



**DIGITAL TECHNOLOGY IN THE CLASSROOM:
REFLECTIVE PRACTICE INFORMING PRIMARY SCHOOL TEACHERS'
PEDAGOGIES**

by
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DECLARATION

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ABSTRACT

The arrival of the Fourth Industrial Revolution has ignited a transformative era, characterised by the rapid integration of advanced technologies into various spheres of human existence. In the realm of education, this technological revolution has paved the way for innovative approaches to teaching and learning, prompting an increased utilisation of digital technology within the classroom environment. As traditional educational paradigms evolve to embrace the digital age, educators find themselves navigating a dynamic landscape where pedagogical practices are filled with the potentialities of technology.

Grounded in the interpretive paradigm, this qualitative research used a single exploratory case study to delve into the reflective practices and pedagogical strategies used by primary school educators as they navigated the ever-evolving landscape of education in the digital era. Furthermore, in the hopes of exploring their reflective practices, the study aims to glean insights into the dynamic interplay between technology, pedagogy, and the frameworks that shape educators' instructional decisions. These frameworks include constructivist teaching and learning theories, and various models of incorporating digital technology into the classroom.

The researcher made use of purposive sampling to recruit six primary school teachers from two independent schools in the Western Cape. These teachers made use of and had access to digital technology in their classrooms. Data was generated through semi-structured interviews and teachers' reflective journals. Thematic analysis was used to reveal the themes and narratives from these sources. Through this process, the educators demonstrated adeptness in leveraging digital tools, aligned with their pedagogical ideals. Challenges, including distractions to learning and the negative impacts of using digital media, underscored the need for careful integration. Amidst these, gamification and project-based learning stood out, fostering engagement and critical thinking. This delicate interplay between technology and pedagogy emphasised the need for reflective practices when incorporating digital technology into education.

Navigating the technology-pedagogy interface demands nuanced understanding and purposeful application. This research contributes to the discourse on digital technology's role in education, advocating a harmonious synthesis of innovation and pedagogical intent.

Keywords: Digital technology integration, primary school teachers, reflective practice, pedagogical strategies.

OPSOMMING

Die koms van die Vierde Industriële Revolusie het 'n transformerende era ingelui, wat deur die snelle integrasie van gevorderde tegnologieë in verskeie sferes van die menslike bestaan gekenmerk word. Op die gebied van die opvoeding baan hierdie tegnologiese omwenteling die weg vir innoverende benaderings tot onderrig en leer, met 'n gevolglike toenemende gebruik van digitale tegnologie in die klaskameromgewing. Namate tradisionele opvoedkundige paradigmas ontwikkel en die digitale era omarm, bevind opvoeders hulle in 'n dinamiese landskap waar pedagogiese praktyke volop potensiaaliteit vir tegnologie bied.

Hierdie kwalitatiewe navorsing wat in die interpretatiewe paradigma geanker is, gebruik 'n enkele verkennende gevallestudie om te delf in die reflektiewe praktyke en pedagogiese strategieë wat laerskoolopvoeders gebruik namate hulle die immer ontwikkelende opvoedingslandskap in die digitale era navigeer. Met die oogmerk om opvoeders se reflektiewe praktyke te verken wil die studie verder insig bekom in die dinamiese interaksie tussen tegnologie, pedagogie, en die raamwerke wat opvoeders se onderrigbesluite vorm. Hierdie raamwerke omvat konstruktivistiese onderrig- en leerteorieë, asook verskeie modelle vir die inkorporering van digitale tegnologie in die klaskamer.

Die navorser het doelgerigte steekproefneming gebruik vir die werwing van ses laerskoolopvoeders uit twee onafhanklike skole in die Wes-Kaap. Hierdie opvoeders gebruik digitale tegnologie in hul klaskamers en het toegang daartoe. Data is gegenereer deur semi gestruktureerde onderhoude en die opvoeders se reflektiewe joernale. Tematiese ontleding is ingespan om die temas en narratiewe uit hierdie bronne te onttrek. Deur hierdie proses het die opvoeders getoon dat hulle kundig is in die gebruik van digitale gereedskap wat in pas is met hul pedagogiese ideale. Uitdagings, byvoorbeeld wanneer die aandag afgelei word van leer en die gebruik van digitale media 'n negatiewe uitwerking het, het die behoefte aan omsigtige integrasie beklemtoon. Spelaanwending en projekgebaseerde leer het uitgestaan as aspekte wat betrokkenheid en kritiese denke bevorder. Hierdie delikate interaksie tussen tegnologie en pedagogie beklemtoon die behoefte aan reflektiewe praktyke wanneer digitale tegnologie by opvoeding geïnkorporeer word.

Die navigering van die tegnologie-pedagogie-raakvlak vereis genuanseerde begrip en doelgerigte toepassing. Die navorsing dra by tot die diskoers oor die rol van digitale tegnologie in die opvoeding, en bepleit 'n harmonieuse sintese van innovasie en pedagogiese bedoeling.

Sleutelwoorde: Digitaal-tegnologie-integrasie, laerskoolopvoeders, reflektiewe praktyk, pedagogiese strategieë.

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CHAPTER 1

INTRODUCTION TO THE STUDY

The study aimed to explore primary school teachers' reflective practices that inform their pedagogy when using of digital technology in their classrooms. The nature and practices of education have gone through many transformations over the last few decades. The most recent development was the introduction of digital technology into the classroom. Many educators have gradually increased the use of digital technology in their classrooms; however, the COVID-19 pandemic propelled many students and teachers into the virtual digital teaching space (Mbhiza, 2021). Pre-2020, there was a steady increase in the use of digital technology as a resource in the classroom to aid curriculum delivery. However, digital technology, including online communication platforms, has recently reshaped and shifted the education paradigm (Mbhiza, 2021). These gradual and more rapid evolutions in education have seemingly developed into a new learning area that requires particular knowledge, training and skills.

1.1. Background and Contextualisation

1.1.1. *The 4th industrial revolution*

Aviram and Talmi (2004) state that the recent technological revolution is part of several 'intertwined revolutions' that have affected many facets of our lives and culture and that the Fourth Industrial Revolution (4IR) has far more technological advancements than the Third Industrial Revolution (Mpungose, 2020). New emerging technologies, like artificial intelligence and robotics, have revolutionised many parts of the world and shifted the focus on the required expertise and skills to function in the 21st century. Education is increasingly facing challenges of preparing a generation with the knowledge, skills and values required of the 21st-century global citizen (Chalkiadaki, 2018). Educational reform is an ongoing process and has shifted its aims to align with the demands of the current times and the emerging technologies in the 4IR. Educational goals are required to align with the future, especially the skills and competencies required of a 21st-century learner. These skills and sub-

skills are intended to equip learners with adequate academic and practical experience to be effective national and global citizens (Chalkiadaki, 2018).

Chalkiadaki (2018) found that digital literacy skills are ranked higher than other skills for education researchers and critical role players' interests. Information, knowledge, and communication have changed due to the rapid emergence of digital technology. The pace of these technological developments within education has significantly increased during the emergence of the COVID-19 pandemic, as many teachers and learners had to rely on remote digital teaching (Prieto-Ballester et al., 2021). It is essential for students and teachers to learn how to navigate this endless quantity of information, but to do so, the necessary skills are required to participate and engage with the different types of digital technology. This digital technology within a classroom can be described as electronic devices, tools, or platforms (apps and websites) that provide strategies to support schools' learning and teaching (The Education Endowment Foundation, 2021). The influence of this digital era, combined with the rapid emergence of remote teaching, has brought about a technological revolution in the educational context.

As a result, it is no surprise that incorporating technology into the education system has become a growing interest globally and in South Africa. Many stakeholders in the Department of Education, particularly the Western Cape Government (WCG) and Western Cape Education Department (WCED), have rolled out several action plans to increase school technology resources to create more opportunities for virtual learning environments. In 2003, the Department of Education released a Draft White Paper on e-Education which outlined the government's response to 'teaching for the twenty-first century' (Department of Education, 2003). This response emphasised that e-learning and information and communication technologies (ICT) resources have several benefits, such as increasing access to and quality of learning, reducing inequalities and providing opportunities to accommodate different learning styles (Department of Education, 2003). The WCG vision for e-learning in the Game Changer Roadmap aims to increase these resources and "enable universal access to an eLearning environment to all schools by 2019" (Department of the Premier, 2017). Increasing access to digital learning will

provide the skills needed for the future success of a 21st-century learner and has been said to increase learner engagement and effectiveness (Underwood, 2009). The eLearning Game Changer plan aims to use technology to improve the teaching and learning processes in the district, with a particular focus on languages and mathematics (Department of the Premier, 2017). This document serves as a commitment for the Department to “expand on its existing technology base and digital resources to create virtual learning environments at all schools by 2030” (Department of the Premier, 2017).

1.1.2. *The 2020 pandemic and e-Learning*

In March 2020, the WHO declared COVID-19 a global pandemic (WHO, 2020). Due to several precautions and lockdown measures, learning and teaching were significantly impacted. The UN reported that 94% of the world’s student populace was affected by the closure of schools and learning institutions, with an even higher percentage in lower-income countries (United Nations, 2020). As a result, several schools and teachers across the world and South Africa used alternative modes of teaching to attempt to continue teaching for the 2020 academic year. Several innovative methods, such as radio, television and ‘take-home packages’, were used as distance learning methods (United Nations, 2020). Many countries relied on ICT to deliver online lessons and continue teaching and learning for the year; however, this method was significantly varied. According to the United Nations (2020), this was primarily due to economic factors that impacted access to technology and its infrastructure and the digital literacy of students, parents, and teachers.

Incorporating and adapting to these new teaching methods in a turbulent year was a considerable challenge for many teachers. According to the United Nations (2020), not all were ready for the changes that took place. Only 64 % of primary and 50 % of secondary school teachers acquired minimum level of training, which did not always cover basic digital skills” (United Nations, 2020). The COVID-19 pandemic indicated significant economic disparities worldwide, especially in the education system; however, it highlighted new possibilities for the future of education. While the migration to virtual classrooms was more accessible for some developed countries, many developing countries, like South Africa, faced significant challenges in quickly adopting this approach (Oyedotun, 2020). This highlights

the significant role teachers play in this new paradigm of education. Therefore many education systems and teachers have had to adjust to the challenges and impacts of the COVID-19 pandemic (Mbhiza, 2021)

1.2. Problem Statement and Purpose of the Study

The importance of adopting and enhancing digital technology in the teaching and learning space has never been more apparent (Jansen & van der Merwe, 2015; Mbhiza, 2021). A review of literature on digital technology in the classroom and the 2020 COVID-19 lockdown highlighted that it is increasingly forming a large part of teaching and learning (Oyedotun, 2020; Schleicher, 2020; United Nations, 2020). As a result, there are many new possibilities for education and developing curricula. Many countries, including South Africa, are adjusting their curriculum to address the needs of the 4IR (Mpungose, 2020). Several authors and institutions have indicated that technology can provide countless opportunities for teachers to meet learning outcomes while providing several benefits to students' learning experiences (Jansen & van der Merwe, 2015). As Hashim (2018) explains, this new generation of learners and emerging technologies is challenging many educators' traditional education paradigms. Due to these developments, educators will therefore have to reflect on how technology is used in their classrooms, as this new model of education may create different challenges in teaching and learning processes (Mayes & De Freitas, 2007)

A good pedagogical design is said to have congruency between the curriculum, teaching practices, the learning climate, and how we assess learning (Biggs, 2003). Biggs (1999) explains that one must first analyse the underlying assumptions of learning before adopting teaching practices that align with them. Therefore, there is a substantial need to explore and investigate the consistency of the teaching practice of digital learning technology with the underlying assumptions about learning. The education system and its vital role players may need to become more reflective in their learning and teaching practices to ensure they align with the intended learning outcomes. Educators are challenged to advance their training and knowledge of emerging technologies. They need to "rethink and redesign education that suits the need of the new generation of learners in the digital era" (Hashim, 2018, p. 4).

The study aimed to explore and understand teachers' experiences incorporating digital technology into their classrooms using a basic interpretive qualitative design. The study attempted to uncover teachers' reflective practices which inform their pedagogy when using digital technology as a teaching method. Furthermore, it was examined whether their adoption of this method aligns with their underlying assumptions of teaching and learning. This research was conducted using a qualitative design grounded in the interpretivist paradigm (Merriam, 2002)

1.3. Concept Clarification

In the context of this discussion, it is necessary to clarify several concepts and ideas as they hold significance central to this study. These include "Digital technologies in the classroom", "Teachers as reflective practitioners", and "Reflective pedagogies and practices". Through a comprehensive examination of their contextual relevance within this study, the aim is to delve into the importance of these specific concepts that underpin the research questions and overall study.

1.3.1. *Digital technologies in the classroom*

Several forms of digital technology are emerging at a quickening pace, and these advancements have started to influence the process of teaching and learning (Hashim, 2018). For the purpose of this research, the broad term of digital technology will include different forms of new technology that have emerged in the classroom setting. Hashim (2018) described examples of these emerging technologies as cloud computing, mobile technology, open online platforms, electronic games and augmented and virtual realities. Mpungose (2020) defines educational technology as the use of resources to assist in delivering the curriculum in the classroom setting. Therefore, the term digital technology is not only limited to physical, electronic devices like computers, tablets, interactive whiteboards and phones but also includes the platforms, media, applications and online tools educators use in their teaching and learning processes. All resources, platforms, and technology mediums used to assist educators in the teaching and learning processes were explored.

1.3.2. *Teachers as reflective practitioners*

Teachers must navigate the space between being taught theoretical practices and pedagogies and applying this knowledge in practice. Kinsella (2010) highlights that within this gap of the implementation of theoretical understanding to a less than pristine context, reflection is an essential skill in the process. Kinsella goes as far as to connect the ability to be a reflective practitioner to developing the artistry of practice (2010). Many authors have referred to John Dewey's work from 1904, which points out that a teacher in training should instead be more aware and reflective than focusing on their 'immediate proficiency' (Dewey, 1904). Within the teaching profession, countless decisions need to be made; some require more time and planning, and others require a faster response (Adler, 1991). Therefore, as Dewey noted, a teacher needs the expertise, training and critical reflective skills to be mindful of the impact of their decisions and practices (1904).

This ability to use a reflective and thoughtful approach in many different and novel scenarios is what Schön (1983) defines as a reflective practitioner. He continues to differentiate this process into several levels. The first is "knowing in action", which is shown in applying one's skill or knowledge in practice (Schön, 1983). This level does not necessarily include the element of reflection, as one is responding to various events from experience and training. The next level would be "reflection-in-action", summarised as the ability to use thoughtful reflection to make decisions (Adler, 1991). Schön highlights 'naming the problem' and 'framing the context' as essential elements of reflection in the action process (1983). Zeichner and Liston (1987) expand on reflective teaching by describing three levels of reflection. The first is for the professional to evaluate whether their application of skills and practices has resulted in meeting objectives (Zeichner & Liston, 1987). The second and the third levels delve deeper into considering the influence of the context in the teaching and learning process and finally consider the ethical and moral impacts of one's practices (Zeichner & Liston, 1987). Navaneedhan (2011) explains that reflective teaching examines the thoughts and processes of the methodologies or practices in the classroom. This motivates educators to be "reflective practitioners" when combining technology with their teaching (Beetham & Sharpe, 2007). Introducing technology into education may raise questions

about how learners learn best and how teachers should incorporate this into the classroom, the pedagogy of technology (Beetham & Sharpe, 2007). Crook et al. (2010) note that introducing technology to education can create unmeasurable impacts and shift the balance of different learning experiences.

Therefore, educators may have to reflect on how they incorporate technology into their lessons, as there could be many undetermined effects. They should ensure that they reflect on their pedagogies and find the balance between using innovative technology to enhance and transform learning. Makarova (2018) warns educators to “not be carried away with all the innovations and new technologies no matter how well they are right for a particular class” (p. 58). Essentially, as the nature and platform of the classroom revolutionise, it appears that teachers are required now more than ever to be reflective practitioners.

1.3.3. *Reflective pedagogies and practices*

Pedagogy is a term frequently used to describe the ‘how’ of teaching. Beetham and Sharpe (2007) highlight how this term has evolved from simply the mechanisms, processes and techniques of teaching to include a learner-centred frame of reference. More recently, rather than merely considering pedagogy as the ‘art or science of teaching’, it considers the learners’ experiences, engagement, and outcomes as a central point (Beetham & Sharpe, 2007). The term has shifted from a ‘teacher’ or ‘teaching’ focus to having the ‘learner and ‘learning’ as the central goal and measured outcome. Schön (1983) notes that ‘reflective practice’ should help connect the application of theory to achieving the learning goals. The reflective practice would encourage teachers to ensure they have the ‘how’ of teaching while still employing a learner-centred approach. Considering the discussion of what a reflective teacher is, one could assume that their pedagogies and practices would need to allow them to reflect and consider alternatives critically. Susan Adler notes that critical pedagogy, the ability to be aware of different perspectives and question or analyse assumptions within a particular context, needs to start from their ‘pre-existing beliefs’ in training (1991). This is promoted by encouraging teachers to become aware of their sense of agency, reflect on their assumptions and even see themselves as creators of the curriculum (Adler, 1991).

Arguably, for practitioners to reflect on their pedagogies, one would suppose that they are adequately trained in employing technology in their classroom. Pedro et al. (2018) highlight this as a gap in the “theoretical and pedagogical foundations regarding the implementation of mobile learning in educational contexts” (p. 5). Whether teachers have been adequately prepared and trained to incorporate such a complex tool into their classroom is another issue when looking at digital technology in education. Beetham and Sharpe (2007) note that many teachers who do incorporate digital technologies are “accused of using them regardless of whether or not they are pedagogically effective” (p. 3). Instead, they note that reflective teachers should aspire to incorporate digital technologies into ‘proven practices’ and pedagogies without shifting the core structures of how people learn (Beetham & Sharpe, 2007). Valli’s (1992) reflection framework was employed in this research to aid in differentiating the various levels of reflection expressed by the participants.

