities, numeracy exercises, stories, songs, images, and interactive tasks aligned with Foundation Phase outcomes. Learners engaged in touch-based manipulation, matching activities, and visual sequencing tasks, which encouraged active participation and sensory engagement. These practices reflect core constructivist principles of active learning, guided participation, and knowledge construction.

However, integration remained inconsistent across participants. Some teachers used Smartboards interactively to structure learner-centred activities, while others relied on them as projection tools for static content delivery. Interviews revealed this divergence in teacher confidence, observations confirmed uneven enactment, and documents highlighted aspirational commitments to interactivity. This distinction is theoretically important, as it demonstrates that technology does not determine pedagogy; rather, pedagogical enactment depends on teacher knowledge and contextual readiness.

From a TPACK perspective, effective integration occurred where teachers were able to align technological tools with pedagogical strategies and curriculum content. Less effective integration reflected fragmentation between these knowledge domains. This variation directly supports the theoretical claim in Section 5.3 that TPACK is contextually mediated and not uniformly enacted.

5.2.2 Research Question 2: Pedagogical Benefits of Smartboards

The findings reveal that Smartboards contributed to improved learner engagement, conceptual understanding, and classroom participation. The most prominent benefit was the use of multimedia resources, which enhanced comprehension through visualisation and auditory reinforcement. Teachers reported improved learner attention and retention when abstract concepts were presented through visual and interactive formats. Observations confirmed these benefits in practice, while documents reinforced them through planned activities and policy framing.

These findings provide direct empirical support for CTML, particularly the principle that learning is enhanced through integrated verbal and visual channels. In Foundation Phase classrooms, multimodal instruction was especially effective in supporting early literacy and numeracy development, where concrete representation is critical for conceptual formation.

In addition, Smartboards supported inclusive pedagogical practices by accommodating diverse learning needs. Learners who experienced difficulty with text-based instruction benefited from visual scaffolding, interactive engagement, and multimodal presentation. This increased participation and reduced learner anxiety, reinforcing inclusive education principles and SIAS policy expectations. Observations confirmed these inclusive practices, while documents revealed lesson plans embedding Smartboards as tools for differentiated instruction.

The findings also highlight the role of Smartboards in supporting formative assessment practices. Teachers were able to assess understanding in real time, provide immediate feedback, and adjust instruction accordingly. Observations illustrated these practices in

classrooms, while documents revealed lesson plans embedding Smartboards as formative assessment tools. This strengthened instructional responsiveness and learner engagement. However, these benefits were contingent on interactive pedagogical use rather than passive presentation, reinforcing the argument that pedagogical design mediates technological impact.

5.2.3 Research Question 3: Professional Development and Institutional Support

The findings indicate that professional development opportunities were limited, fragmented, and largely focused on technical rather than pedagogical competence. Teachers reported insufficient preparation for integrating Smartboards meaningfully into instruction, particularly in relation to interactive and learner-centred pedagogies. Interviews highlighted this gap, observations confirmed uneven enactment in classrooms, and documents revealed policy emphasis on training that did not always translate into pedagogical depth.

Sustained professional learning was identified as a critical need. Teachers emphasised the importance of ongoing, collaborative, and practice-based development rather than isolated training workshops. This directly informs the extension of TPACK in Section 5.3, where professional learning is conceptualised as continuous knowledge integration rather than a one-off acquisition process.

Institutional and infrastructural constraints also significantly shaped implementation. Electricity instability, connectivity challenges, and limited technical support frequently disrupted lessons and reduced opportunities for sustained use. Interviews revealed teachers' frustration, observations documented lesson disruptions, and documents acknowledged infrastructural limitations in ICT policy frameworks. These constraints frequently forced teachers to revert to traditional instructional methods, limiting pedagogical innovation.

Instructional leadership emerged as a key enabling factor. Where leadership actively supported digital integration, encouraged collaboration, and prioritised ICT use, teachers demonstrated greater confidence and consistency in Smartboards enactment. Where

leadership support was weak, implementation remained inconsistent and fragmented. Interviews highlighted the importance of leadership, observations confirmed its impact on classroom practice, and documents revealed institutional commitments to ICT leadership. This finding directly informs the contextual dimension of the theoretical framework developed in Section 5.3.

5.2.4 Integrated Interpretation (Direct Bridge to Theory Section)

Overall, the findings demonstrate that Smartboards hold significant pedagogical potential in rural Foundation Phase classrooms, particularly in enhancing engagement, multimodal learning, formative assessment, and inclusive participation. However, this potential is not automatically realised, but is contingent upon the alignment between teacher knowledge, pedagogical design, institutional support, and infrastructural stability.

The study therefore rejects technologically deterministic interpretations of digital learning and instead positions Smartboards integration as a socially and contextually mediated pedagogical process. This integrated interpretation directly informs the theoretical argument in Section 5.3, where constructivism, CTML, and TPACK are extended to account for contextual constraints and rural educational realities.

Interviews consistently revealed teachers' perceptions of Smartboards as tools that could transform classroom engagement and support curriculum delivery. Classroom observations confirmed these perceptions to an extent, showing moments of heightened enthusiasm, multimodal learning, and formative assessment, but also highlighted practical challenges such as uneven participation, technical interruptions, and varying levels of teacher confidence. Documentary analysis reinforced these findings by demonstrating how lesson plans and ICT policies positioned Smartboards as central to learner-centred pedagogy, while simultaneously exposing a policy–practice gap when compared with observed classroom realities.

Taken together, the triangulation of interviews, observations, and documents strengthens the credibility of this interpretation. Interviews captured teachers' aspirations and reported benefits, observations revealed the enacted practices and constraints in real classroom

contexts, and documents provided evidence of institutional framing and planned commitments. The convergence of these sources demonstrates that Smartboards integration is not determined by technology alone, but by the dynamic interplay of teacher competence, pedagogical intention, and systemic support.

5.3 THEORETICAL SYNTHESIS AND CONTRIBUTION

This study contributes theoretically by extending constructivist learning theory, the Cognitive Theory of Multimedia Learning (CTML), and the Technological Pedagogical Content Knowledge (TPACK) framework within the under-researched context of rural Foundation Phase classrooms in South Africa. Rather than merely confirming established assumptions regarding educational technology integration, the findings demonstrate that digitally mediated pedagogy is shaped by the dynamic interaction between teacher agency, pedagogical knowledge, infrastructural reliability, institutional leadership, and broader socio-educational conditions. In doing so, the study advances a more contextually grounded understanding of technology-supported learning within rural schooling environments characterised by structural inequality and uneven access to educational resources.

The triangulation of interviews, classroom observations, and document analysis strengthens this contribution. Interviews captured teachers' perceptions of Smartboards as enabling tools for learner engagement and curriculum delivery. Observations revealed how these perceptions translated into practice, showing both interactive successes and constraints such as technical interruptions and uneven participation. Documents reinforced institutional commitments to learner-centred pedagogy and professional development, while also exposing gaps between policy aspirations and classroom realities. Together, these sources confirm that meaningful Smartboards-mediated learning emerges through complex processes of pedagogical mediation, contextual adaptation, and institutional enablement.

Consequently, the study positions digital pedagogy not as a purely technical innovation, but as a socially situated educational process shaped by both human and structural conditions. This integrated interpretation directly informs the theoretical argument

developed below, where constructivism, CTML, and TPACK are extended to account for contextual constraints and rural educational realities.

5.3.1 Extension of Constructivist Learning Theory

Constructivist learning theory conceptualises learning as an active and socially mediated process in which learners construct knowledge through interaction, exploration, collaboration, and guided participation. The findings strongly support this perspective: interviews revealed teachers' emphasis on Smartboards-supported lessons as promoting learner participation and collaborative engagement; observations confirmed these practices through touch-based manipulation, interactive demonstrations, and visual sequencing; and documents highlighted lesson plans embedding Smartboards as tools for scaffolding and social learning.

However, the study extends constructivist theory by demonstrating that digitally mediated constructivist learning is neither automatic nor universally enacted. Although Smartboards created opportunities for learner-centred engagement, the extent to which these opportunities translated into meaningful pedagogical transformation depended largely on teacher competence, instructional confidence, and contextual support structures. Observations revealed that confident teachers facilitated exploration and collaborative meaning-making, while less prepared teachers used Smartboards primarily for procedural presentation. Documents reinforced this unevenness, showing aspirational commitments to constructivist pedagogy that were not consistently realised in practice.

Importantly, the study further extends constructivist theory by foregrounding the influence of infrastructural and institutional conditions on learner participation and pedagogical interaction. Teachers' efforts to implement learner-centred instruction were frequently shaped by unstable electricity supply, intermittent connectivity, and inadequate technical support. This situated interpretation of constructivism recognises that opportunities for collaborative and interactive learning cannot be separated from the socio-material conditions within which teaching occurs.

5.3.2 Extension of the Cognitive Theory of Multimedia Learning (CTML)

CTML explains how learners process information through visual and auditory channels and posits that learning is enhanced when verbal and visual representations are meaningfully integrated. The findings strongly support CTML: interviews highlighted teachers' perceptions of multimedia as strengthening comprehension and retention; observations confirmed improved learner attention and participation during multimedia-supported lessons; and documents reinforced this through lesson plans embedding animations, songs, and interactive graphics.

Nevertheless, the study extends CTML by demonstrating that the effectiveness of multimedia learning is shaped not only by cognitive design principles, but also by infrastructural feasibility and teacher digital competence. Observations revealed that technical interruptions disrupted lesson flow and reduced instructional continuity, while interviews captured teachers' frustration with unstable electricity and connectivity. Documents acknowledged infrastructural limitations within ICT policy frameworks, reinforcing the contextual dimension of multimedia learning.