1.4. Theoretical Framework

1.4.1. *Constructivist learning and teaching*

Contemporary pedagogies focus on incorporating the constructivist view of learning and note that learners are not “passive recipients of knowledge and skill” (Beetham & Sharpe, 2007, p. 2). As Biggs (1999) terms it, educators modelling the ‘constructive alignment’ would hope to associate their pedagogies and practices with the underlying constructivist assumptions. In essence, these assumptions place the learner at the centre of the classroom and promote the idea that understanding is gained when a learner actively engages in learning activities (Mayes & De Freitas, 2007). The concept of a child learning through actively engaging with learning material rather than passively receiving information is one of the central notions of Piaget’s constructivist theory of knowledge (1970). In a ‘constructivist-aligned’ classroom, each learner’s needs, and personal factors, like motivation, autonomy and self-efficacy, are valued (An & Reigeluth, 2011). A further influence of constructivist pedagogy stemmed from the work of Vygotsky (1978). He defined the zone of proximal development (ZPD) as the “awakening” of inner development through interactions with the child and others in their environment

(Vygotsky, 1978). Considering a constructivist approach to learning, it is believed that learning occurs through social interaction and active meaning-making (Oliver & Herrington, 2003). From this approach, for learning to occur, a child needs to engage with others and take an active role in formulating their understanding of the content.

As digital technology becomes more apparent in the classroom, the possible influences on this 'constructivist alignment' must be considered. Teachers intending to include digital technology need to reflect on their pedagogies to ensure it is aligned with the constructivist assumptions of learning. Mayes and De Freitas (2007) note that in some cases, digital platforms, like the internet, allow for social interaction on a significantly larger scale, which promotes the ideals of Vygotsky's (1978) core concepts of learning. They note that the 'e-learning' practices can promote learners' active engagement and empower "learners to take reflective control of their own learning" (Mayes & De Freitas, 2007, p. 23).

However, several researchers highlight the possible impacts of adopting emerging technologies in education on teaching and learning processes (Aviram & Talmi, 2004; Crook et al., 2010; Underwood, 2009). One of the concerns is that educators need to be conscious of the threats to the "human dynamics" that this new digital world could impose in their classrooms (Pedro et al., 2018). Nevertheless, according to Oliver and Herrington (2003), utilising technology as a learning tool may increase the opportunities for constructivist learning. They state that the nature of technology is learner-centred and allows individuals to make relevant connections or meaning from their contexts (Oliver & Herrington, 2003). In addition, Beetham and Sharpe (2007) state that digital technology offers ways in which education can make a difference by providing an inclusive education system. Teachers must be cognisant of the possible implications that it may have on learning and the possibilities to develop 21st-century skills.

1.4.2. *Models of incorporating digital technology in the classroom*

Several models have been created to incorporate and make effective decisions regarding digital technology in the classroom (Keshavarz & Ghoneim, 2021; Wang, 2008). These include SECTIONS (Students, Ease of use, Cost, Teaching functions, Interaction, Organizational issues, Networking,

Security and privacy) by Bates and Poole (2003) and the ICARE (Introduce; Connect; Apply; Reflect; Extend) model by Hoffman and Ritchie (1998). A generic model, outlined by Wang (2008) highlights the core components to consider when hoping to incorporate digital technology effectively, these are pedagogy, social interaction and technology. This model notes the importance of considering how the use of digital technology influences social dynamics and collaboration in the classroom, as well as how learning is designed and scaffolded (Wang, 2008). Dr Ruben Puentedura presented a specific model which assisted in comprehending how educators used digital technology in 2006 (2006). He formed a model where one could consider the use of technology in the classroom (Puentedura, 2006). This model, called the SAMR Model (Substitution, Augmentation, Modification, and Redefinition), was intended to help educators reflect on why they selected digital technology in their classroom processes and how they use it (Puentedura, 2013). Puentedura (2013) remarked on how digital technology had the potential to help with teacher's pedagogical development and find more confidence in incorporating technology into the classroom. The SAMR Model will be used in this study as a framework for analysing teachers' use and decisions of incorporating digital technology into their classrooms.

1.5. Research Question and Objectives

The research question that guided this research was formulated as: *What reflective pedagogical approaches and practices do primary school teachers employ when integrating digital technology into their classrooms?*

Research objectives stemming from this question include the following:

1. To determine the pedagogical approach (how) employed when digital technology is used for teaching and learning in the classroom.
2. To investigate the reflective practices or processes educators employ when they incorporate digital technology into their teaching.
 - a. Investigate how educators rationalise including digital technology in their teaching and learning.
 - b. Explore the educators' evaluation of the effectiveness of making this inclusion.

3. To generate suggestions to improve the implementation of relevant digital technologies in the classroom.

1.6. Overview of Research Methodology and Approaches

Various approaches and aspects of this study were conducted with a perspective framed by the interpretivist paradigm. Qualitative research methods were used in the methodological approach. Consequently, an exploratory case study design was chosen to provide insights and answers to the research query at hand. To delve deeper into these methodological decisions, Chapter three will comprehensively elaborate on the rationale behind these selected approaches.

1.6.1. *Epistemological paradigm: Interpretivism*

The research drew from the foundations of the interpretivist theoretical paradigm, which underpin the nature in which we come to know knowledge (epistemology), the nature of reality (ontology) and the discipline used in collecting information. The research operated on the theoretical assumption that no singular and objective reality exists. Instead, reality is seen as multiple perspectives that each individual has constructed from their social and experiential backgrounds from which they would make meaning of their world (Cohen et al., 2018; Lincoln et al., 2018). Based on this ontological assumption, the researcher became immersed in the context and actively engaged with the participants, attempting to understand the multiple views and experiences that were held. These efforts were vital in ensuring the knowledge produced is reflective of the participant's perspectives and realities (Lincoln et al., 2018). Through participation with the educators, one gained a better understanding of their expectations, previous experiences and thoughts about technology in education. Furthermore, this highlighted their reflective practices in their teaching and learning pedagogies.

Within this lens, gaining knowledge and viewing knowledge (epistemology) needs to be based on acknowledging the importance of the context, such as the cultural and historical setting of the participants (Creswell, 2020). Understanding the environment the educators work in aided in understanding how the participants formed their interpretations. Krauss (2005) highlights that this

meaning-making is done through a co-created process between the participants and the researcher. A deeper understanding was constructed by engaging in dialogues through semi-structured interviews with educators about their practice and personal reflections on using digital technology in their classrooms.

1.6.2. *Methodological approach: Qualitative research*

This study utilised a qualitative design, as it correlated with the interpretivist paradigm's underpinning and theoretical assumptions. The reason for selecting this approach was that qualitative research aims to understand social interactions and find meaning in phenomena within the context (Carter & Little, 2007). Furthermore, the basic qualitative design provides opportunities for the researcher to get insight into the participant's experiences and understanding of particular phenomena, like using technology in the classroom (Merriam, 1998, 2002). Data collection was done using inductive research methods for descriptive data (Merriam, 2002). Instead of narrowing the data down, like many quantitative techniques, qualitative methods aim to work inductively to enhance themes and subjective meanings from the data received (Creswell, 2014). These attributes of qualitative research relate to the objectives of this study, which hopes to explore and understand the participant's reflective approaches to incorporating digital technology in the classroom.

1.6.3. *Research design: Single exploratory case study*

A case study design has traditionally been understood to be an intensive analysis of a 'bounded unit' or an understanding of a particular time, event or group (Merriam, 1998). More recently, the definition has been expanded to it being a means of understanding how specific phenomena in a particular place are connected to broader contexts and processes (Schwandt & Gates, 2018). The research made use of a single case study design, as it referred to one group of Grade 4 to 7 teachers' experiences of using digital technology across multiple sites; however, it did not compare these to another group (Tight, 2017). An exploratory case study was conducted to uncover patterns and themes from the data, namely the reflective practices that teachers used when including digital technology in

their teaching and learning processes (Yin, 2009). Further rationalisation for selecting this design is discussed in Section 3.3.

1.6.4. Research setting and sampling

Two educational settings were identified as research sites. They met the selection criteria of being independent schools based in Cape Town that have exposure to and existing use of digital technology as a resource in the classroom. They have access to different digital resources, like computers, tablets and other devices. These schools also may have offered some form of online learning platforms during the lockdown period.

Six participants were selected from these two sites by the use of purposive sampling. This form of sampling is the method of selecting participants with specific characteristics who would provide the best information per the purpose of the research (McMillan & Schumacher, 2014). These participants met the selection criteria in that they had access to and incorporated digital technology into the teaching and learning processes. The targeted participants teach grades four to seven. The motivation for selecting these grades is that there are more content-heavy subjects which may provide greater diversity for incorporating digital technology into teaching and learning. The participant particulars are discussed in greater detail in Chapter 3.

1.6.5. Data collection

Qualitative research design uses an inductive data collection approach, focusing on exploring the participants' experiences (Creswell, 2014). Semi-structured interviews were conducted. This structure provided several predetermined questions and allowed for the opportunity to ask open-ended questions, probe, and clarify to gather the inner perspectives of the educators. Patton (2002) states that the nature of the open-ended questions allows researchers to gain the participants' insights rather than predefining them with narrow lines of questioning. Educators were given the opportunity to share their insights and experiences of using digital technology in their classrooms during the interview. Interviews were conducted either online, using Microsoft Teams, or in person. The interview platform depended on the

participant's preference. In addition, they were asked to provide a reflective journal of what a typical week would look like in their classroom, and specifically identify how they incorporated digital technology in their teaching and learning. These reflections offered some considerations of how digital technology was used in teaching and learning processes in the classroom. Participants shared these reflections in voice clips or written form. Memos, field and research notes assisted in the data generation process as the researcher was able to keep track of different choices that were made regarding the collection and analysis of the data (Cohen et al., 2018). Furthermore, these notes allowed for further reflection and awareness of personal thoughts and reactions during the research process.

1.6.6. Data analysis

Braun and Clarke (2006) outlined thematic analysis, which was more recently adapted to create the reflective thematic analysis in six phases (2019). These reflective processes were used in the data analysis process and will be described in greater depth in Chapter 3. These phases are as follows: familiarising with the data, generating initial codes, searching for themes, developing and reviewing themes, refining, defining and naming themes and producing the report and contextualising (University of Auckland, 2019). This analysis aims to help identify patterns and themes from the data, which is said to be more of a bottom-up or inductive process (Maguire & Delahunt, 2017). With a reflective approach, the themes were drawn from the interview data and educators' reflections. The researcher's subjective role during this knowledge production remained cognisant during the analytical process and reporting on the data. These patterns may provide insight into how educators think about or plan for using digital technology in their classrooms across the two educational settings.

1.6.7. Quality criteria

Several authors note criticism that questions the credibility and quality of this interpretivist qualitative approach, namely surrounding subjectivity and bias (Cohen et al., 2018; Lincoln et al., 2018; Willis, 2012). Potential disadvantages of this approach claim that the subjective nature of the researcher's methods of enquiry lacks rigour and could introduce bias when interpreting the data

(Lincoln et al., 2018). However, there is some irony in the fact that an interpretivist paradigm adopts a relativist ontology and does not believe there is a singular objective reality that a researcher could measure (Lincoln et al., 2018; Willis, 2012). Rather, human phenomena and experiences are subjective in their nature and one must immerse themselves in this to enhance their understanding within the context (Lincoln et al., 2018).

Despite this, in an attempt to address credibility and quality challenges, specific measures were employed to ensure the validity and trustworthiness of the data. As Patton (1999) states, this is done by providing the rigour of the methods to gain high-quality data, which will be analysed using triangulation. Patton (1999) explains that the process of triangulation involves using multiple methods and perspectives to provide opportunities to cross-check the validity of the data. The six semi-structured interviews and the educator reflections review allowed for such validity checks of the data and to understand any inconsistencies that arose.

As Braun and Clarke (2020) recommend, the quality and reliability of the data analysis will be gained through reflexivity. Braun and Clarke's (2020) set of reflective questions assisted in evaluating the researcher's paradigmatic, epistemological and ontological assumptions, which undeniably informed the thematic analysis process. Another measure that was used to ensure data credibility was member checking. Lincoln and Guba (1985) describe this as a way to check findings, interpretation and conclusions with the participants and is said to be a vital technique for ensuring credibility. Informal techniques, such as providing the educators with verbal summaries during their interviews, were used to ensure their perspective was accurately understood. This allowed educators to respond immediately and correct errors or add further details to ensure the data collected was credible and authentic to their perspective.

1.6.8. Ethical considerations

In order to uphold a high ethical standard in the research, several considerations and guideposts, like those mentioned in Allan (2016), were included. Informed consent was obtained from participants, and they were assured that their participation in the research was voluntary to ensure the right to

autonomy was respected. Confidentiality, anonymity and privacy were included as ethical considerations in the decision-making. Additionally, we utilised data collection and analysis methods that had a sound ethical approach to ensure that every aspect of the research was conducted ethically. These specific considerations and choices will be discussed in greater detail in Chapter 3.

1.7. Conclusion

This chapter outlined the introduction and rationale for the study, the research questions, and the methodologies employed. Several ethical considerations were also outlined. The research aims to explore the practices and decisions of teachers regarding the use of digital technology in the classroom. The following chapter will explore the existing literature on using digital technology in the classroom and how teachers use reflective practice. The relationship between these two concepts will be discussed, highlighting any possible gaps in research or literature.

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

The previous chapter provided a brief insight into digital technology and the emerging trends in education. It offered an overview of reflective practices and how teachers may utilise them when incorporating digital technology into their classroom teachings and learning processes. This chapter's literature review aims to comprehensively analyse various sources related to the research topic and identify gaps in current knowledge with certain areas being discussed (Figure 2.1).

Firstly, the overarching constructivist learning theories will be reviewed to gain an extensive understanding of teaching and learning, which form part of the current study's theoretical framework. Secondly, the impact of the 4th Industrial Revolution is discussed with a specific focus on what this looks like in a South African context. Thirdly, more recent impacts of the COVID-19 lockdown and the growing emergence of e-learning are explored. Finally, reflective practice is conceptualised from various literature, concentrating on whether teachers use it when incorporating digital technology into their classrooms. Several models of incorporating digital technology into the classroom, like the SAMR model, are reviewed and discussed. While there has been a significant increase in literature on digital technology in the classroom and teachers being reflective practitioners, there appears to be less combining the two topics. There appears to be a gap in the literature regarding teachers employing reflective practices when utilising digital technology in education.

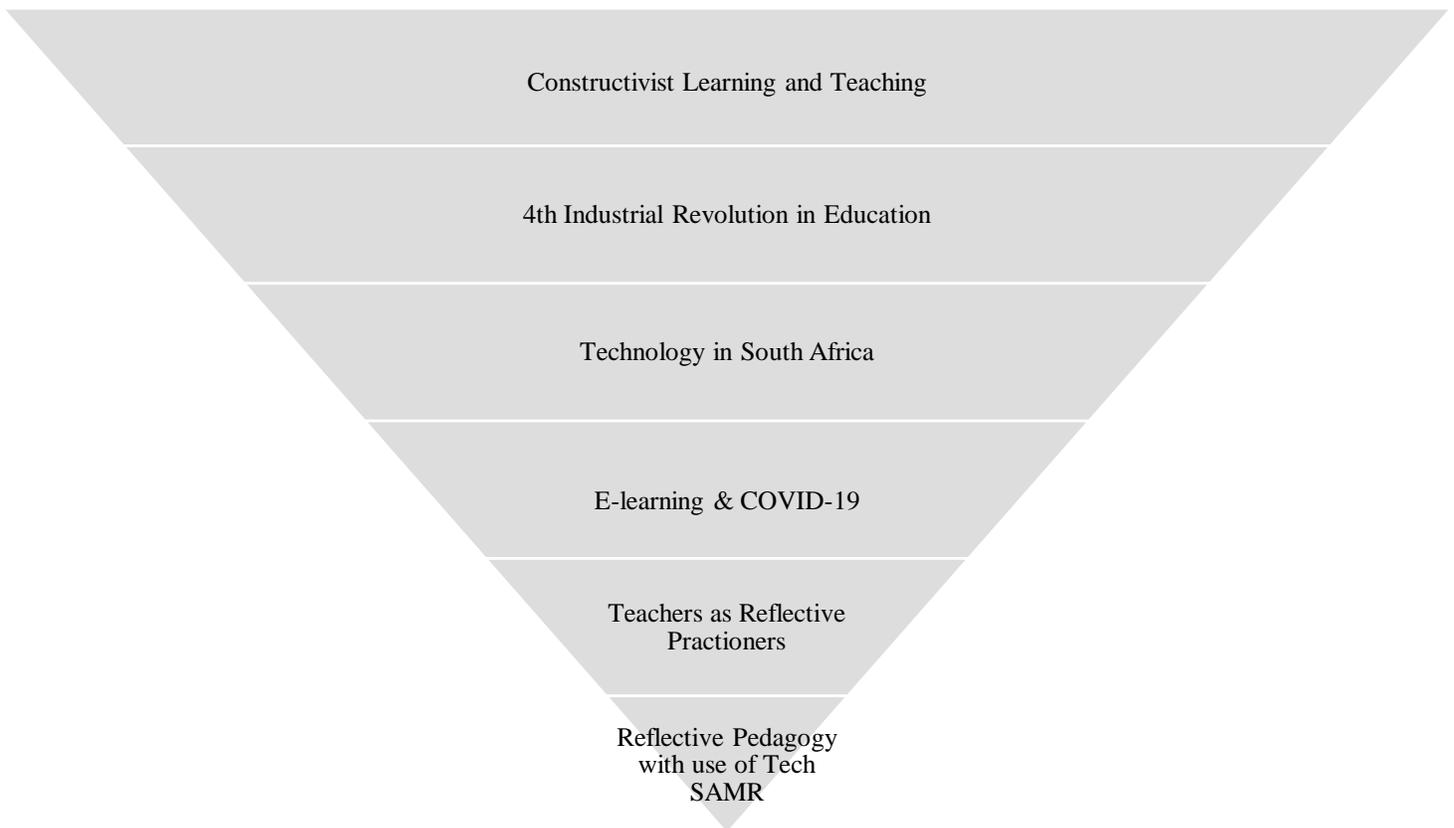


Figure 2.1: Conceptualisation of Chapter 2

2.2. Theoretical Framework

2.2.1. *Constructivist learning and teaching*

Constructivist learning, also known as social constructivism, encourages learners to be active and self-directed in their learning for it to be a meaningful experience (Dewey, 2009). This is the central common focus held by developmental theorists such as Piaget and Vygotsky; however, Vygotsky's social constructivist approach strongly emphasises the social aspect of learning, recognising its power to facilitate the process (Brown et al., 1986). In addition, Vygotsky (1978) introduced the concept of the Zone of Proximal Development (ZPD), which is the space where learning occurs via social interaction.

"The zone of proximal development is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers"
(Vygotsky, 1978, p. 86)

During social interaction, learning is facilitated by watching, copying, and collaborating with others (Mellis et al., 2013). As Wertsch (1998) described, intersubjectivity - the mutually created understanding between the expert and the learner - is vital to the learning and mediation process. Within this shared understanding and mediated space, information is processed and internalised into the learner's understanding. This results in a gradual reduction in support and assistance as the learner grapples with and comprehends the information (Verenikina, 2003). However, a simple understanding of transferring knowledge or skill from the expert to the learner is not an adequate conceptualisation of learning. Bransford et al. (2000) reinforce that learning is enhanced when teachers are mindful of the learners' perspectives and prior knowledge of that particular concept. Therefore, constructivist teachers are reflective of the framework that their learners enter the classroom with and continue to monitor their learners' assimilation of the knowledge to their pre-existing understandings. When these elements are dismissed, learners may acquire an incorrect and varied understanding of new material as opposed to what the teacher intended (Bransford et al., 2000). This educational implication of the social constructivist approach has significance to the discussion of teachers' reflective practices when incorporating digital technology into their classrooms. Moreover, if teachers make use of digital technology in their pedagogy without the consideration of intersubjectivity, it could influence teaching and learning.

Brown and Reeve (1985) reiterate that the expert's or teacher's roles are significant but not explicitly crucial to learning, as children can direct and coordinate their own learning. Thus, self-directed and active learning can initiate a child's learning that is independent of the influence of adults. This view is supported in further literature from Brown et al. (1986) who note that the teacher or teachings do not have to be central to the learning activity. In this context, learning can occur when a teacher carefully

sets tasks within the ZPD allowing for self-directed problem-solving and exploration of topics. This principle links to an overt implication of using digital technology in the classroom as the teacher becomes less centralised in the learning process. Therefore, the use of digital technology as a medium to explore and uncover different topics in the classroom reduces the dependency on the teacher to impart the knowledge, but rather reinforces their role as the facilitator of the learning process (van Harmelen, 1998).

In addition to self-directed and teacher-mediated learning, peer and collaborative problem-solving also provides opportunities for learning growth and development (Kelley & Thihaut, 1969). Working in a group to find solutions allows for opportunities to learn from peers and has several benefits. Engagement with peers and working in groups can often be a preferred way of doing tasks for many learners (Brown et al., 1986). Several reports have noted that this preference may not solely be motivated by the perceived enjoyment of working with others but also the benefits of task completion (Brown et al., 1986; Doolittle, 1995). In this context, the responsibility for solving problems is shared amongst the group members and learners can rely on others' support in achieving their individual and group goals (Doolittle, 1995). Further, Brown et al. (1986) explain that learners are given the opportunity to be exposed to differing perspectives and skills and can gain an understanding of others' perspectives. However, it is still vital for teachers to monitor these group tasks to ensure learners remain cooperative. Teachers must therefore ensure that tasks are structured to promote equal responsibility and foster the social skills required for group work (Doolittle, 1995). Teachers should also remain cognisant of any changes to the environment as variations in a learner's learning or social environments could result in vital differences in their thinking and development (Brown & Reeve, 1985).

Although the descriptions above indicate that teachers are not always central, it does reiterate the critical role in designing and monitoring the learning process. This highlights the importance of teachers' reflective practices. Whether learning tasks are designed to incorporate group problem-solving or digital technology, teachers must continue to monitor and analyse the learners' progress and facilitate any necessary skills, (socially or digitally). This view is further elaborated upon by Brown and Reeve (1985), who describe teachers' responsibilities to include designing appropriate and reachable tasks (within the

ZPD), separating the task into more manageable steps, creating and monitoring interactions that are at the learners' cognitive level, and continuously adjusting these strategies as the learners indicate mastery. If tasks or assessments are too static or advanced, or if the teacher does not allow for reflective thinking, the results can be an insufficient measure of a learner's true potential. Several of these implications for teachers were discussed by Bransford et al. (2000) who provided an overview of the implications of teaching and learning (see Figure 2.2).

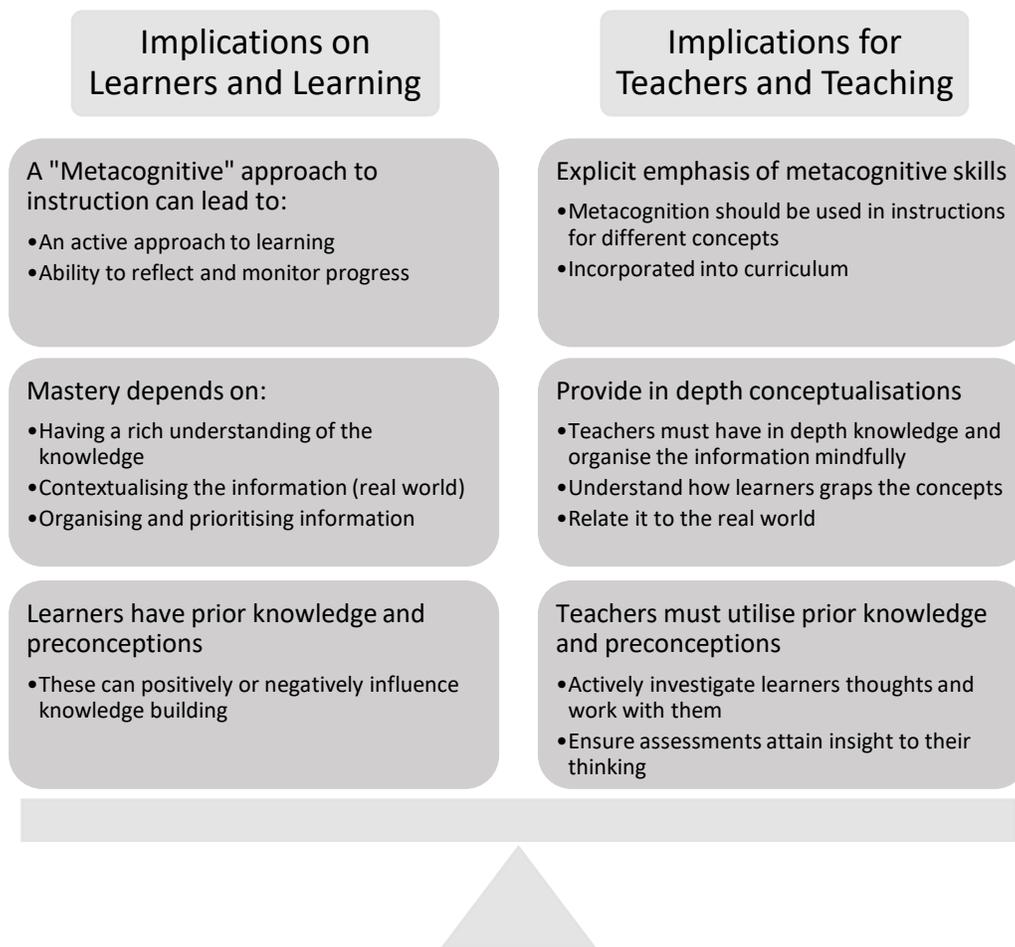


Figure 2.2: An adaption of Bransford et al. (2000) overview of research on the implications on education

Note: Summary of research on the implications of teaching and learning. Adapted from How People Learn: Brain, Mind, Experience, and School (p. 14), by J. Bransford, A. Brown and R. Cocking, 2000, The National Academies Press. Copyright 2000 by National Academy of Sciences.

The figure above indicates that mastery of a concept or skill requires contextualisation of information so that learners can solve problems that are relatable to their own contexts (Bransford et al., 2000). This type of *situated learning* is a constructivist approach that focuses on providing students with meaningful tasks and activities based on their individual needs, interests, and experiences (Lave & Wenger, 1991). These activities are designed to help students develop their understanding of concepts by engaging in meaningful and relevant learning experiences. Furthermore, situated learning has been correlated with increased motivation among learners as they can relate to the content and see the need to gain that particular knowledge or skills (Doolittle, 1995). As digital technology becomes a more prominent part of learners' everyday lives, incorporating it into teaching and learning adds relevance and may assist in creating opportunities for situated learning. However, as Verenikina (2010) emphasises, the interactivity must remain in the teacher's control and not the implemented device. They reinforce that "it is the teacher who orchestrates the classroom learning environment by making everyday decisions on pedagogically appropriate interaction arrangements." (Verenikina, 2010, p. 6).

2.2.2. *Models of incorporating digital technology*

Several educational researchers have developed frameworks to guide teachers in integrating digital technology into the classroom; however, Wang (2008) notes that their usage is reduced due to their impracticality. This ineffectivity relates to the dilemma posed earlier by Schön (1995) who notes that a technical rationality approach is not as simple when applying it to a more complex and intricate environment such as a classroom. In this context, teachers may not find it easy to apply these technical and intricate frameworks to their day-to-day planning and decision-making. Kirschner et al. (2004) reinforced that although teachers would prefer to follow a simplistic tool, like a checklist, they must follow models that stimulate deeper reflection about the pedagogical choices regarding the use of digital technology. In response to this, Wang (2008) suggests a generic model which involves only three components: pedagogy, social interaction, and technology. It is essential to consider the educational or digital resources (pedagogical design) used to reach the goal of carefully scaffolding the learning experience (Kirschner et al., 2004; Wang, 2008). This design planning is not limited to before the

induction of a lesson but must be continually reassessed during the task, applying reflection-in-action (Schön, 1995; Wang, 2008). The social constructivist teacher must therefore ensure that the design and use of digital media also foster an environment for collaboration and learning with/from others (Mellis et al., 2013).

This leads to the second component of Wang's (2008) generic model - social interaction. Wang (2008) reiterates that when selecting various digital media, a teacher must consider how the learner interacts with the content and other people using different digital media (interface). As highlighted earlier, collaborative learning promotes learner engagement and motivation. Moreover, digital-based collaborative learning brings similar benefits to the learner's ability to work through different problem-based tasks (Uribe et al., 2003). The constructivist concept of interactivity, the communication, and mediated space between two individuals can also be applied to the interactions between the learner and content (learner-content), the learner and others (learner-people), and the learner and the digital technology (learner-interface) (Wang, 2008).

The final component noted in the generic model relates to digital technology and its usefulness. Wang (2008) notes that teachers must be cognisant of the interface's ease of use and ease of learning to enhance learning goals. Kirschner et al. (2004) provide a concept of usefulness to investigate the benefits and implications of selecting digital technology for an activity. They divided usefulness into utility (educational and social functionality) and usability (technological usage) (Kirschner et al., 2004). Using this conceptualisation of digital technologies' usefulness will help teachers reflect on the educational, social, and technological affordances it could provide in the learning tasks (Kirschner et al., 2004). This is an essential reflective step because as different learning activities can change learning outcomes, so can the use of different digital technologies.

2.2.2.1. The SAMR Model

The purpose of the SAMR model was to guide and assist teachers in utilising digital technology in the classroom more effectively. It is represented as a ladder, as seen in Figure 2.3, and encourages teachers to enhance their teaching and learning by moving to higher levels of educational digital

technology integration (Hamilton et al., 2016). The lower two levels of the model allow for the enhancement of tasks, but have limited ability to change and transform them. The first level, *substitution*, is when a teacher replaces a physical activity with one that is based on digital media without creating any functional change or enhancement (Puentedura, 2016). Next, *augmentation* refers to the use of digital technology that provides some changes to functionality and enhances some aspects of the learning activity (Puentedura, 2016). For example, while a child is reading an online passage they can click on unknown words that would then have an audio voice interface which could define them. The following two levels allow for the transformation of the learning tasks and goals. *Modification*, the third level, substantially redesigns a learning task (Puentedura, 2016). Augmented reality applications are an example of this transformation as the learners can see a visual representation of a concept while being able to interact with and manipulate it. The final level is *redefinition* where the integration of digital technology provides innovative activities (Puentedura, 2016). For example, learners can display their understanding of a concept or skill in a completely different digital format such as a video or online website.

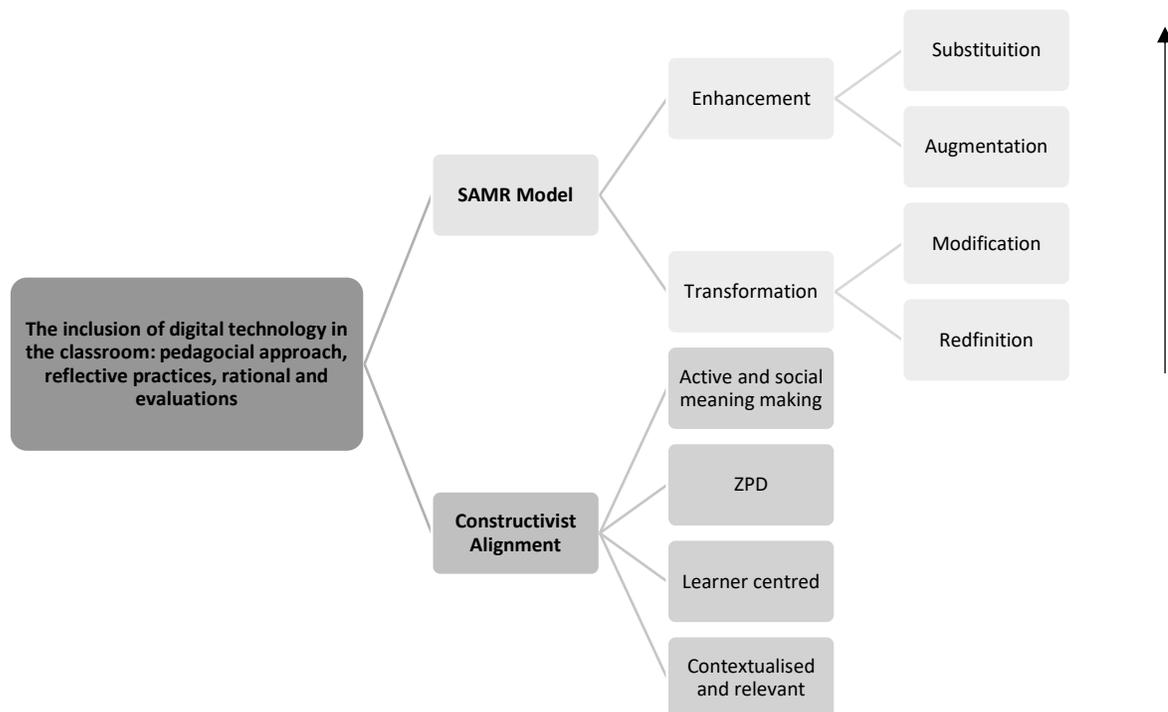


Figure 2.3: A combined representation of the theoretical frameworks used in this study

2.3. 4th Industrial Revolution in Education

The industrialisation of the first three revolutions not only influenced the global markets and forms of communication but also changed the teaching and learning landscape (Oke & Fernandes, 2020). During the third industrial revolution (3IR), the use of electronics and information technologies allowed for greater automation of different industries (Benešová & Tupa, 2017; Hussin, 2018; Schwab, 2016). In comparison, the 4th industrial revolution (4IR) was marked by an introduction of artificial intelligence, bio- and nano-technology, quantum computing, digitalisation, robotics etc (Benešová & Tupa, 2017; Hussin, 2018; Shahroom & Hussin, 2018). Schwab (2016) also noted that the 4IR is characterised by how technology distorts the boundaries between the physical, biological, and digital realms. The influence of this emerging technology filters through several different fields in the modern world, creating unprecedented changes and exponentially evolving nearly every industry worldwide. In reviewing the changes noted in Schwab's (2016) study, this revolution has a notable impact on education, allowing educators and learners to connect in numerous ways and access unlimited information.

Consequently, the term *Education 4.0* emerged, which was described as a response to the demands of the latest industrial revolution (Hussin, 2018). It is envisioned that the 4IR innovations will begin to diffuse into the education system in the hopes of “enhancing socioeconomic and environmental performances” (Oke & Fernandes, 2020, p.2). It should be noted that although education has passively benefited from the 4IR, changes were a necessary step in aligning the teaching and learning principles to that of the broader context. As Wallner and Wagner (2016) explain, for learners to join the working world successfully they must acquire a new range of skills to cope in an ever-changing globalised society. However, they do note the difficulty in achieving this goal as new careers and required skills are also ever-changing (Wallner & Wagner, 2016). Therefore, *Education 4.0* is the pertinent adaption in fostering contemporary knowledge and skills, as well as characteristics of adaptability and flexibility that would aid in developing professional paths. Frisk (2017) details this new vision and its influences on teaching and learning in nine trends (Figure 2.4). These trends will be used as a framework to discuss the implications on teaching and learning.