The findings further reveal that some teachers experienced difficulty identifying or designing developmentally appropriate multimedia resources aligned with Foundation Phase pedagogy. This suggests that the effectiveness of multimedia learning also depends upon teachers' capacity to evaluate, adapt, and pedagogically integrate digital resources in contextually responsive ways. The study therefore contributes to emerging scholarship advocating for a practice-oriented interpretation of CTML that incorporates teacher expertise, contextual adaptation, and infrastructural realities into understandings of multimedia learning processes.

5.3.3 Extension of the TPACK Framework

The TPACK framework emphasises the interaction between technological, pedagogical, and content knowledge as essential for meaningful educational technology integration. The findings strongly support this framework: interviews revealed teachers' recognition of the need to align Smartboards with curriculum objectives; observations confirmed that

effective integration occurred where teachers combined multimedia resources, interactive activities, and learner participation into coherent lesson structures; and documents reinforced institutional expectations for ICT-aligned pedagogy.

The study extends TPACK by illustrating the uneven, adaptive, and contextually situated nature of knowledge integration within rural schools. Rather than functioning as a stable body of teacher competence, TPACK emerged as a dynamic and continuously negotiated process shaped by infrastructural constraints, institutional support, learner diversity, and classroom realities. Teachers were required to adapt instructional strategies in response to unstable connectivity, inconsistent electricity supply, overcrowded classrooms, and limited technical assistance.

Importantly, the findings foreground contextual knowledge as a critical dimension of effective digital pedagogy. Teachers' ability to enact technology-supported instruction depended not only on their knowledge of content, pedagogy, and technology, but also on their capacity to navigate the material and institutional conditions shaping rural schooling environments. This supports growing calls for ecological and context-sensitive interpretations of TPACK, sometimes conceptualised as TPACK-C, which recognise context as an integral rather than peripheral component of effective technology integration.

The study therefore contributes to TPACK scholarship by demonstrating that teacher knowledge cannot be understood independently of the socio-material environments within which teaching occurs. In rural Foundation Phase classrooms, effective digital pedagogy emerged not through technological competence alone, but through teachers' ability to adapt pedagogical and technological knowledge to contextually constrained educational realities.

5.4 CONCEPTUAL POSITIONING OF THE STUDY

To synthesise the theoretical insights and empirical findings emerging from the study, a revised conceptual framework is proposed: the Context-Responsive Smartboards Integration Framework for Rural Foundation Phase Classrooms. The framework

conceptualises Smartboards enactment not as a technical intervention, but as a socially situated and pedagogically mediated process shaped by four interrelated dimensions:

1. Pedagogical mediation
2. Technological-pedagogical-content knowledge integration
3. Instructional digitalisation practices
4. Contextual and infrastructural conditions

The framework therefore represents a shift away from linear and technologically deterministic models of educational technology adoption towards a relational and context-sensitive understanding of digitally mediated pedagogy.

The framework is directly grounded in the study's triangulated empirical findings**.** Interviews revealed teachers' emphasis on learner-centred and interactive teaching practices, which reflect pedagogical mediation**.** Classroom observations confirmed these practices in action, showing Smartboards used for phonics games, numeracy activities, and collaborative tasks. Document analysis reinforced this dimension, with lesson plans and ICT policies embedding Smartboards as tools for scaffolding and participation. Instructional digitalisation was evident in multimedia use to support conceptual understanding and learner engagement, a pattern consistently reported in interviews, observed in classrooms, and documented in lesson plans. Teacher knowledge integration was highlighted across all data sources: interviews revealed teachers' recognition of the need to align pedagogy, technology, and content; observations showed uneven enactment depending on teacher confidence; and documents reflected institutional expectations for coherent integration. Finally, contextual and infrastructural conditions were repeatedly emphasised: teachers reported challenges in interviews, observations documented disruptions, and documents acknowledged infrastructural instability and resource constraints.

Taken together, the framework positions Smartboards integration as a contextually mediated process of pedagogical enactment occurring within structurally constrained rural educational ecosystems. The findings therefore suggest that technology integration is

best understood not as a purely pedagogical innovation, but as an adaptive educational process shaped by the interaction between teacher agency, institutional capacity, and material conditions.

5.5 Revised Conceptual Framework Based on the Findings

Drawing on constructivist learning theory, CTML, and TPACK, the revised framework reconceptualises digitally mediated instruction in rural Foundation Phase classrooms as a dynamic interaction between teacher knowledge, pedagogical practice, and contextual enablement. Existing educational technology frameworks often assume relatively stable institutional and infrastructural conditions and therefore insufficiently account for the uneven realities characterising rural schooling contexts. The proposed framework addresses this limitation by foregrounding contextual influence as central to educational technology enactment.