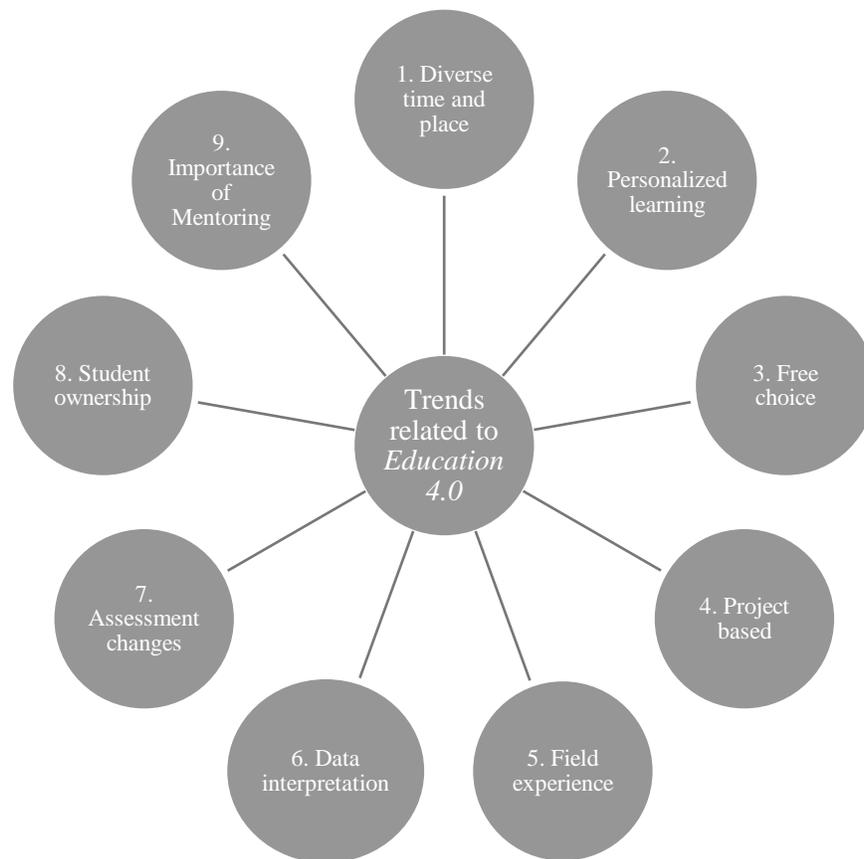


Figure 2.4: Trends related to Education 4.0 (adapted from Fisk,2017)

Note: Fisk's several trends in Education 4.0. Adapted from Education 4.0. The Future of Learning Will Be Dramatically Different, in School and Throughout Life, by P. Fisk, 2017. Copyright 2023 by Peter Fisks.

The significant trends discussed by Fisk (2017) highlight several implications for educators. The first trend notes how learning has gained greater flexibility in where and when it can occur. Even before the COVID-19 lockdown, e-learning and various digital technologies allowed for remote and self-paced learning (Fisk, 2017). However, many parts of the world did not extensively rely upon digital technologies until physical interaction was limited by the recent pandemic. The concept of a 'Flipped Classroom' or 'Flipped Learning' also emerged during *Education 4.0* (Fisk, 2017). This is when active learning and group engagement are prioritised during the class and students prepare or continue their individual learning outside the classroom (Arfstrom, 2021). Through the introduction of e-learning, cloud-based services, and the integration of digital technology into the traditional classroom, there is a more significant opportunity to facilitate learning without time and place restrictions (Oke & Fernandes, 2020).

These tools and online platforms allow learners to continue their work outside the classroom while allowing access to the required material and information. In some cases, they could have continued access to their teachers in a digital sense (Benešová & Tupa, 2017). These elements allow further tailoring the experience to the learner's needs that provide more personalised learning opportunities.

The second trend noted by Fisk (2017) is that *Education 4.0* allows for greater personalisation in an individual's learning and more opportunities for teachers to identify learners' needs. Through the use of numerous digital learning tools, students' progress can be monitored and data can be collected to identify areas where support or extension may be needed. Chang and Wills (2013) expressed that integrating a hybrid of e-learning and digital technology into standard class teaching can also increase learners' performance and enjoyment of their learning environment by up to 15%. Additionally, this result may have some relation to the third trend - free choice. Although students may not have a choice in their expected learning outcomes, there appears to be a greater choice regarding the tools or methods they are able to use (Hussin, 2018). In this context, allowing students to bring their own devices to the classroom means that information, such as a visual or oral project, can be represented in numerous and creative forms like a digital presentation, a self-designed website, or a pre-recorded video.

The fourth trend by Frisk (2017) includes project-based learning. Instead of having skills taught and applied in separate subjects or isolated projects, students learn to apply various skills from different disciplines in an active and collaborative project (Scarborough et al., 2004). Barron et al. (1998) outlined four key principles for project-based learning: 1) providing learning opportunities that lead to a deeper understanding; 2) initiating larger projects with specific problem-based activities; 3) supplying exposure to various examples; and 4) making use of 'embedded teaching' or modelling, designing several possibilities for formative self-assessment and encouraging cooperative group work which fosters participation and a sense of agency in the process. Many of these attributes also link to the constructivist teaching approach, reinforcing the sentiments of creating an engaging and relevant learner-focused classroom. Thus, when learners work with others to solve advanced problems while being provided prompts and guidance from others, they can express their understanding better or adjust their

conclusions during the process (Brown & Reeve, 1985). Moreover, several studies discussed by Barron et al. (1998) provide evidence to support that when learners are given a contextualised and relevant framing problem, it improves their understanding and performance of the intended curriculum while providing them with the opportunity to develop additional skills such as critical and reflective thinking, ownership of learning, and interpersonal skills. Fisk (2017) further explains that this could better prepare them for ever-adapting careers in the 'future freelance economy'.

Exposure to practical, real-world examples is noted as the fifth trend (Fisk, 2017). Accessing the virtual world can provide teachers and learners with many real-world examples in various forms (i.e., videos, images, and real-life experiences). These contrasting cases promote engagement in the task and allow learners to understand different perspectives which provides them with more opportunities to self-assess and identify areas where they may need further support (Barron et al., 1998). In doing so, it can be assumed that the interpretation and application of the concepts would improve, which relates to the sixth trend. This implication results in a growing emphasis on the ability to interpret and infer meaning from data (Fisk, 2017). In this context, Fisk (2017) states that the more elementary and manual mathematics skills could become irrelevant compared to analysing data collected by different technologies.

Furthermore, one implication of *Education 4.0* is that greater focus has been paid to applying a student's knowledge instead of simply being able to recite information, which connects to Fisk's (2017) seventh trend of alternative forms of assessment. Alternatives to summative forms of assessing knowledge and understanding have been introduced since the 1900s. Bloom et al. (1971) first introduced the concept of formative assessment in 1971, allowing students to gain feedback from testing and assessments rather than it simply being a way to evaluate the outcome of each measure. The introduction of technology, project-based learning, and previous trends noted further disruption to the conventional forms of assessment (Hussin, 2018). Learners' formative understanding of a particular topic or skill can be assessed in the application to a project, innovative presentation, or ability to interpret various forms of information (Fisk, 2017). Leadbeater (2000) argues that in modern society, the goal of

education has shifted from inculcating knowledge to the receiver to fostering basic numeracy and literacy skills and encouraging characteristics of creativity, flexibility, and collaboration.

Further emphasis on a learner-centred approach and promoting learners' involvement in the curricula is the eighth trend introduced by Fisk (2017). Learner-Centred Education (LCE) is supported by the constructivist paradigm and promotes the goals for 21st-century skills (Schweisfurth, 2013). This framing notion promotes learners' access to more control and direction of their learning (Schweisfurth, 2013). Fisk (2017) argues that this process will bring the curriculum to a relevant, useful, and contemporary place. Furthermore, several online learning platforms used as 'hosts' provide learners with more opportunities to share their resources and information that provide opportunities to engage in meaningful and relevant ways (Wang, 2008). For this very reason, many e-learning platforms have begun to incorporate simulations, games, and other learner-driven attributes into their design (Williams, 2005). Almeida and Simoes (2019) reinforced the notion that gamification improves the learning process and provides opportunities for increased motivation from the learners, through features like competition, reward systems and continuous feedback.

Finally, the ninth trend links to the roles and responsibilities of a teacher. Just as teaching and learning have changed with the introduction of digital technology, the teachers' roles have also transformed to being focused on facilitating and co-creating knowledge (Schleicher, 2020). The teacher is seen as a 'fundamental' part of the students achieving success in their learning (Fisk, 2017; van Harmelen, 1998). The teacher fulfils the role of facilitator and leader by supporting students in their active learning (van Harmelen, 1998). As discussed extensively in the constructivist theory section, the teacher plays a vital role in maintaining and creating the learning process. Helleve et al. (2020) state that teachers who are in training should become digitally competent and must comprehend all the possibilities digital technology offers and how to use it ethically, while remaining in control of their classrooms. Furthermore, it is said that teachers need to learn how to use digital technology in communication and remain up-to-date with continuous developments (Helleve et al., 2020).

2.4. Technology Usage in South African Schools

An introduction to this topic in Chapter 1 indicated that the South African government initiated several plans, namely the Draft White Paper on e-Education (Department of Education, 2003) and the e-Learning Game Changer (Department of the Premier, 2017) to respond to *Education 4.0*. However, the efficacy and delivery of these intentions have varied in South Africa. Hlatshwayo (2022) raises several crucial factors that have resulted in these setbacks, the first being that the country and leading political party have not met many of the criteria of the 2IR or 3IR. They further explain that South Africa has favoured the privatisation of ICT service providers while providing inadequate infrastructure to deliver the technological revolution and digitisation to parts of the country (Hlatshwayo, 2022). More recently the instability with the electricity supply has not only compromised essential factors like quality internet connections and access to online learning platforms, but has not fully met the requirements for the 2IR (Hlatshwayo, 2022). Considering the pre-existing socioeconomic divide and historic educational inequalities, this instability further highlights and continues the differences that widen the educational gap - as seen during the COVID-19 lockdown.

2.4.1. COVID-19 and e-learning in South Africa

In the efforts to limit the spread of the COVID-19 virus, the majority of schools worldwide had closed by the end of March 2020 and instead resorted to e-learning (Schleicher, 2020). Before this shutdown, a study by the Organisation for Economic Co-operation and Development (Schleicher, 2020) showed that only 60% of teachers in selected countries (South Africa being one of them) had received professional digital training. Of these countries, South Africa's primary school teachers reported below-average use of digital technology in their classes which fell within the bottom 10 countries (Schleicher, 2020). Further, it was reported that once schools were closed, many countries responded to school closures in a similar manner by incorporating some form of e-learning; however, the ability of their learners to access the material varied significantly (Reimers & Schleicher, 2020). Another study found that of the 36 countries that participated in the research, South Africa had the highest number of pupils who had little or no access to the support that teachers provided (Reimers & Schleicher, 2020). Notably,

Statistics South Africa (SSA) provided figures to show that across the country in 2020, only 11,7 % of schools offered distance learning, with a significant disproportion between the racial groups (Statistics South Africa, 2020). From this, 56,7% of households in the highest income group had access to internet connectivity when compared to 8,5% of those in the lowest income group (Statistics South Africa, 2020). In addition, a significant portion of those in the lower income groups used cellphones to connect to the internet and although learners had access to the internet and online schooling, only 70,2% of students actively attended and participated in school from their homes (Statistics South Africa, 2020).

2.5. Teachers as reflective practitioners

2.5.1. *What is reflective thought?*

It is helpful to start by reviewing the work of Aristotle, an Ancient Greek Philosopher, when conceptualising reflective thought (Bulman, 2013). Aristotle's philosophy on the importance of reflection and experience in the 'real world' has remained relevant throughout the ages. They believed emotion, imagination, and perception should be integrated into human thinking to gain insight and understanding (Shields, 2020) and according to Damasio (1994), emotions are necessary to understand and make sense of the world. Furthermore, Damasio (1994) asserts that emotion and imagination are essential for developing a more holistic worldview and providing a richer understanding of an individual's experiences.

Aristotle's philosophy can be applied to everyday life in several ways. By being attentive to emotions and exploring imagination, new perspectives and insights can be gained into the world around us (Damasio, 1994; Nussbaum, 1990; Shields, 2020). This can be beneficial in terms of decision-making and problem-solving. Secondly, Aristotle's philosophy encourages an individual to take responsibility for their own life rather than relying on external sources of knowledge and guidance (Bulman, 2013; Damasio, 1994). In this context, a person can gain greater control over their emotions and imagination and make more informed decisions by paying attention to these concepts.

"Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends, constitutes reflective thought." (Dewey, 1910, p.6)

Furthermore, reflective thought is considered an essential part of education as it is believed to provide individuals with the opportunity to think critically and gain new perspectives (Zeichner & Liston, 1987). It has also been argued that reflective thought can empower individuals to make informed decisions and gain a deeper understanding of the world (Bulman, 2013). Thus, reflective thought allows individuals to better understand their own beliefs and experiences and make informed decisions based on their life experiences.

Additionally, John Dewey (1910) discussed reflective thought as a 'succession' of thoughts that grow from others. The author further emphasises the necessity for individuals to frequently contemplate the foundations or reasoning behind their beliefs and the subsequent logical outcomes (Dewey, 1910). It is therefore a response to previous events where an individual would recall and evaluate the experience to form a plan or action (Mirzaei et al., 2014). In comparison, routine and habitual thinking is primarily informed by one's traditions, context, and governing authorities (Zeichner & Liston, 1987). Dewey (1910) also identifies two critical processes in reflective thinking. The first is that a person needs to be in a space of uncertainty to allow them to challenge and question their current beliefs (Dewey, 1910). Secondly, Dewey (1910) notes that it is through exploring this uncertainty that an individual can confirm or reject a belief by considering other information and perceptions.

2.5.2. What is a reflective practitioner?

Reflective practice can be divided into two main components: 1) reflective thinking and 2) reflective action. On the one hand, reflective thinking involves the practitioner reflecting on their experience, analysing and synthesising their thoughts, and drawing conclusions from their observations (Harrison, 2012). This type of reflection can be used to develop insight into one's practice by identifying strengths and weaknesses and formulating new strategies to improve said practice. Schön (1983) also emphasises that this reflective thinking process is not often neat and clear. On the other hand, reflective

action refers to the application of the conclusions drawn from the reflective thinking process. Knowledge and beliefs are actively and consistently reviewed during this process as they may have different impacts and consequences (Zeichner & Liston, 1987). Often it is in the midst of the action that a practitioner would use this skill to manage unfamiliar, new, and challenging scenarios in their practice (Schön, 1983). In this sense, reflective action allows the teacher to implement new strategies into practice and monitor its effectiveness. Reflective practice is therefore "the process of looking back and considering one's own experiences, actions and thoughts in order to make changes and improve performance" (Harrison, 2012, p.2).

This entire reflective process is vital for professional development as the learning process for professionals is formed through the act of reflecting on their pedagogies and practices, as well as learning from their experiences (Dewey, 1904; Drever & Cope, 1999; Dymoke & Harrison, 2006; Mirzaei et al., 2014; Schön, 1983). It further provides an opportunity for practitioners to evaluate their performance, identify improvement areas, and develop strategies to enhance their practice. This tool of drawing from one's experience distinguishes a reflective practitioner from one who would follow utilitarian and instrumental approaches (Kinsella, 2010; Schön, 1983). Schön (1983) termed this latter approach 'technical rationality' which involved applying theoretically well-formed tools, systems, or solutions to different scenarios. Moreover, it was highlighted that technical rationality was inadequate when applying this to a dynamic, practical situation (Schön, 1983). Therefore, the idea of reflection in action or 'knowing-in action', as Schön (1983) termed it, emphasises that professional knowledge and growth occur in action within the context. Thus, through reflection, an artistry of practice is formed (Schön, 1983).

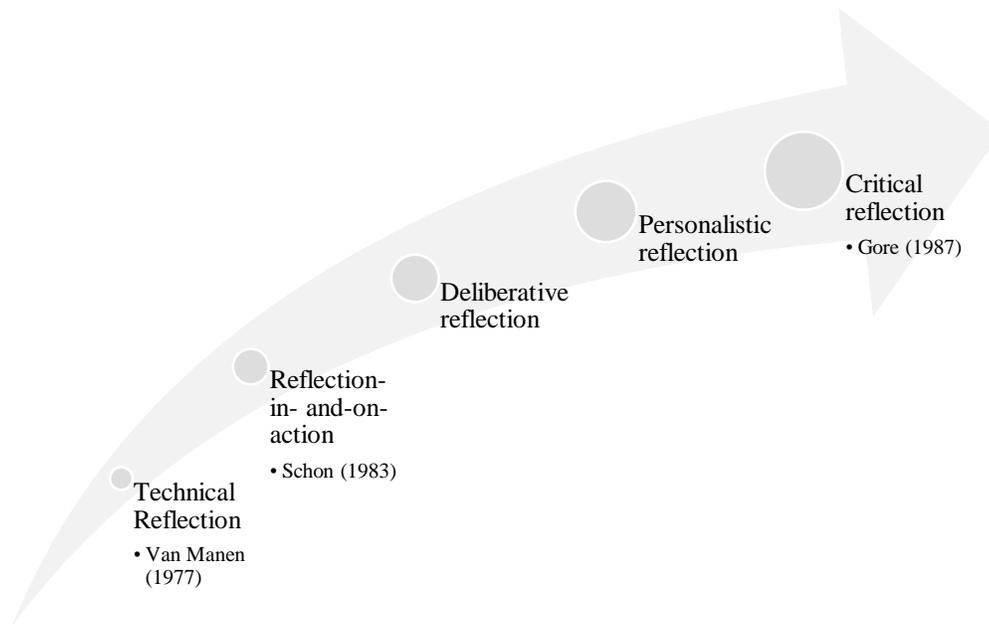


Figure 2.5: An adaption of Valli's (1992) model of reflection and its influences

Note: Valli's (1992) model of reflection and its influences. Adapted from Reflective teacher education: Cases and Critiques. By L. Valli (Ed), 1992. State University of New York Press.

Valli's (1992) framework of reflection (Figure 2.5) helps to distinguish the different levels in the practice of reflection which draws from several models from Van Manen (1977) and Schön (1983). The first level of 'technical reflection' involves reviewing the competencies and processes needed to achieve a goal (Valli, 1992; Van Manen, 1977). At this level, the practitioner establishes what areas in their professional skills need to be developed to achieve set benchmarks (Valli, 1992). Drever and Cope (1999) note that although this is a lower level of reflection, it helps to measure professional training outcomes and is commonly used among professionals. However, Schön (1995) notes the limitations of this approach when a practitioner should face complex and unclear problems. In this context, when a teacher faces a simple problem, they can use technical rationality or professional knowledge to research

the required skills to solve it (Schön, 1995). Comparatively, when more intricate and messy issues arise the same approach is not always effective when using a technical approach (Schön, 1995).

Therefore, a more complicated problem can often be addressed using the second level, 'reflection-in-and-on-action', incorporating Schön's (1983) term 'knowing-in action'. This stage emphasises the need for practitioners to reevaluate and engage in metacognition regarding any barriers or challenges in their contexts (Sellars, 2013). Schön (1995) directly links the teaching field to this act as teachers often use experience, a trial and error method, and intuition when reflecting in action. In addition, the practitioner needs to evaluate and reflect on the 'actions' after the event. Moreover, the process of receiving different cues or information, like a child who appears confused in class, triggers the act of seeking to understand and find solutions in the moment (Schön, 1995).