As illustrated in Figure 5.1, meaningful Smartboards-mediated learning emerges through the interaction between technological, pedagogical, and content knowledge. However, this interaction is simultaneously shaped by contextual conditions such as infrastructural reliability, instructional leadership, policy alignment, resource availability, and rurality. Consequently, digitally enhanced learning is conceptualised not merely as an outcome of technological access, but as the product of pedagogical intentionality, teacher adaptability, and institutional enablement.

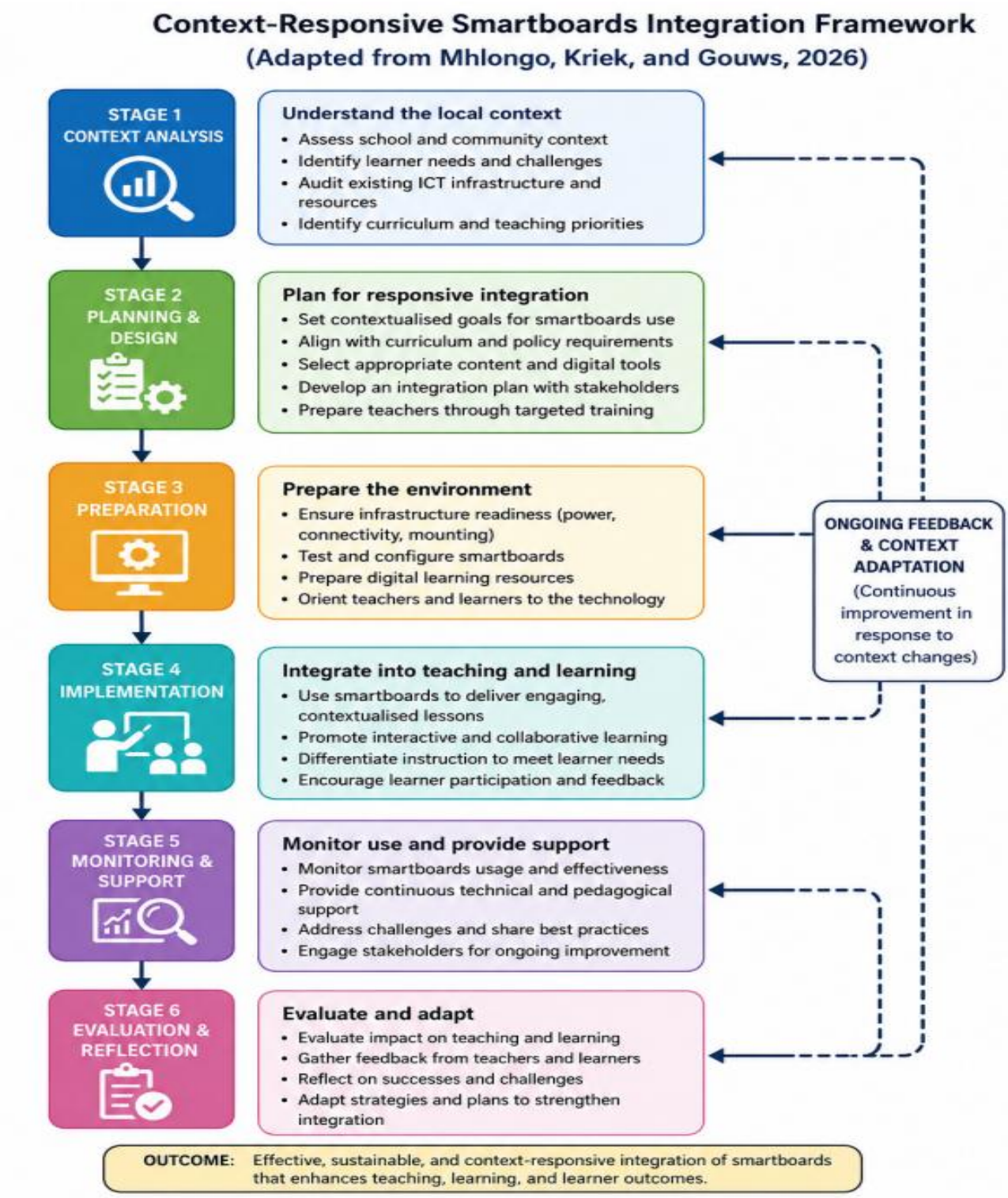


Figure 5.1: Context-Responsive Smartboards Integration Framework (Adapted from Mhlongo, Kriek, and Gouws, 2026)

The framework should be interpreted as a dynamic and relational representation of technology enactment rather than as a linear model of instructional causality. Contextual conditions exert a continuous influence on classroom practice, shaping how teachers integrate technological, pedagogical, and content knowledge within Foundation Phase instruction. The triangulation of interviews, classroom observations, and document analysis confirms this: interviews revealed teachers' aspirations for learner-centred pedagogy, observations documented both interactive successes and infrastructural disruptions, and documents reinforced institutional commitments while exposing policy–practice gaps. The framework therefore demonstrates that meaningful digital pedagogy emerges only when knowledge domains are coherently aligned and supported by enabling institutional and infrastructural conditions.

This conceptual contribution advances educational technology scholarship by visually embedding contextual mediation within understandings of digital pedagogy. It further offers a stronger explanatory model for understanding why technology-supported instruction produces uneven outcomes across rural schooling environments, even where similar digital resources are available.

5.5.1 Proposed Model of Smartboards Integration in Rural Foundation Phase Contexts

Building on the revised framework, the study advances the Contextually Mediated Smartboards Pedagogical Integration Model for rural Foundation Phase classrooms. The model translates the study's theoretical and empirical insights into a practice-oriented interpretation of sustainable digital pedagogy within resource-constrained schooling environments.

The model consists of four interdependent dimensions, each triangulated across interviews, observations, and documents:

- Pedagogical Intentionality Smartboards-supported instruction should be guided by explicit learner-centred objectives that prioritise interaction, collaborative meaning-making, play-based learning, and formative assessment practices

aligned with Foundation Phase pedagogy. Interviews highlighted teachers' emphasis on these goals, observations confirmed their enactment in interactive phonics and numeracy lessons, and documents reinforced them through lesson plans embedding learner-centred strategies.

- **Teacher Capacity and Professional Learning:** Sustainable technology enactment requires continuous and practice-oriented professional development that strengthens pedagogical confidence alongside technological competence (Howard & Thompson, 2023). Interviews revealed teachers' demand for advanced training, observations showed that trained teachers demonstrated greater creativity and adaptability, and documents reinforced institutional commitments to ICT workshops and mentoring.
- **Rural-Responsive Pedagogical Adaptation:** Teachers must adapt digitally mediated instruction to local realities, including unstable connectivity, language diversity, overcrowded classrooms, limited resources, and inclusive education requirements aligned with SIAS principles (Pillay & Tlale, 2024). Observations documented teachers' improvisation in response to disruptions, interviews highlighted the need for adaptability, and documents acknowledged rural constraints in ICT policy frameworks.
- **Instructional Leadership and Infrastructure Enablement:** The findings demonstrate that school leadership plays a critical role in sustaining digitally enhanced pedagogy through maintenance planning, collaborative cultures, professional support structures, and alignment with departmental digital education initiatives (Bush & Glover, 2022; DBE, 2025). Interviews emphasised the importance of leadership support, observations confirmed its impact on classroom consistency, and documents reinforced institutional commitments to ICT leadership and infrastructure planning.

Collectively, the proposed model reframes Smartboards-supported pedagogy as a socially situated and institutionally mediated educational process rather than a purely technological intervention. The triangulation of interviews, observations, and documents demonstrates that sustainable digital pedagogy emerges through the

alignment of pedagogical intentionality, teacher expertise, contextual adaptation, institutional leadership, and infrastructural viability.

5.5.2 Overall Theoretical Contribution

Overall, the study contributes theoretically by demonstrating that constructivist learning theory, CTML, and TPACK remain valuable explanatory frameworks for understanding digitally mediated pedagogy within Foundation Phase education. However, the findings further reveal that the enactment of these theoretical principles within rural schooling contexts is mediated by a complex interaction between teacher capability, infrastructural reliability, institutional leadership, and socio-educational realities.

The study therefore advances a more contextually grounded and rural-responsive interpretation of educational technology integration. Rather than conceptualising digital learning as an automatic consequence of technological access, the findings demonstrate that meaningful pedagogical transformation emerges through the alignment of teacher knowledge, pedagogical intentionality, institutional support, and enabling material conditions.

In extending existing scholarship, the study foregrounds rurality, contextual mediation, and institutional enablement as central determinants of technology-supported teaching and learning. This contribution provides a more nuanced explanatory model for understanding uneven educational technology outcomes in rural Foundation Phase classrooms and advances theoretical discourse on digital pedagogy within structurally constrained educational environments.

5.6 RECOMMENDATIONS

The recommendations are grounded in the study's findings and aligned with South Africa's national commitments to digital transformation, inclusive education, and curriculum enhancement as articulated in the CAPS framework, SIAS policy, and the Department of Basic Education's Digital Education Strategy. They translate the study's theoretical

contribution into a context-responsive implementation approach sensitive to the infrastructural and pedagogical realities of rural schooling.

The central implication of the findings is that Smartboards integration must be treated as a *systemic pedagogical intervention* rather than a technological rollout. Accordingly, recommendations are organised across interdependent domains: teacher development, institutional support, instructional leadership, and infrastructure enablement.

In the short term, priority should be given to strengthening teacher pedagogical capacity through sustained, school-based professional learning. Training must move beyond technical instruction towards pedagogical design competence, including interactive lesson structuring, multimodal integration, formative assessment strategies, and differentiated instruction. Interviews revealed teachers' demand for deeper pedagogical training, observations confirmed that trained teachers enacted more interactive lessons, and documents reinforced institutional emphasis on professional development. This aligns directly with the study's finding that pedagogical intent, rather than device availability, determines classroom impact.