The third stage of 'deliberate reflection' refers to the active review of the actions and decisions that are made (Valli, 1992). It involves intentionally reviewing theoretical and practical knowledge and other perspectives to ensure that one's practices are most effective. Snoek et al. (2003) describe this as scenario planning whereby professionals develop different scenarios to simulate changes for the present and future. Further, 'personalistic reflection' is the fourth stage which draws on Aristotle's notions of being aware of one's emotions, thoughts, and metacognitions (Valli, 1992). In doing so, the effectiveness of the practices and personal growth may continue to develop. Finally, the fifth level of 'critical reflection' encourages practitioners to be aware of social, political, and ethical issues which may influence their context and practices (Sellars, 2013).

2.5.3. *Teachers as reflective practitioners*

Harrison (2012) outlines that there needs to be an acquisition of knowledge in the teaching profession, similar to constructivist learning theories. Teachers' professional development and training require them, like their students, to actively construct and reconstruct their "knowledge by interpreting events on the basis of existing knowledge, beliefs and dispositions" (Uhlenbeck et al., 2002, p.243). Thus, the nature of teaching requires reflective practice as teachers' work involves and directly impacts others. Should a teacher's professional development as an educator remain at the technical or 'technical

reflection' level, they would be limited in their ability to review and modify teaching and learning pedagogies and resources (Harrison, 2012). However, as they move deep through the level of reflectivity, teachers would be able to draw information from their context, other perspectives, and their own emotions and metacognitions to improve the teaching and learning experiences for their learners and their own personal growth (Dymoke & Harrison, 2006; Sellars, 2013; Valli, 1992). Dewey's literature provides the idea that reflective teachers in their practice should be open-minded and responsible; they should promote abilities to observe and analyse information (Zeichner & Liston, 1987). Harrison (2012) further outlines core skills they deem essential for reflective practitioners and notes their importance in the teaching profession. These are summarised below (Figure 2.6).



Figure 2.6: Five core competencies needed as a reflective practitioner (adapted from Harrison, 2012)

Note: Harrison's five core competencies required as a reflective practitioner. Adapted from Professional Learning and the Reflective Practitioner. By J. Harrison, 2012. SAGE Publications Ltd.

Furthermore, such as many other authors, Harrison (2012) highlights the importance of observation and self-awareness for reflective teachers (Dewey, 1904; Mirzaei et al., 2014; Schön, 1983). Using self-evaluation and analysis by noting details in critical moments, gaining others' perspectives, checking in with one's abilities and weaknesses, and ensuring that one takes note of the contextual factors, could lead to an improved practice (Harrison, 2012; Mirzaei et al., 2014). This also includes being aware of any biases that teachers may have and understanding the roles they play in the educational process. This self-awareness helps them identify areas of growth and improvement, which in turn, serve their students' needs better.

The second competency required to develop reflective teachers is communication. Critical reflection is promoted through journaling or discussing scenarios with mentors (Harrison, 2012). This can promote more profound levels of reflection and research indicates that teachers who engage in higher levels of self-reflection are more likely to provide a positive learning experience for their students (Crisp, 2006). Judgement and critical thinking is the third skill which promotes reflection. By using 'reflection-in-and-on-action', educators can think critically and analyse situations to identify underlying assumptions, draw logical conclusions, and make informed, evidence-based decisions (Dymoke & Harrison, 2006; Schön, 1983; Valli, 1992). They can consider multiple perspectives, past experiences, and various factors to make the best decisions possible - which is the fourth competency noted by Harrison (2012). This promotes intentional reflective practice and deepens professional development. It also provides educators with the opportunity to consider the impact of their teaching on learners and to think deeply and critically about how their teaching can benefit their learners.

The final competency of 'teamwork' is said to be further developed through co-teaching, collaboration, and action research (Harrison, 2012). These processes can further encourage reflection and refinement of teaching and learning practices. For reflective practice to be effective, educators must be willing to take risks and question the status quo. Harrison (2012) notes that working alongside others can provide a 'safer' space for improving practices, sharing and learning from others, and helping to redefine existing pedagogies. In this context, working with others can enhance and promote a space for

metacognition to gain further insights and increase professional development. As educators, it is vital to understand the importance of reflective practice as it is an essential part of professional growth and development. Thus, reflection allows educators to be mindful and intentional in their practice and to identify areas for improvement in their own practices and subsequently, their learners.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

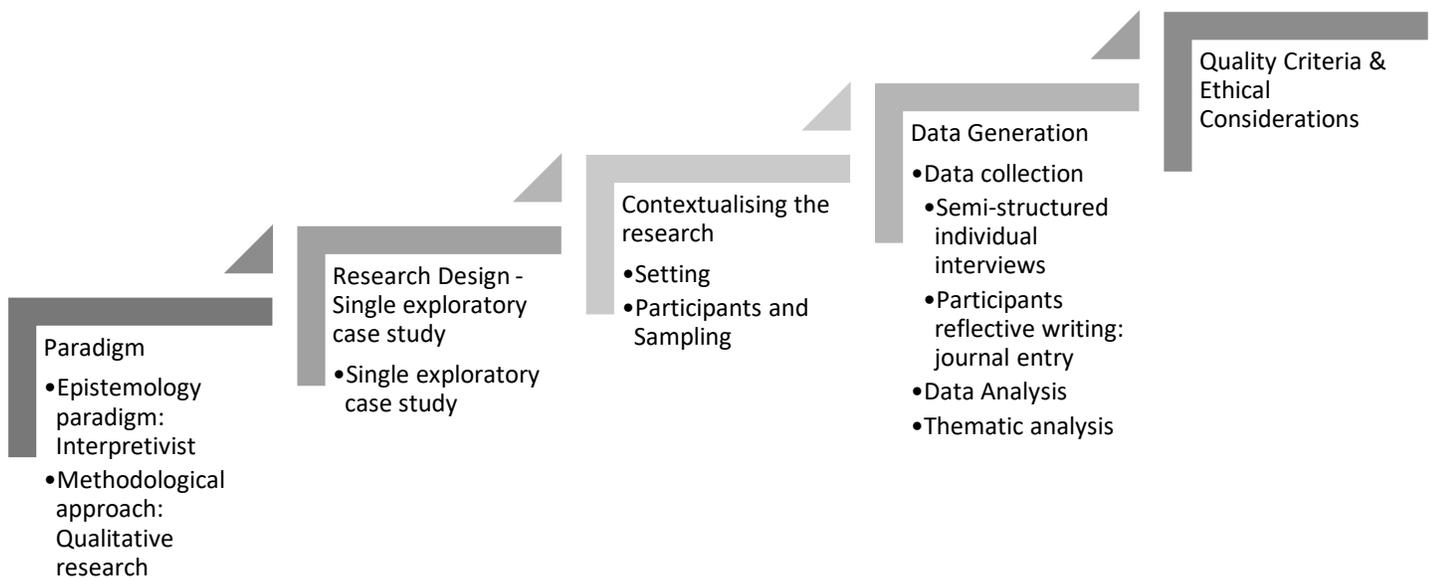


Figure 3.1: Conceptualisation of Chapter 3

3.1 Introduction

Figure 3.1 provides an overview of the conceptualisation of the following chapter. Stemming from the interpretivism paradigm, this qualitative study's research design will be unpacked. The theoretical assumptions underpinning the overarching paradigm will be outlined, along with a more detailed explanation of the research design and methodologies. In addition, this chapter will provide further insight into the participants, their setting, the data collection and analysis methods, quality assurance measures, and ethical considerations that have been taken into account throughout the research process.

3.2 Research Purpose and Questions

The research question was formulated as follows: *What reflective pedagogical approaches and practices do primary school teachers employ when integrating digital technology into their classrooms?*

Research objectives stemming from this question include the following:

1. To determine the pedagogical approach (how) employed when digital technology is used for teaching and learning in the classroom.
2. To investigate the reflective practices or processes educators employ when they incorporate digital technology into their teaching.
 - a. Investigate how educators rationalise including digital technology in their teaching and learning.
 - b. Explore the educators' evaluation of the effectiveness of making this inclusion.
3. To generate suggestions to improve the implementation of relevant digital technologies in the classroom.

3.3 Research Paradigm: Interpretivist Paradigm

A paradigm is considered to be a format of perceptions and assumptions. Foucault's (1989) theory aids in broadening this concept by describing that there are different collective mentalities in different

contexts, varying in time and place. These mindsets, or paradigms, have an influence on how people act and their perceptions and assumptions of the world (Kinash, 2006). In the application of social research, a paradigm or mindset can have an influence on the rationale and how it is investigated. The framework for qualitative research typically takes a stance of acquiring information from a context in a way "that is sensitive to underlying meaning" (Merriam & Tisdell, 2016, p. 2). The research is not seen as getting data or knowledge but rather constructing it through understanding different perspectives or interpretations (Guba & Lincoln, 1994; Merriam & Tisdell, 2016). This paradigm is known as constructivism or interpretivism, as these two terms are often interchangeably used (Merriam & Tisdell, 2016).

"Proponents of these persuasions share the goal of understanding the complex world of lived experience from the point of view of those who live it. This goal is variously spoken of as an abiding concern for the life world, for the emic point of view, for understanding meaning, for grasping the actor's definition of a situation, for Verstehen." (Schwandt, 1998, p. 221)

Schwandt (1998) outlines the perspective of interpretivism and constructivism, which progressed from a field known as Hermeneutics and Verstehen (George, 2021; Schwandt, 1998; Willis, 2012). The link between interpretivism and constructivism lies in their shared epistemological and ontological assumptions. Both paradigms reject the idea of a single, objective reality that can be uncovered through empirical methods (Bryman, 2012; Guba & Lincoln, 1994). Instead, they view reality as socially constructed and shaped by individual experiences, interpretations, and meanings (Bryman, 2012). This shared view leads to similar methodological approaches, such as using open-ended interviews, participant observation, and content analysis to explore and interpret the data (Merriam & Tisdell, 2016).

In the constructivist paradigm, the researcher aims to construct knowledge by understanding and interpreting different perspectives and meanings within the context rather than simply acquiring data (Guba & Lincoln, 1994; Merriam & Tisdell, 2016). The emphasis on subjective experiences and the importance of the context is also a key feature of interpretivism (Merriam & Tisdell, 2016). Interpretivism acknowledges that knowledge is constructed and influenced by the researcher's values, experiences,

and interpretations. Therefore, the researcher's role is to make sense of the data and the context in collaboration with the participants to uncover underlying meanings and perspectives (Merriam & Tisdell, 2016).

In contrast to the importance of understanding and interpreting human behaviour, the positivist paradigm focuses on gaining answers to a proposed hypothesis through empirical, objective and reductionist methods to account for behaviour or phenomenon (Bryman, 2012; Cohen et al., 2018). Where interpretivism, from an anti-positivist movement, values the subjective lived experiences and places a high emphasis on the impact of the context, the positivist paradigm sees the importance of objective, 'value-free' research methods to be able to make broader generalisations (Cohen et al., 2018; Lincoln et al., 2018). Interpretivism aims to gain a theory 'grounded' in data rather than have that presumed thinking precede the collection of information (Cohen et al., 2018). As seen in Figure 3.1, the selected interpretivist paradigm notably influenced the approach and perspective during the research. A paradigm impacts a researcher's methodology, rationale and research design (Mackenzie & Knipe, 2006). The three dimensions in which it may do so are ontology, epistemology, and methodology, which will be explored further.

3.3.1 *Ontology*

Ontology is said to be how one views the world and how this reality impacts what is known (Barbour & Schostak, 2005). Bryman (2012, p. 34) notes the importance of ontology in designing and conducting research, "Ontological assumptions and commitments will feed into the ways in which research questions are formulated and research is carried out." The interpretivist ontological assumptions are that individuals have their perspectives and realities, which they create and are influenced by their world and environment (Guba & Lincoln, 1994). The social contexts and realities are believed to impact their actions and the meaning they attribute to them, highlighting the importance of understanding the context in the interpretivist paradigm (Bryman, 2012; Cohen et al., 2018).

Therefore, in this research, it is understood that the educator's realities are influenced mainly by their context and experiences. Many factors may affect their perspectives, like their exposure to and the

availability of technology and the training they have received in incorporating it effectively into a classroom. Consequently, the researcher needed to understand how these perspectives were constructed within the educator's context to understand their subjective teaching and learning experiences within their realities.

3.3.2 *Epistemology*

Epistemology can be described as the ways in which information is gained, how humans gain understanding and the perspective on how research should be conducted (Bryman, 2012; Steup & Neta, 2020). Within the interpretivist paradigm, this qualitative research aimed to understand the environment and the setting in which educators work. A significant influence on this paradigm, Max Weber (1947, p. 88) describes this notion of interpretive understanding as *Verstehen*. Weber emphasised the importance of gathering an understanding of the person's point of view to better interpret the social action (Bryman, 2012).

An interpretivist researcher values that meaning (information and data) is created or co-constructed by accessing and understanding the socially constructed reality (Willis, 2012). Rather than having the theory of how behaviour or a phenomenon comes about before conducting research, they aim to uncover the meaning through understanding the context, lived experiences (narratives and language) and how meaning is constructed (Cohen et al., 2018; Merriam & Tisdell, 2016; Willis, 2007). The way educators make sense of their motives and thoughts around the use of digital technology is the particular 'social action' that is being understood in this research. This knowledge was gained through the researcher immersing themselves in the realities of the participants and understanding how the context of their education setting can influence their practice and pedagogies in using digital technology in their classroom.

3.3.3 *Methodological approach: Qualitative research*

Somekh & Lewin (2005) define methodology as how principles and values inform a particular approach in research and, more specifically, the types of methods used. The selected qualitative

methodology used to investigate educators' reflective practices and pedagogies when using digital technology in their classrooms aligns with the overarching interpretivism research paradigm. Denzin and Lincoln (2018) explain qualitative research involves an interpretivist view of the world and places the 'inquirer' within the world. The methods of gaining information and investigating phenomena hoped to create detailed reconstructions of the participants' experiences and meanings attributed to certain phenomena (Cohen et al., 2018). This meaning is gathered in an interactive manner, where the research is immersed in the context and meaning is gained inductively from the data (Willis, 2012). A qualitative approach allowed the researcher to gain a richer understanding of the realities and experiences of educators in hopes of understanding their day-to-day teaching practices, classroom dynamics and the broader school context in which they work.

3.4 Research Design: Single Exploratory Case Study

A case study design can be used to inquire about a singular unit, such as a person, group, phenomenon or period of time (Hamilton & Corbett-Whittier, 2014). These cases are studied within their natural setting and emerge in reality (Merriam & Tisdell, 2016). The case study design allows a researcher to be immersed in the context and gain rich insight into the phenomenon, like incorporating digital technology into the classroom. An exploratory approach was employed. This aligned with interpretivist principles, focusing on delving into the viewpoints of individuals and unravelling underlying meanings and theories. Through an exploratory case study, patterns and themes within the data were unearthed, specifically illuminating the reflective practices employed by teachers when integrating digital technology into their instructional and learning methodologies (Yin, 2009). A singular case study was undertaken, concentrating on a specific and defined setting: independent primary schools. This research design proved to be highly suitable, offering a comprehensive and contextualized understanding of how Grade 4 to 7 teachers integrate digital technology and its potential impact on the teaching and learning dynamics.

Although case studies have been criticised for their limitations in providing generalisations, Schwandt and Gates (2018) highlight that they can be extended to highlight connections between

practices in particular sites to the larger context. Furthermore, case studies can also provide information that can further refine theories, like highlighting gaps in knowledge or improvement in implementation (Crowe et al., 2011). It is for this reason that the design was selected. While this research focuses on deepening understanding within a specific domain (independent primary schools), its objective extends beyond this context. The study seeks to contribute to the broader exploration of integrating digital technology into education, utilising insights gained from this particular case.

3.5 Contextualising the Research

In order to contextualise the investigation, the setting, population and sampling methods used in selecting research participants are discussed in this section.

3.5.1 *Research setting*

In this single exploratory case study design, the selected context involved in this study was private primary schools (grades 1 to 7). These schools typically serve middle- to upper-class communities residing in Cape Town in the Western Cape and have English as the language of teaching and learning. One of the schools is in the southern suburbs and the other in the city's centre. The class size is typically smaller, and the schools have access to digital technology, which is frequently used both with class and specialist subjects. These particular schools were chosen due to their frequent access to and use of digital technology in their teaching and learning processes. During the COVID-19 lockdown, these schools were able to continue teaching remotely. These schools have access to different digital resources, like computers, tablets and other electronic/ technological devices, and use several online learning applications and platforms. Three participants were selected from each school setting. Six educators between grades 4 and 7 were approached to participate in this research. These grades were chosen as they have broader learning areas, providing more opportunities to incorporate digital technology in diverse ways.

3.5.2 Participant sampling

The type of participant required for this study was one with specific criteria and in-depth experience and understanding of the research topic. It is for this reason that purposive sampling was used. As Patton (2002) details, purposive sampling allows the researcher to select information-rich cases to learn more about the phenomena. This method is an intentional way of selecting participants that are well-suited to the research questions (Bryman, 2012). The selection of these participants ensures that the goals and selected criteria will be met and the research questions will be answered more thoroughly (Bryman, 2012). The sites for sampling were selected explicitly as they met a criterion which provided relevance to the research goal. Criteria used to sample participants included access to and use of various digital technologies in their teaching and learning processes. The gatekeepers at each school indicated which staff member best suited this criterion so that the selected 'information-rich' educators would allow for a deeper understanding of the use of technology in their classroom.

3.6 Data Collection

The data collection process was initiated when two schools that met the explicit criteria were identified. The principals of these schools were approached via email, in which an introduction was made, and an outlined intention of the research was shared. The attached outline included a description of the research and evidence of the ethical approval from the Research and Ethics Committee. Principals were encouraged to ask any questions they may have or arrange an appointment to discuss it further. They were reminded that their school's participation in the research was entirely voluntary. Both principals provided a letter of consent after these correspondences.