In parallel Structured PLCs and mentorship systems should be institutionalised to sustain peer learning and reduce teacher isolation in digital practice. Collaborative knowledge-sharing was found to be a key enabler of confidence and consistency in Smartboards enactment, particularly in resource-constrained environments. Interviews highlighted the importance of collegial support, observations demonstrated stronger integration in classrooms where peer collaboration was evident, and documents reinforced policy commitments to mentorship and ICT champions.

Curriculum-Aligned Digital Resources: Schools and districts should prioritise the provision of CAPS-aligned digital teaching resources, including offline-accessible materials to mitigate connectivity challenges. This recommendation responds directly to the finding that limited access to ready-to-use content constrains meaningful pedagogical integration. Interviews revealed teachers' frustration with resource scarcity, observations

documented reliance on improvised materials, and documents confirmed institutional recognition of the need for curriculum-aligned digital content.

Instructional leadership must be strengthened to ensure that digital pedagogy becomes embedded within school improvement processes. Leadership practices that promote experimentation, peer observation, and instructional dialogue were found to significantly influence the depth of technology integration. Interviews emphasised the role of supportive leadership, observations confirmed that schools with active leadership demonstrated more consistent Smartboards use, and documents reinforced departmental expectations for ICT leadership.

Infrastructure Enablement: In the longer term, sustainable Smartboards integration requires structural investment in electricity reliability and digital connectivity. Without infrastructural stability, pedagogical innovation remains fragile and inconsistent. Interviews repeatedly highlighted infrastructural frustrations, observations documented lesson disruptions due to power and connectivity failures, and documents acknowledged systemic infrastructural challenges. These interventions are therefore essential to ensure equity in digital learning opportunities across rural contexts.

Collectively, these recommendations reinforce the study's central argument: meaningful digital transformation depends on the alignment of pedagogy, professional capacity, leadership, and infrastructure rather than technology provision alone. The triangulation of interviews, classroom observations, and documents ensures that these recommendations are empirically grounded, contextually responsive, and institutionally relevant, offering a robust pathway for sustainable Smartboards integration in rural Foundation Phase classrooms.

5.7 LIMITATIONS OF THE STUDY AND FUTURE RESEARCH

While this study provides rich interpretive insight into Smartboards-supported pedagogy in rural Foundation Phase classrooms, its findings must be understood within clearly defined methodological boundaries. These limitations do not undermine the credibility of

the findings but rather contextualise their scope and highlight areas for cautious interpretation and future inquiry.

5.7.1 Sample Scope and Transferability

The study was conducted across three rural primary schools in Limpopo Province and involved a small, purposively selected sample of eight teachers. Although this multiple case study design enabled rich, context-sensitive insights, the findings cannot be generalised to all South African schools or to urban contexts. Variation across South African schooling environments means that findings should be interpreted as contextually situated rather than universally representative. Interviews captured diverse teacher perspectives, observations provided depth into enacted practices, and documents revealed institutional commitments, but together they reflect a bounded rural sample rather than a national picture.

5.7.2 Sampling Bias

The sampling of schools already using Smartboards introduces potential positive bias, as experiences of non-use or implementation failure were not captured. Interviews highlighted teachers' enthusiasm for Smartboards, observations confirmed active use in classrooms, and documents reinforced institutional framing of Smartboards as enabling tools. However, this focus excluded schools where Smartboards were absent or underutilised, limiting insight into barriers to adoption.

5.7.3 Data Source Constraints

Triangulation across interviews, observations, and documents enhanced validity, yet each source carried inherent limitations. Interviews relied on self-report, which may have been influenced by social desirability or teachers' perceptions of departmental expectations. Observations were non-participant and limited in duration, meaning they captured enacted practices at specific points rather than sustained patterns over time. Document analysis revealed institutional framing but did not always reflect actual classroom realities. Furthermore, language and translation nuances may have influenced the depth of

meaning captured during interviews, while researcher positionality may have shaped interpretive emphasis despite efforts at reflexivity and methodological rigour. These constraints highlight the interpretive nature of qualitative inquiry.

5.7.4 Learner Outcomes and Perspectives

By foregrounding teacher experiences, practices, and institutional conditions, the study utilised a lens highly appropriate for exploring pedagogical enactment; however, this focus ultimately limited direct engagement with learner perspectives. Learner responses were inferred through observations and teacher accounts rather than systematically collected through learner interviews or focus groups. The absence of quantitative learner performance data also limits the ability to establish measurable academic impact. This methodological choice represents a clear limitation and a gap that future research could address to provide a more holistic understanding of Smartboards' impact on learners.