School A's principal requested a personal visit to the school to discuss the premise of the research in a staff meeting. During this presentation, the teachers were informed about the nature and intent of the research, and they were encouraged to consider volunteering for the study. Several interested participants provided their contact information, and once the list was reviewed, three potential participants were contacted via email. School B's principal discussed the nature of the research in their

staff meeting, and interested participants' contact details were shared. From this list, three potential participants from school B were contacted via email, in which further information about the study was shared. Certain limitations, like unresponsive potential participants and school holidays, delayed the process of completing all the data collection. Additional potential interested teachers were approached to complete the data collection process.

3.6.1 *Semi-structured individual interviews*

Interviews are seen as a way in which meaning is 'co-constructed between the interviewer and the interviewee' (Kelly, 2006, p.297). As Kelly (2006) highlights, the data constructed in these interviews do not just reflect the information co-created but, more importantly, highlight the influence of the larger context. A semi-structured interview follows several questions from a previously designed interview schedule; however, these are often open-ended and allow further follow-up questions depending on the information gained in the responses (Barbour & Schostak, 2005; Bryman, 2012; McMillan & Schumacher, 2014). This approach was preferred because it allowed for the exploration of additional topics and more detailed insights from the interviewee's responses (Barbour & Schostak, 2005; Bryman, 2012). It also enabled the researcher to better understand the teachers' views and lived experiences within their classroom (Patton, 2002).

Once the interested participants confirmed their willingness to participate in the study, a convenient meeting time and date was set up with them. These interviews occurred in a hybrid of online and in-person meetings, depending on the interviewee's preference. Semi-structured interviews using the interview schedule (see Addendum C) were conducted with the six participants. These interviews provided the researcher with the ability to gather basic demographical information as well as richer details surrounding the research question. The questions and discussions which followed gave insight into how participants navigate the use of digital technology in their planning and practices.

These interviews were recorded and then transcribed. This occurred in two phases, initially, a computer program converted the recordings to written format and then an editor reviewed all the transcripts and corrected any technical errors.

3.6.2 Reflective writing

Participants were asked to document their insight into a typical week in their classroom. A writing prompt (Addendum D) was provided with specific questions to help structure the educator's reflective writing. Participants shared their reflections from the week in voice clips or written form. The reflective writing piece provided another opportunity for the researcher to gain further insight into a typical workweek and gave more profound accounts of teachers' day-to-day teaching experiences. This additional source of data provided an opportunity for the researcher to develop a better understanding of the teacher's contexts, elicit themes and integrate them with each participant's interviews. This allowed for further triangulation and confirmation of the understanding gained in each interview.

3.7 Data Analysis

In 2006 Braun and Clarke first outlined thematic analysis (TA), which was more recently adapted in 2020 to create a more contemporary approach to reflective thematic analysis (Braun & Clarke, 2020). This six-step reflective process was applied to the data analysis procedure. They are as follows: familiarising with the data, generating initial codes, searching for themes, developing and reviewing themes, refining, defining and naming themes and producing the report and contextualising (University of Auckland, 2019). The overarching goal of this process was to identify themes and interesting patterns in qualitative research data that provide further insight into the research topic and literature (Maguire & Delahunt, 2017). The format of this approach is said to be more of a bottom-up or inductive process (Maguire & Delahunt, 2017). With a reflective approach, the themes were drawn from the interview data, educators' reflections and documentation. The researcher's subjective role during this knowledge production remained cognisant during the analytical process and reporting on the data. The patterns and themes elicited from the data analysis process provided insight into how educators think about or plan for using digital technology in their classrooms across the two educational settings. Figure 3.2 below summarises the different phases initially outlined in their six-step framework (Braun & Clarke, 2006).

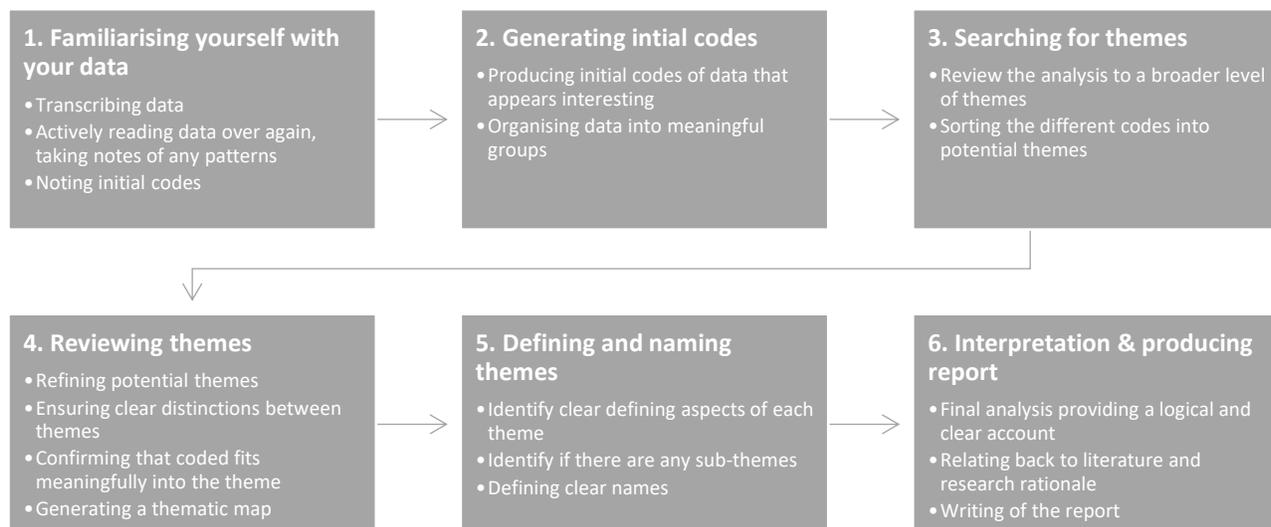


Figure 3.2: Overview of the thematic data analysis process (adapted from Braun and Clarke, 2006)

Note. The six steps of thematic data analysis. Adapted from: "Using thematic analysis in psychology," by V. Braun and V. Clarke, 2006, Qualitative Research in Psychology, 3(2), p. 15.

These six steps were followed in analysing and summarising the main themes and patterns in the data. The initial process started with working through the transcribed data, noting possible codes and identifying patterns in step one to creating initial codes, organising them into meaningful groups and finally, proposing and refining the overarching themes in steps two to four. The final two stages of this analysis were to clarify and clearly define these themes and subthemes whilst confirming that the codes fit meaningfully into the different themes (Braun & Clarke, 2006). Evidence of proposing and refining these themes can be found in Addendum G and Addendum H.

Using the TA process was a helpful approach to assessing the data gathered, as it provided the researcher with a systematic method to observe and reflect on the realities and perspectives of the participants. In addition, further guidance and consideration were taken from Braun and Clarke's more recent writings (2012, 2016, 2019, 2021), noting the importance of reflexivity during the thematic analysis process. Braun, Clarke and several other authors have noted their reservations about possible interrupted 'rigidities' in this data analysis process (Braun & Clarke, 2021; Byrne, 2022; Maguire & Delahunt, 2017). A noted caution from the literature is that TA could produce varying results depending on the researcher's subjectivity (for example, their orientation on inductive or deductive approaches)

(Braun & Clarke, 2019). Therefore, these steps have not simply been adopted as a procedure to follow but as a means to reflectively and thoughtfully engage with the data and "unpick or unravel the surface of reality" (Braun & Clarke, 2006; Braun & Clarke, 2019). This reflective analysis provided more significant opportunities to identify the connection between the educators' pedagogies and practices to those discussed in the other literature and models.

3.8 Quality Criteria

Predominantly, qualitative research is often evaluated in accordance with trustworthiness criteria (Krefting, 1991). These criteria are aligned with the chosen research methodologies. For example, the trustworthiness criteria that the quantitative researcher would focus on are validity, reliability and objectivity, whereas the qualitative research would contemplate credibility, dependability, confirmability and transferability (Anney, 2014; Guba, 1981; Schwandt et al., 2007). Lincoln and Guba (1985) outline the required criteria that are appropriate for qualitative research in an effort to uphold the same rigour as quantitative research is alleged to have. These criteria and the ways in which they were met are described below.

3.8.1 Credibility

As Guba and Lincoln (1985) explain, it would be inappropriate for a naturalistic qualitative researcher to aspire to gain true internal validity or a 'truth value', as a quantitative researcher would. This 'truth value' is instead acquired by adequately representing reality and the many different constructions that could be held within it (Lincoln & Guba, 1985). Krefting (1991) notes that this true value is one of the most critical trustworthiness criteria, as it is 'subjectively oriented' to ensure an accurate understanding of the phenomenon or realities are gained. The term used is credibility, which aims to ensure that the methods for conducting research produce findings that have greater credibility and that these 'uncovered realities' are seen as accurate by those being studied (Lincoln & Guba, 1985). In an effort to shape this subjectively-oriented credibility, it was ensured that the interview structure included efforts to build rapport and develop an understanding of their experience and context.

Questions that were used to build rapport focused on the participants' current role within the school and their teaching philosophies. To improve the credibility and accuracy of the transcript, it went through two phases of transcription. By having an editor reread the automatically generated transcripts, it reduced the chances of impacting the 'truth-factor' of the interviews. During the research process, further guidance was sought from a private mentor with a Masters in Social and Psychological Research, and is currently a PhD candidate. In these discussions, several areas of the research process were reflected on. This allowed for the interview process to be refined and improvement to the methods of data analysis, which added further credibility to the research.

3.8.2 Triangulation

Triangulation assisted in adding credibility and ensuring the quality of the research. This method is described to be a way in which several methods or sources of data confirm similar specific findings (Patton, 1999). In this research, this was applied by referring to themes across the interview, as well as the themes which came from the reflective writing the participants submitted. These multiple data sources provided more opportunities to cross-check and confirm specific trends or themes.

3.8.3 Member checking

Member checking was used to ensure the credibility and quality of the research data. As Lincoln and Guba (1985) explain, this technique is used to guarantee that the researcher's interpretations are congruent with the participant's experiences. During the individual interviews, the researcher assessed the participant's understanding throughout the conversation by providing several short verbal summaries. This allowed for immediate correction of errors and additional details to ensure credible and authentic data collection.

3.8.4 Dependability

Lincoln and Guba (1985) offer the substitution of the criterion of *reliability* in quantitative research for *dependability* in naturalistic qualitative research. They note that the term dependability allows for the

consideration that within naturalistic research, it may not be possible to obtain a purely replicable study (Lincoln & Guba, 1985). The nature of this research, for example, the researcher's role of co-constructing knowledge and the subjectivity of the participants, introduce many variabilities that could introduce change in a qualitative study (Shenton, 2004). To enhance the degree of dependability in this study, the researcher followed Bryman's (2012) writing recommendations to keep a clear record of all research processes. According to Creswell and Miller (2000), providing detailed and descriptive information in research can increase the reader's trust in the study's accuracy and help them understand how the findings could be applied to other contexts. Clear and detailed records of the interview transcripts, processes of participant selections, data analysis steps and how findings were established. In this way, the researcher's supervisor played the role of the 'inquiry auditor' by reviewing notes and records to determine the dependability of the processes and the research product. This 'audit trail' also added to the confirmability criterion (Lincoln & Guba, 1985).

3.8.5 Confirmability

This criterion ensures that the researcher does their best to overtly not allow for personal perspectives to influence the findings and processes (Bryman, 2012). The two techniques that aided in safeguarding the quality of the data were the audit trail mentioned above, and the researcher's reflexivity.

3.8.6 Researcher's reflexivity

For the researcher to be reflexive during the study, it requires being aware of the possible impacts of their research processes, decisions, values and assumptions of the social world (Bryman, 2012). Therefore, the researcher had to explicitly unpack their own biases and beliefs to be mindful of these during the different steps in the research procedure. Reflective notes aided in documenting these during the interviews and thematic coding procedure, which assisted in hearing the participants' actual voices and understanding their lived experiences. Furthermore, the reflective thematic analysis provided a more substantial opportunity to contribute to this trustworthiness criterion. As Braun and Clarke (2019)

highlight, quality reflective thematic analysis is mainly about the researcher's reflexive thoughts and engagement during the stages of data analysis.

3.8.7 Transferability

Transferability is a more appropriate trustworthiness criterion than external validity when considering the nature of naturalistic qualitative research (Lincoln & Guba, 1985). This is because findings in qualitative research may not hold in another context or time as an empirical study would (Bryman, 2012). Therefore, the study documented rich, clear and detailed descriptions of the specific context and period of time.

3.9 Ethical Considerations

In his 2016 publication, Allan emphasised the crucial factors for ethical research. Firstly, research must bring scientific benefits either to society or the participant to justify its ethical value. Secondly, it should follow a reasonable methodology. In order to meet these conditions, the following ethical principles were taken into consideration when conducting the research.

Beneficence and No Harm. The researcher ensured that potential benefits to the participants exceeded any costs (Allan, 2016) and that the participants did not experience any harm from taking part in the research (McMillan & Schumacher, 2014). The right to autonomy and informed consent respected the right of the participant to participate in the research voluntarily. No participant was forced or compelled to participate (McMillan & Schumacher, 2014). Therefore, each participant was provided with detailed knowledge of the research, the methodology used, any possible risks or benefits and the certainty that they have the right to withdraw at any point (McMillan & Schumacher, 2014). This implies that the researcher provided full disclosure and open communication about all aspects of the study (McMillan & Schumacher, 2014).

Confidentiality and Privacy. The researcher assured participants that recordings and information were stored correctly and that their privacy was ensured through limited access (McMillan & Schumacher, 2014). The limits to confidentiality were also fully disclosed. To meet the ethical

principles in research, ethical clearance and permission to proceed with the research were obtained from the University of Stellenbosch Ethics Committee and the principals of each school. Permission to approach the participants was obtained from the school's principals. All the participants were given clear definitions of what the research entails, and informed consent was obtained. Their right to privacy, anonymity, confidentiality, and refusal to participate was respected. The interviews were conducted on Microsoft Teams, built on the Microsoft 365 and Office 365 platforms. This ensured hyper-scale and enterprise-grade cloud security. The researcher ensured the interviews were done in a private room without interruptions.

Furthermore, the data and recordings from their interviews were treated with respect and stored securely. The Microsoft Teams folder, which stored the raw data, was encrypted, password protected and had two-factor verification. The computer which stores the data was stored securely in the researcher's home, with no access by others in the house. Any identifying information, like the participants' and schools' names, was removed to respect the privacy and right to anonymity. A copy of the raw data and the reports were shared with participants and the school to which they belong.

3.10 Conclusion

This chapter provides a detailed methodology for investigating research purposes and questions from an interpretivist perspective. The study utilised an interpretive qualitative design contextualised within the broader research context. Data collection methods included semi-structured, individual interviews and reflective writing. The data was analysed using reflective thematic analysis, and quality criteria such as credibility, dependability, confirmability, and transferability were considered throughout the research process. Ethical considerations were strictly adhered to. This chapter provides a clear and detailed account of the research methodology adopted, which will facilitate the validity and reliability of the research findings. Chapter 4 will present the research findings and discuss the analysis in greater detail.

CHAPTER 4

DATA PRESENTATION

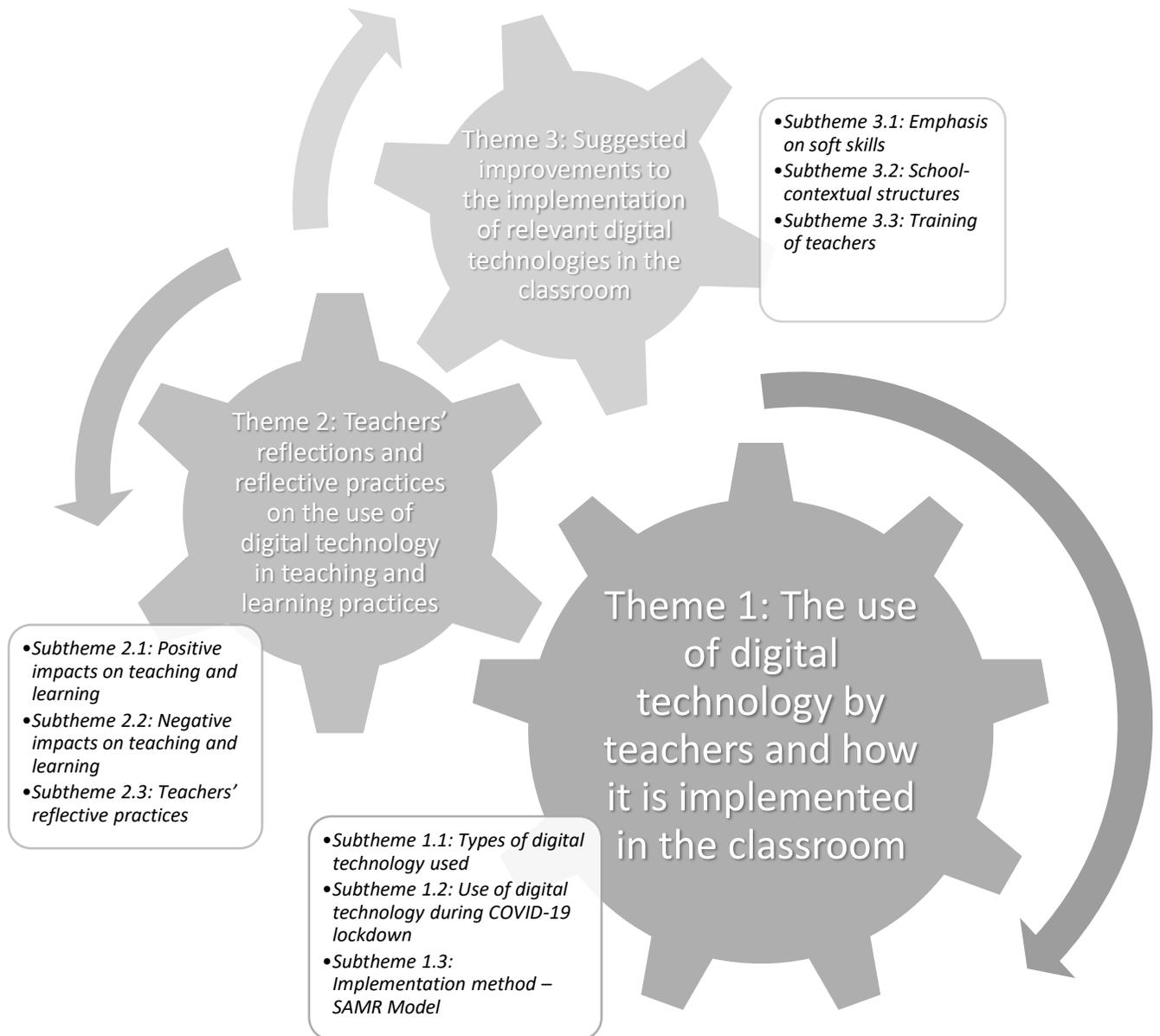


Figure 4.1: Conceptualisation of Chapter 4

4.1. Introduction

The previous chapter discussed the research paradigms and methodologies selected as a framework for collecting and analysing data for this study. Information and the selection process regarding the participants were also detailed. Moreover, the researcher outlined the selection process for participants and the instruments used. This chapter presents the results and findings of the study which emerged from utilising a reflective thematic analysis of the verbatim transcribed interviews and written journals. Themes, subthemes, and categories are outlined and discussed in this chapter.

4.2. Participants and Procedures

As discussed in prior sections, namely 1.6 and 3.4, six participants were selected using purposive sampling according to specific criteria. The teachers invited to participate worked at either of the two selected independent primary schools in Cape Town. Further criteria for their selection included that they have access to and use digital technology, and online platforms and applications in their classrooms. The methods of collecting data included individual interviews and a one-week reflective journal entry, which was collected from each participant. These two sources were vital in the contextualisation of the participant's experiences and in gaining a richer understanding of how digital technology was used, the choices they made when deciding to use it and the influences it had when incorporating it into their classroom. The participants' biographical information was collected in these interviews and presented below (Table 4.1). To ensure their confidentiality and anonymity, the names of participants were replaced with P1, P2, P3, P4, P5, P6.

Table 4.1: Particulars of the participants

NAME	Age	Years of practice	Roles in context	Site
P1	40	17	Head of iPads, Gr 6 & 7 Maths and Science specialist teacher	A
P2	52	29	Head of Academics, Gr 7 Geography teacher	A
P3	63	36	Head of Arts and Culture, Currently a relief teacher, was a Gr 4 teacher	A
P4	32	8	Life Skills teacher, Gr 5 - 7	B
P5	29	6	Gr 5 and 7 Maths teacher	B
P6	65	44	Head of English, Managing IT, Gr 6 teacher	B

4.3. Presentation of Themes

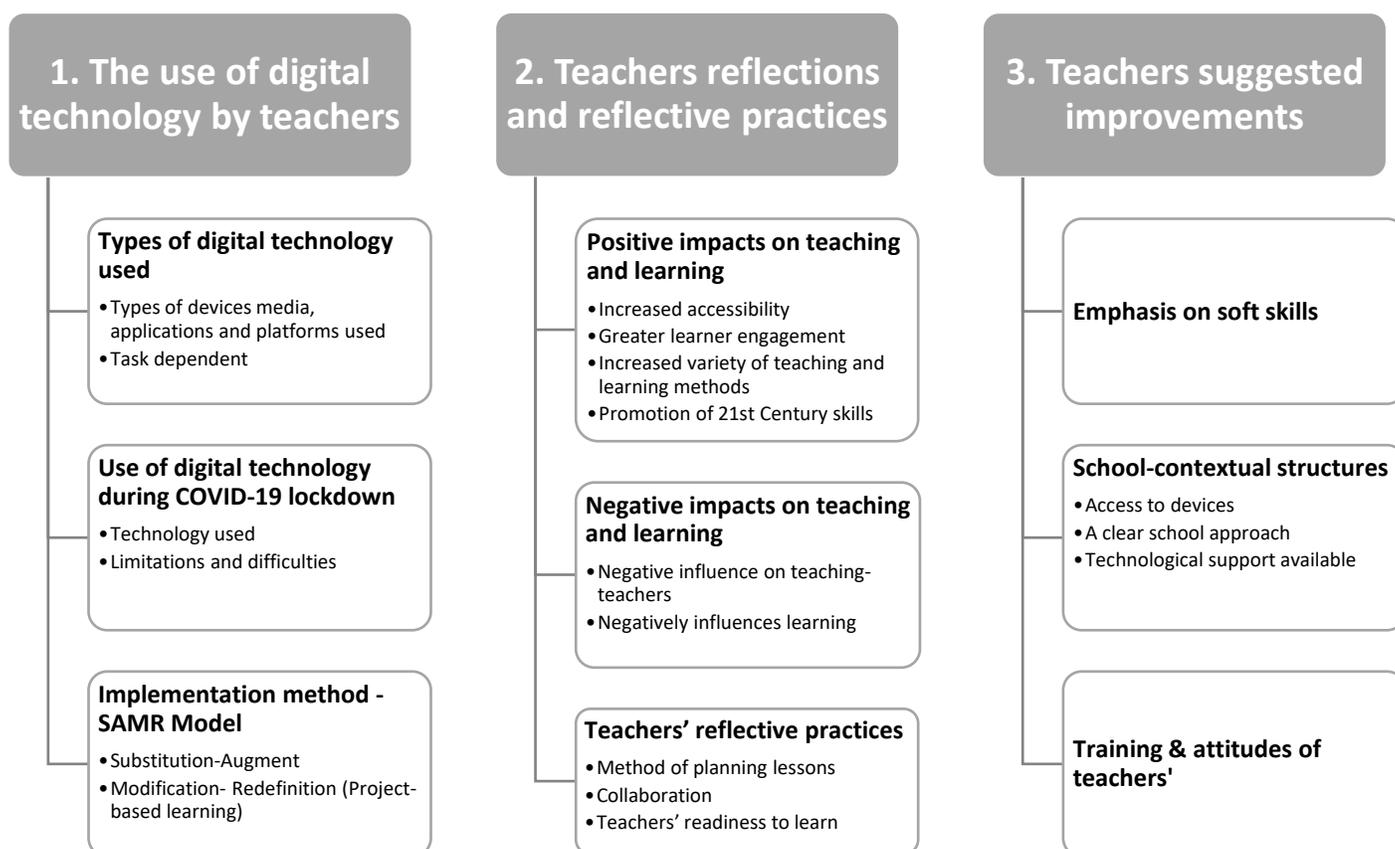


Figure 4.2: Visual overview of themes derived from the data

4.3.1. **Theme 1: The use of digital technology by teachers and how it is implemented in the classroom**

The first theme, which relates to how teachers use digital technology in the classroom, addresses the first research objective *“To determine the pedagogical approach (how) employed when digital technology is used for teaching and learning in the classroom.”* The first subtheme outlines the type of devices, media, applications, and digital platforms used in the classroom. The second subtheme includes the teachers’ reflections on how digital technology was used during the COVID-19 lockdown and the impacts this had on teaching and learning. The final subtheme provides an account of how teachers use digital technology in their teaching and learning practices.

The description and definitions used in developing the subthemes within this first theme are outlined in Table 4.2 below.

Table 4.2: Graphic descriptions of findings within Theme 1

Theme 1: The use of digital technology by teachers and how it is implemented in the classroom	
Subtheme	Categories & Description
Types of digital technology used	<ul style="list-style-type: none"> • Types of devices, media, applications and platforms used. • Depends on the task (goals). Specific tasks or goals will need it more than others/ be well suited to tech or not.
Use of digital technology during COVID-19 lockdown	<ul style="list-style-type: none"> • Types of digital technology used for teaching. Platforms/ devices used to aid the delivery of the concepts to the pupils. Examples of lessons • Limitations and difficulties. Elements that created challenges and difficulties in using tech and teaching during COVID-19
Implementation method -SAMR Model	<ul style="list-style-type: none"> • Substitution-Augment - A direct substitution that supplements teaching methods - does not transform it. Some functional changes • Modification- Redefinition - Allows tasks to be significantly redesigned and the creation of new tasks, not possible before. Applying learning and concepts to different scenarios, connecting to real-life scenarios, and using context to make sense of the information taught.

4.3.1.1. Subtheme 1.1: Types of digital technology used

This subtheme offers greater insight into the main research objective of how teachers incorporate different digital technologies in their day-to-day practices. The first category which emerged from the teachers' responses included the types of devices used and the different applications and online platforms used in teaching and learning practices. The second category sheds light on the different factors determining the use of digital technology.

4.3.1.1.1. Category 1.1.1: Types of devices, media, applications and platforms used

Interestingly, all six participants from both sites reported that their schools opted around the same time to incorporate digital technology more intensively, with specific emphasis on Chromebooks and *Google Classroom*.

Participant 2 from school A explains: *"The timing of our Google training in 2019, was just perfect in terms of that. And the fact that we had already started to get Chromebooks into the school."* (Participant 2, interview)

Participant 4 from school B explains the introduction of Chromebooks, *Google Classroom* and various platforms: *"So in 2019, we introduced them. And we started with a combination of exercise books and textbooks, and the Chromebooks with quite a lot of work being done through a Google Classroom. And simultaneous to that, introducing other things like Kahoots, like Flipboard, Flipgrid, I think there were about 30 different things that we were introducing simultaneously."* (Participant 4, interview).

The introduction of Chromebooks to different grades varies between the two schools. Participant 1 and 2 outlines the device that learners at school A have access to: *"... a decision was made a number of years ago, they would run iPads up to up to grade five, and then the grade six and seven, they'd have Chromebooks."* (Participant 2, interview)

However, school B uses Chromebooks more extensively in the higher grades of their primary school. Participant 4 from school B explains: *"In 2021, the school decided to make Chromebooks*

compulsory for all grades four, five, and six, which means the grade four and five teachers also evolved their lessons to a whole different level. Last year, in 2022, they were introduced to grade three. So, grade threes also had Chromebooks in the classroom.” (Participant 1, interview).

Both schools noted that teachers had access to Chromebooks, laptops, interactive whiteboards, projectors, and TVs. Participant 2 specifically noted an additional device they used to make their whiteboard interactive. *“In my classroom, I have a device, which I’ll put onto the board and I can make that then interactive board. But so it’s not a, it’s not a full-on, you know, interactive whiteboard, but can have some interactive capabilities added to my normal whiteboard.”* (Participant 2, interview)

Participant 5 referred to *Google Classroom* as their primary source of disseminating and collecting tasks, articles, and information. *“So we obviously use Google Classroom quite a bit. We post all our work on Google Classroom, so trying to incorporate, you know, slides, Docs, Google Forms and so on.”* (Participant 5, interview)

Other online educational platforms mentioned by the participants in both the interviews and reflective writing included the entire *Google Suite* (Google Docs, Slides, Sheets, Forms and Maps), Maths and English platforms (Mathletics, Matific, MyTutor, Reading Eggs), Multiple choice and quiz platforms (Kahoots, Quizizz, Quizlet), Presentation Platforms (FlipGrid, Canva). The specific details can be seen in the table (Table 4.3) below.

Table 4.3: Educational platforms and programs mentioned by participants

Educational Platforms/Programs	Mentioned by Participant	Sites used in
Google Slides	P1 – P6	A & B
Google Docs	P1 – P5	A & B
Google Forms	P2 & P5	A & B
Google Maps	P1, P2, P4	A & B
Matific	P1	A
Mathletics	P1, P2, P3, P5, P6	A & B
My Tutor	P3, P5	A & B
Reading Eggs	P1-P3 (School A)	A
Text to speech	P1, P4, P6	A & B
FlipGrid	P3, P4	A & B
Kahoot, Quizizz, Quizlet	P4, P6	A & B
Canva	P1, P6	A & B
YouTube	P1 – P6	A & B
Khan Academy	P5	B

4.3.1.1.2. Category 1.1.2: Depends on the task (goal)

This category illustrates the various factors that affect how teachers use digital technology. These factors determine the type of device or platform they use and whether they use digital technology in their classrooms at all.

Participants had different perspectives on the types of devices used and their capabilities for the lessons. Participant 1 noted a preference for iPads compared to Chromebooks: *“I sometimes find the Chromebooks a bit limiting. I think the Apple devices and the apps, the sort of working apps that you can get on an Apple device, are superior to the sort of open source free stuff that you can get on the Chromebook”* (Participant 1, interview). They went on to explain the various ways these devices are used for the younger grades: *“...the iPads, the juniors, they use a lot of sort of gamified apps for the literacy and numeracy, which is, which they like. And then they also use the Google platform for sort of presenting and publishing. So they also use the Google Docs and the slides...”* (Participant 1, interview).

Participant 2 echoed the benefits of using iPads for specific functions and lower grades by stating: *“...if you want him to shoot a video, or do something like that, that they’re more useful, and that there are some really cool apps particularly, I think, particularly lower down.* (Participant 2, interview). However, they offered an alternative perspective in favour of Chromebooks and noted the grade-specific expectations: *“I mean, with a Chromebook with a keyboard, it’s just your inputting of information is far easier. You know, in terms of typing skills, the speed at which they process and get stuff done. And I think it’s more relevant to that age group. And I think going forward, again, as I said, you know, we’re preparing them for high school, you know, in a high school environment. There’s a lot of writing, there’s a lot of, you know, researching, which requires the use of the keyboard.”* (Participant 2, interview).

When reflecting on using different types of devices, Participant 5 noted that various applications or tasks are sometimes better suited to a tablet, phone, or laptop. *“...it’s a different story, typing something on your phone with your laptop, or it’s easier to do something on the smartphone than to use your mouse to do on the laptop.”* (Participant 5, interview).

Further, several participants noted that the types of tasks and aims of those tasks would determine the use of the preferred digital technology, if any. Participant 4 explained that the continuation of a task might be done on technology or in a different form: *“...it could be a presentation that was going to be oral or written, or dramatised. And once you’ve decided what presentation, you want to definitely determine what technology you want.”* (Participant 4, interview). They continue to explain that it rests on

what a teacher wants from the learners: *“Depending on what you want from them, it (assessing understanding) might be pencil and paper.”* (Participant 4, interview).

The teachers also noted that technology was more applicable for specific tasks within a subject than others. Participant 2 noted a specific aversion to using digital technology within the subject of Mathematics: *“The place where I do find it quite tough is when we do the problem-solving Maths.”* (Participant 2, interview). Participant 5 concurred with this perspective as they described: *“So, with Maths, it’s difficult, or it was particularly difficult, especially for the kids to do the work, because of a lot of it is handwritten in the books, and we’ll work on the layout and that kind of thing.”* (Participant 5, interview)

4.3.1.2. Subtheme 1.2: Use of digital technology during COVID-19 lockdown

This subtheme offers teachers’ reflections on how they used digital technology during the COVID-19 lockdown and the limitations and difficulties they experienced. The two categories emerging from this subtheme are outlined below.

4.3.1.2.1. Category 1.2.1: Digital Technology used for teaching

When faced with the COVID-19 lockdown, participants reported that both their schools responded similarly. *Google Classroom* was predominantly used, as Participant 2 explained: *“That was our chosen platform because we were Google school. So we use Google Meets. We set up our links for Google Meets in our classrooms and our Google Classroom.”* (Participant 2, interview). However, in school B, *Zoom* was used as a lesson platform, as Participant 4 noted: *“So that it was that year that Zoom lessons became prevalent.”* (Participant 4, interview).

Participant 5 highlighted the need to explore many different teaching and learning platforms and applications: *“During this time, there was a need to explore many different teaching and learning platforms and applications.”* (Participant 5, interview).

4.3.1.2.2. Category 1.2.2: Limitations and difficulties.

The majority of participants discussed access difficulties during the COVID-19 lockdown. Participant 3 discusses the stresses that this caused: *“Because if there was more than one child on a device, and the families didn’t have enough devices, and the battery ran out, and the parents had important meetings, because juggling all those different things that made it quite stressful...”* (Participant 3, interview). Participant 2 reflected on their own daughter’s school experience: *“...it was very much reliant on what was the kids access at home. And they couldn’t help anybody with that access because there had no bank of resources on mobile devices to do that.”* (Participant 2, interview).

This challenge of access with regards to connectivity was echoed by Participant 5, who stated: *“And I think, or something we have to consider as well as I mean, where we are in South Africa and the technology that’s available. I mean, not everybody has the fastest internet speed. So we could be watching a video and it buffers every five seconds.”* (Participant 5, interview). Learners did not just face this problem but teachers as well, as Participant 4 details: *“...we didn’t have very good Wi-Fi at home.”* (Participant 4, interview).

Depending on the type of device the learners had access to, Participant 5 continued to expand on additional concerns by saying: *“...some people have cell phones and some have laptops, you know, do they see things differently? Can they see the full picture on a cell phone? I mean, even just the spatial influences in the learning.”* (Participant 5, interview).

Participant 2 reflected on concerns about having too much access: *“...they (learners) are attached to technology for so many for so much of their time outside of the classroom. And then we were doing full-on online classroom.”* (Participant 2, interview).

Additional difficulties that the teachers experienced were discussed by Participant 3: *“...we had a lot to learn in terms of the platforms we wanted to use. So it was yeah, it was an overload of information...”* (Participant 3, interview). Participant 4 also expanded on further challenges they faced: *“...But I would state it took forever to design it.”* (Participant 4, interview). These challenges were further echoed by Participant 2: *“So the amount of time it took to prepare those online lessons was just insane.”*

I mean, I was working, I was working, like ridiculous amounts of time to prepare a lesson. That I have never spent preparing, simply because it's because it was so different." (Participant 2, interview). In addition, Participant 5 raised concerns about the following: *"...the most challenging part was how the kids then did their work and how that was monitored. I wasn't there to see as they were going to see a final product. And that was so questionable because how much did they do themselves?"* (Participant 5, interview).

4.3.1.3. Subtheme 1.3: Implementation method – SAMR Model

Participant 1 had knowledge and training on the SAMR model and spoke about it directly when discussing their method integration of digital technology: *"...I've sort of swayed more towards using the iPads for the creation and the augmentation of knowledge rather than so if you look at the SAMR model, the upper part of the SAMR model rather than just the stuff at the bottom"* (Participant 1, interview). They continue to provide specific examples such as: *"...augmented reality which allows them to hold the iPad up and actually see the planets, you know, in front of them in the classroom."* (Participant 1, interview). However, Participant 1 does contrast this advanced approach of the SAMR model with the following observations: *"...they (teachers) are not really embracing the full power of the use of the device in the classroom. So there, as far as the SAMR model goes again, they're sort of just dabbling, dabbling in the shallows, you know, there's very little deep learning. So to me, a lot of a lot of still typing out of essays. Very little recording of videos or making music or, or creating campaigns or sending out questionnaires you know, that can really enhance the understanding."* (Participant 1, interview).