5.7.5 Infrastructural and Contextual Variability

The study was situated in rural schools characterised by infrastructural instability, including unreliable electricity and limited connectivity. These conditions shaped both the enactment of Smartboards and the research process itself. For example, observations were occasionally disrupted by technical interruptions, interviews frequently referenced infrastructural frustrations, and documents acknowledged systemic resource constraints. This variability underscores that findings are deeply embedded in rural realities and may differ in more resourced environments. The infrastructural and contextual conditions of the study therefore form part of its interpretive frame, rather than a neutral background.

5.7.6 Temporal Boundaries

The study captured Smartboards integration at a particular moment in South Africa's evolving digital education agenda. Policy frameworks, infrastructural investments, and professional development initiatives are dynamic and may shift over time. Consequently, the findings reflect conditions during the research period and may not fully account for

subsequent developments. The study's contribution is therefore best understood as a contextualised account of practice within a specific policy and institutional moment.

5.7.7 Future Research Directions

Future research should adopt longitudinal and mixed-methods designs to examine sustained pedagogical change and measurable learner outcomes over time. Comparative studies across diverse rural and urban contexts are also needed to better understand how infrastructure, leadership, and professional development ecosystems shape technology integration. Further inquiry should focus on threshold conditions for effective teacher development in digital pedagogy, as well as learner perspectives on Smartboards-supported instruction. Intervention-based studies examining scalable models of leadership, infrastructure support, and professional learning communities would further strengthen the evidence base for sustainable digital transformation in rural education.

By acknowledging these limitations, the study situates its contributions within a realistic and bounded scope. The triangulation of interviews, classroom observations, and documents strengthens credibility, yet the identified constraints highlight the interpretive nature of qualitative inquiry and the contextual specificity of rural schooling environments. These boundaries do not diminish the value of the findings; rather, they frame them as situated insights that illuminate both the potential and the challenges of Smartboards integration in South African Foundation Phase classrooms.

It is within this interpretive frame that the study's broader conclusions can be drawn. The limitations underscore the importance of cautious generalisation, while simultaneously reinforcing the significance of the study's contribution: a nuanced account of how Smartboards function as pedagogical tools within rural contexts. This careful positioning provides the foundation for the final synthesis, where the study's theoretical, practical, and policy implications are articulated.

5.8 CONCLUSION

Building on the limitations acknowledged above, this study has demonstrated that Smartboards technology can enhance teaching and learning in rural Foundation Phase classrooms, but only when embedded within coherent systems of pedagogical practice, teacher capability, instructional leadership, and infrastructural support. The findings show clear benefits in learner engagement, conceptual understanding, formative assessment, and inclusive participation; however, these outcomes are contingent rather than automatic.

A central insight is that Smartboards operate as pedagogical amplifiers rather than autonomous agents of transformation. Their effectiveness depends on the quality of teacher enactment and the stability of the institutional environment in which they are used. Where enabling conditions are present, Smartboards support interactive and conceptually rich learning; where they are absent, their use remains largely procedural.

The study further highlights digital inequality as a structural condition shaping educational opportunity in rural contexts. Uneven access to infrastructure, professional development, and institutional support continues to produce inconsistent learning experiences, reinforcing the need to conceptualise digital transformation as a systemic rather than technological challenge.

Theoretically, the study advances an ecological understanding of educational technology integration in which pedagogy, teacher knowledge, leadership, and context interact dynamically. This challenges linear models of technology adoption and reinforces the importance of contextual mediation in understanding digital learning outcomes.

In closing, Smartboards hold significant pedagogical potential, but their impact is realised only through systemic coherence. Sustainable digital transformation in rural Foundation Phase education depends not on technology provision alone, but on the alignment of human capability, institutional support, and infrastructural equity. Without this alignment, digital innovation remains uneven; with it, it becomes a meaningful lever for inclusive and high-quality education.

Ultimately, this study affirms that the integration of Smartboards in rural Foundation Phase classrooms is not merely a question of technological provision but of systemic coherence. By situating its findings within the lived realities of teachers, schools, and communities, the research contributes an original lens that foregrounds context as the decisive mediator of digital pedagogy. In doing so, it challenges universalist narratives of technology adoption and advances a more nuanced, ecological understanding of educational transformation. The originality of this contribution lies in its insistence that sustainable digital innovation in South Africa must be theorised and enacted as a relational endeavor, where pedagogy, infrastructure, leadership, and equity converge to shape meaningful learning opportunities.

“In re-centering digital pedagogy within the lived realities of rural schooling, this study affirms that educational technology becomes transformative only when grounded in context, sustained by human agency, and aligned with systemic vision.”

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APPENDICES:

Appendix A: Summary of Theme 1 sub-themes (data–literature–theory–interpretation)

Sub-theme	Example from data (participants responses)	Supporting literature (supports/contrasts)	Theoretical framework / challenges	Researcher's point of view
Interactive, hands-on activities	FPT1 and FPT2 describe learners coming to the board to drag/match and interact with storybooks and number lines.	Volpe & Gori (2019); Wilson & Duran (2025).	Constructivism/scaffolding (Vygotsky, 1978); disrupted by power/internet cuts.	Dragging/matching supports fine-motor coordination and concept formation; plan tactile routines.
Multimedia presentations	FPT3 and FPT8 emphasise pictures, songs and videos aligned to the curriculum.	Mayer (2009); De Silva et al. (2016).	Multimedia learning (Karthigesu & Mohamad, 2020); risk of overload/distraction.	Use short clips; pre-download resources for offline use.
Engagement / fun	FPT3 reports lessons are 'fun and interactive'; learners want to participate.	Djatmiko (2025); Higgins et al. (2012).	Learner-centred pedagogy; novelty may fade; requires purposeful tasks.	Use turn-taking and group roles to harness excitement.

Assessment & conceptual understanding	FPT7 uses Smartboards technologyfor comprehension; FPT4 uses colourful math activities.	Moran et al. (2023); Cabus et al. (2020).	Formative assessment + scaffolding (Vygotsky, 1978); teacher explanation needed.	Embed quick checks and explain reasoning behind answers.
Inclusivity	FPT6 adjusts font size; FPT1 supports struggling learners through multisensory tasks.	Qorib (2024); Rau et al. (2020).	Differentiation (Tomlinson, 2014); inequity if access/support is uneven.	Differentiate pace and modality; pair learners and rotate tasks.
Efficiency & pace	FPT2 notes reduced printing and smoother transitions between activities.	Shi et al. (2012); Shenton & Pagett (2022).	TPACK: efficiency depends on teacher fluency and prepared resources.	Create shared lesson banks and templates to reduce preparation time.
Connectivity & technical issues	FPT1–FPT5 report slow internet, power cuts, glitches and hardware problems.	IIARI (2025); SkoolBeep (2025).	Infrastructure as prerequisite; failures force reversion to traditional methods.	Mitigate with UPS/battery, offline apps, and printed backups.
Preparation & classroom management	FPT3 and FPT1 highlight time-consuming planning and learner crowding.	Beauchamp & Kennewell (2010); Wilson College Online (2024).	Classroom management routines needed for shared screen use.	Use stations/rotations; peer helpers; clear rules for turns.

Appendix B: Summary of Theme 2 sub-themes (data–literature–theory–interpretation)

Sub-theme	Example from data (participants responses)	Supporting literature (supports/contrasts)	Theoretical framework / challenges	Researcher's point of view
Skills coverage & development	FPT1/FPT4/FPT5 report confidence, listening and focus improvements.	Beauchamp & Kennewell (2010); Higgins et al. (2012).	Social constructivism; skills develop through participation.	Design participation tasks that build confidence and communication.
Lesson delivery & concept clarification	FPT1/FPT2/FPT3 report streamlined delivery and clearer explanations.	Mayer (2009); De Silva et al. (2016).	Multimedia learning; needs pacing to avoid overload.	Chunk content and use highlighting tools to guide attention.
Academic performance & multisensory learning	FPT1–FPT3 perceive improved retention and performance.	Cabus et al. (2020); Mnisi et al. (2024).	VAK/multisensory; sustained gains require alignment to outcomes.	Link activities to outcomes; track progress with simple rubrics.
Immediate feedback & assessment	FPT1 highlights instant assessment and progress tracking.	Moran et al. (2023); Vygotsky (1978).	Formative feedback loop; teacher must explain 'why'.	Use instant feedback to reteach misconceptions immediately.

Appendix C: Summary of Theme 3 sub-themes (data–literature–theory–interpretation)

Sub-theme	Example from data (participants responses)	Supporting literature (supports/contrasts)	Theoretical framework / challenges	Researcher's point of view
Professional development	FPT1/FPT2/FPT7 cite DOE, district and partner workshops.	Moran et al. (2023); Seaton et al. (2024).	TPACK development; quality and follow-up matter.	Prioritise hands-on PD with coaching and classroom application.
Skills acquired	Mixed: FPT1–FPT3 confident; FPT4–FPT5 need more advanced guidance.	Beauchamp & Kennewell (2010); Amemasor et al. (2025).	Teacher self-efficacy; practice time essential.	Provide practice time and micro-training on advanced features.
Ongoing support & mentorship	FPT5 reports limited structured mentorship; others rely on peers/SMT.	Haddad & Draxler (2021); Mwesigwa & Nakato (2025).	Organisational support; inequity where resources are scarce.	Set up ICT champions and structured peer mentoring.
Future PD opportunities	Requests for bursaries, ICT courses, creative training and peer sharing.	ETDP SETA (2024/2025); Digital PD & PLCs (2025).	PLC/communities of practice; needs context-sensitive delivery.	Cluster-based sharing, offline PD resources, and sustained mentoring.