Some examples of Augmentation-level (second level of SAMR Model) tasks were explained by Participant 2, yet the model was not directly referred to: *"And rather than, you know, with all of that on paper, it starts becoming a little bit complicated. I suppose you could do overlays and things like that, but it's - the editing is easy. And it's (digital version) quick and easy for the kids."* (Participant 2, interview). However, they continue to describe the different possibilities of Modification and Redefinition with the use of digital technology: *"So sort of, I've done it as a joint thing with history. So we'll say we've done some map work... So now we're going to create a local history route. ... have to identify five points*

of historical interest in a small area, they have to drop a pin, they have to add an image, they have to explain its historical significance, all in that digital format, all working in that Google Map, then link them to have a route so that people would be able to follow it as well, as a little tourist route, ...” (Participant 2, interview).

Participant 4 provides additional examples of how digital technology modified and redefined the teaching and learning experiences: *“And then walk around the museum in the University of Pretoria showing them things virtually and yes, and showing them photographs of places before we even started.”* (Participant 4, interview). These new possibilities were echoed by Participant 6 when they stated: *“I think especially for children, that might not be exposed to these things. If a child has never been to the beach, or they’ve never been to the zoo or Egypt or wherever they’re able to access this information. I mean, the other day, I was scrolling, and I saw how you can walk into the tombs in Egypt, I’ll never be able to go to Egypt, but yet I’m walked in the tomb. So it really has enhanced teaching so much...”* (Participant 6, interview).

4.3.2. Theme 2: Teachers’ reflections and reflective practices on the use of digital technology in teaching and learning practices

Theme 2 relates directly to the main research question: *“What reflective pedagogical approaches and practices do primary school teachers employ when integrating digital technology into their classrooms?”*, as well as the following objective: *To investigate the reflective practices or processes educators employ when they incorporate digital technology into their teaching.* This theme explores the teachers’ evaluations of the effectiveness of teaching and learning processes and motivations for using digital technology in the classroom. The subthemes identified included the teachers’ observed positive and negative impacts on teaching and learning and the teachers’ paradigm (values, theoretical frameworks and pedagogical practices). The description and definitions used in developing the subthemes within this first theme are outlined in Table 4.4.

Table 4.4: Graphic descriptions of findings within Theme 2

Theme 2: Teachers' reflections and reflective practices on the use of digital technology in teaching and learning practices	
Subtheme	Categories & Description
Positive impacts on teaching and learning	<ul style="list-style-type: none"> • Increased accessibility - Reduces physical barriers, new administrative possibilities, Assists in assessing • Greater learner engagement - Positive impact on pupils' experiences, Gamification of learning, Learning styles- learning barriers -Adds value to those with learning barriers or learn better in specific ways (auditory) • Increased variety of teaching and learning methods <ul style="list-style-type: none"> ○ Research possibilities ○ Assists in their learning • Promotion of 21st-century skills (Project-based learning),
Negative impacts on teaching and learning	<ul style="list-style-type: none"> • Negative influence on teaching- teachers • Teaching affected by being too reliant on technology • Control issues for teachers - Teachers find it difficult to control in the classroom and manage their use • Negatively influences learning • Instant gratification - A need for quick instant responses and output of work • Pupils Responsible habits & use – Distraction, social and emotional concerns, Responsible behaviour- digital citizen, evaluating info, plagiarism, research.
Teachers' reflective practices	<ul style="list-style-type: none"> • Method of planning lessons - How they plan their use of digital technology in lessons. • Intentional - Specifically planning for it • Organic - casual way of integrating tech • Collaboration - Learning from other staff members • Teachers' readiness to learn – The attitudes and buy-in of staff. Self-taught or trial and error attitude.

4.3.2.1. Subtheme 2.1: Positive impacts on teaching and learning

This subtheme details teachers' reflections on the benefits they see in using digital technology in their teaching and learning practices. The findings of this subtheme are organised into the following categories that pertain to increased accessibility, increased variety of teaching and learning methods, greater learner engagement, and the promotion of 21st-century skills.

4.3.2.1.1. Category 2.1.1: Increased accessibility

Participants identified and shared their experiences of technology providing themselves and learners with greater access to teaching and learning processes. Concerning the teachers' responsibilities, participants discussed factors such as marking and administration which became more accessible to them. Participant 4 details this by stating: *"And they would punch in their answers on the Chromebooks. And they'd have whatever the time it was for the question that one minute or one and a half minutes for this or two minutes. And it would mark them..."* (Participant 4, interview). In addition, they recalled: *"We needed to do English orals. ...we lost so much teaching time... we needed oral marks to go in ... So we said to them, you're not going to do this oral in front of the class, you've got four days. On Monday, we want it posted into the classroom, a link to your Flipgrid oral good on Flipgrid, we will listen, and we will mark."* (Participant 4, interview)

Participant 3 explained when talking about online quizzes, that: *"It's obviously a quick way to mark it, quick way to assess. It takes a load of the teachers and it is all done in assessments and the results are instant."* (Participant 3, interview). Additional benefits to reviewing marks were discussed by Participant 5 in saying that: *"Mathletics shows you, your pupils, who are at risk, maybe if they did badly in a section to highlight that kind of thing. So you can also get a general overview and see how things went and then go into that specific pupil's work they see? Oh, maybe they did just skip the answer or they don't understand the question."* (Participant 5, journal reflection).

Participant 2 spoke to specific access with regards to having information centrally located, explaining that: *"...you can set your task in the classroom, you can have your rubric set in the classroom."*

You know, it's all there.... then the marks can be accessed and the feedback access via the Google Classroom...” (Participant 2, interview). They continued to detail the benefits that learners have greater physical access to their work: *“Whereas in the Google Classroom, if, if the notes are there, the links to videos, are there... And my assignment is there, and the marking of that assignment is there with feedback and everything. And that's also part of what I need to prepare for it. Again, it's all in one place. So neatly packaged ...”* (Participant 2, interview).

Increased accessibility was also referred to when working in groups, as Participant 4 explains: *“Because it just made it so accessible for the pupils and the teachers, the accessibility to more technology came because everybody had access to it. They could actually use it on a device, they could work in groups, Google allows them to access each other, in groups and so on.”* (Participant 4, interview). They continued to describe this benefit they perceived since introducing digital technology: *“we moved more into group teaching than we had in the past, all of us because the technology-enabled children to work in a group without having to go to someone else's house. And transport difficulties or parents didn't have time to take the child. All of that was resolved through having a device.”* (Participant 4, interview).

Participant 4 related the increased accessibility with their administrative procedures: *“...they moved that (administrative system) online so that teachers could now log in and access it from home. ...made it easier for teachers and parents to communicate and to do just to run the admin of the school has been much easier.”* (Participant 4, interview).

4.3.2.1.2. Category 2.1.2: Greater learner engagement

All participants commonly mentioned the impact digital technology has on learner engagement. Learner engagement was viewed as an increase in participation and interest in the teaching or learning activities. The participants noted that providing a digital medium for tasks often improved their active participation and had the potential to improve the quality of their learning, even for those learners with different learning needs or preferred learning styles. Participant 1 noted a specific aspect of ‘gamification’ that assisted with learner engagement, explaining that: *“...it gives us a gamification. And*

that's what hooks the kids..." (Participant 1, interview). This is further reinforced by Participant 2's statement: *"...when that is the digital format, the kids respond to very well, from that point of view with that particular exercise, they, they really do enjoy that exercise, because it's, it's creating it... it's kind of like the gamification I suppose."* (Participant 2, interview).

Participant 2 continued to reflect on the impact of this, by saying: *"If they're more engaged, they're probably going to learn more."* (Participant 2, interview). This notion was further expanded on by Participant 4: *"But for this generation, they get bored very quickly. And if they're not entertained, they give up..."* (Participant 4, interview). Participant 4 corroborated this further: *"I think having the pupils be comfortable and excited about doing things using technology. Yeah. It's because maybe someone who's not so keen to do Maths today is suddenly thinking - okay fine, I'll take out my laptop - and be a little bit more willing, or just softens them slightly. You can get them and reach them to teach concepts. I think half the work is getting a pupil to be willing."* (Participant 4, interview).

Participants 3 and 6 discussed the benefit of increased learner engagement and different learning styles. Participant 3 described that: *"And it's catchy and engaging. And it makes more sense because they remember it. It can present the lesson in a way they learn better like children have different learning styles. Using all the senses, so it might be good for the visual or auditory learner."* (Participant 3, interview). This was echoed in Participant 6's statement: *"With the different styles of learning, ... But also you can listen back, for an auditory style of learning, so there are different ways that they starting to engage... a visual learner ... Google the picture to be able to see what she's talking about ... we can watch a YouTube video on it ... I think you're accessing a lot of senses."* (Participant 6, interview).

This benefit was explored further by Participant 1 who spoke about the different formats of presenting work on digital technology for learners with a specific learning need and their engagement: *"...you get your boys who have concessions who don't have to, to write out stuff so as long as you're allowing them to do whatever works best for them, then they'll buy into it."* (Participant 1, interview).

4.3.2.1.3. Category 2.1.3: Increased variety of teaching and learning methods

Participants noted an increase in the ways in which digital technology changes the methods of teaching and learning. Several participants noted the possibility of introducing topics or lessons in various ways. Participant 4's lesson description highlighted this: *"We developed a relationship with a lecturer at the University of Pretoria, who would introduce the theme. But they've never had heard of Mapungubwe before at all, introduce the theme through a zoom question and answer session with the whole grade six group together."* (Participant 4, interview). They continued to summarise that: *"the introduction is crucial in terms of catching the kids attention. And it will be technological if there is a better expert than you."* (Participant 4, interview).

Participant 6 indicated: *"So it (digital technology) really has enhanced teaching so much, where traditional classrooms, it's very much the teacher is the core source of information, and how she or he delivers whatever's in the textbook. And that's it."* (Participant 6, interview). Participant 2 provided an example of this sentiment: *"I want them to, to be able to look at what's current, active volcanic activity, you know, what Volcanoes are erupting, right? So, you know, giving them a link to a volcano watch website, which gives up-to-date, real-life information about what volcanoes around the world are erupting..."* (Participant 2, interview).

Other aspects noted relate to the different and creative possibilities in which learners can display their work. The examples from Participant 1 speak to this: *"...they're busy doing advertising ... and to create these really slick looking adverts ... that that could be used in print media ... whereas if you're sitting with a piece of paper and you poky having to draw and, and make bubble letters, doesn't quite have the same effect."* and *"So teaching them that you can draw your graph on a piece of paper, but look at how much more powerful your data is when you import it into an Excel spreadsheet, or into Google Sheets. And then look at what you could do to manipulate this data."* (Participant 1, interview).

Further, Participant 1 referred to the enhanced research possibilities which introduced a different way of teaching: *"But the advantage of technology has meant that they also have research at their fingertips, so you don't no longer have to teach them everything, you can pose the problem, and they*

can go find the knowledge for themselves, you know, and for me, that's very, very exciting." (Participant 1, interview). The benefit was endorsed by Participant 3: *"I think that the excitement of learning knowledge, research in every subject to be honest because there's a lot of an undefined possibility for research..."* (Participant 3, interview). Yet, Participant 3 cautioned that: *"You can't just say go and do research and whatever. And I make it very clear to the children and I show them from grade four, five and six plus, I showed them how easy it is for teachers to check plagiarism."* (Participant 3, interview). Similarly, Participant 5 discussed reservations with regard to the latest revolutions in digital technology. They said this when discussing the role of ChatGPT in education: *"But it's going to change technology. I mean, it's going to change teaching and the way we assess I think language specifically."* (Participant 5, interview).

4.3.2.1.4. Category 2.1.4: Promotion of 21st century skills

During the discussion, all the participants highlighted how digital technology enhances various skills essential for learners in the 21st century. One of these skills that were mentioned included creativity, which Participant 5 explained regarding a digital technology lesson: *"And yeah, I think it's creativity, it's initiative, you know, kind of seeing things for themselves."* (Participant 5, interview). Participant 3 concurred by saying: *"They were able to be creative and try things using devices. So there are lots of possibilities."* (Participant 5, interview).

Participant 4 mentioned the possibilities to enhance problem-solving skills when using digital technology: *"...I want them to think, and want them to problem solve. And I don't want them to give up. The textbook isn't doing it for them, so how can I make it more interesting? And moreover, (digital technology) a wider range of activities, so that they do the thinking and the problem solving, and the learning."* (Participant 4, interview). Participant 1 further reflected on the promotion of critical thinking by saying: *"But it also teaches them to critically look at the research, because often we find some dodgy sites that are saying things that are, are not what we're what we're going for."* (Participant 1, interview). This similar thought was reiterated by Participant 6 when discussing skills for digital technology: *"...it's*

not just about regurgitating facts, but it's about the learning process. How did I learn?" (Participant 6, interview).

Additionally, collaboration was noted as an important skill that emerged from activities that incorporated digital technology. Participant 1 shared: *"You know, we teaching them to digital citizenship ... They're learning how to collaborate with each other."* (Participant 1, interview). When speaking about the changes that digital technology introduced, Participant 4 said: *"It made it brought in a dynamic into teaching, which I've always preferred group work. Because I've always believed you learn a lot from your peers. And I believe that your brain power is not just doubled... you've got access to so many different thoughts and trigger off new things."* (Participant 4, interview). Participant 6 linked the project-based learning to the skill of collaboration: *"And I think the project-based learning focuses so much more And also I think people skills come into play there, how did I socially interact with my group? And that gets evaluated throughout this project-based learning as well."* (Participant 6, interview).

Project-based learning (PBL), mentioned in more detail by Participant 1, 2 and 5, enhanced the skill of connecting information to the real world. This was described further by Participant 2 when discussing PBL: *"So we're trying to draw on skills and make it skills-based education, rather than content-based education. So it's driven by themes and ideas, which we try to make real and relevant and as current and meaningful to the children as possible."* And *"...using the information and giving information context, I think is my approach. So I would rather use this information. And rather, develop the context so that the understanding information, and with a deeper understanding can use that information and apply it more effectively."* (Participant 2, interview). In addition, Participant 5 explained the following benefit when using digital technology: *"...it's having more problem-based real-world scenarios, and applying it just in a different setting."* (Participant 5, interview).

Participant 1 explained PBL and how it promotes the skill of independence and self-directed learning: *"So project-based learning is when we have a different way of teaching. So we have the whole grade together, and we pose a project or a problem to them. Sometimes we give them background, sometimes, the project is the research. And it's independent learning. So each group or person takes*

ownership and guides the learning in whichever sort of direction they want to take it in." (Participant 1, interview). The skill of independence and responsibility was reflected further by Participants 4 and 6. Participant 4 said: *"Also, it has allowed me to, I think, make children take responsibility for their own learning. That's been a big thing. When I started teaching, I was responsible for the learning of all the pupils in my class..."* (Participant 4, interview). And Participant 6 discussed that: *"... with project-based learning to teach children other essential soft skills, taking more of an active responsible role in their learning and their learning, which is so appropriate today."* (Participant 6, interview).

Furthermore, Participant 3 discussed the promotion of 21st Century skills expected in the working world. When asked about digital technologies' role in education, they responded: *"Think it has a place in the classroom, I really do because I've seen how effective it's been. And just with, what comes to mind is with the 21st century, they said what skills students need to have. They said what skills they need to have to be able to be successful in the 21st century. And a lot of our subjects are not catering for that. And that's why I think new subjects are being formed or started. And because technology is moving so fast, and when you think of AI, I mean..."* (Participant 3, interview).

4.3.2.2. Subtheme 2.2: Negative impacts on teaching and learning

This section contains the perspectives of teachers regarding the negative effects of digital technology on the teaching and learning process. The impacts are divided into two categories: 1) those that affect teaching or teachers and 2) those that affect learning or learners.

4.3.2.2.1. Category 2.2.1: Negative influence on teaching- teachers

Several Participants mentioned that using digital technology in their classroom can challenge the level of control they have. Participant 1 explains this challenge and the difference they experience between the use of iPads and Chromebooks: *"...control, is, is quite a big thing ... So with the iPads, as, as a teacher, remembering I was teaching grade four, a few years ago, so I've got sort of knowledge on both. The control is so much better with an iPad, because I can, as a teacher, you can decide which Apps kids are using, you can actually specifically lock a child into an app.... Whereas with the*

Chromebooks. Now, with grades six and seven, I find that I have less control. And I've resigned myself to the fact that if you're going to sit in my class, and you're not going to do what I've asked you to do, you're wasting your own time." (Participant 1, interview). Participants 3 and 5 echoed this with the following: *"How do you monitor when a kid's not doing the work and watching YouTube videos or whatever, and it happens, you've got to actually physically walk around. So it's just being everywhere?"* (Participant 3, interview). And: *"I think it's, it's difficult to control, especially in a classroom setting, because you want pupils to stay on task"* (Participant 5, interview).

Participant 1 extensively discussed the negative impact of teachers struggling to find a balance in using digital technology. They explained the consequences of this: *"But as a teacher, if you don't have the balance, if a kid walks into your class, and they know that every day, they're going to be playing a game on the device, that's what the device becomes, you know."* (Participant 1, interview). They added that: *"And I think that's as teachers, I think, sometimes we miss that mark, it's very easy to give a kid a device and say, Oh, you've got 15 minutes go play again."* (Participant 1, interview).

Teachers relying on digital technology was noted by Participant 2 and 6. Participant 2 noted that after the COVID-19 lockdown: *"...reliance on it, I think, I think is the, is the big thing. And I think, you know when we came back initially ... we're so used to setting everything up in the Google Classroom. ... And now your engagement in the classroom is reduced because you know, the kids sitting on a device, they plug in the headphones that listen to the video clip, they do this now they are working on that worksheet, and they think that little Google Form."* (Participant 2, interview). This was further reiterated by Participant 6: *"I think that just like tech can make lazy students, so taken aback lazy teachers, and that it is important that as a teacher, you're still well prepared, you are still using technology to the advantage of the learners ... so that you are still the active participant in the classroom, you really still have control over your classroom."* (Participant 6, interview).

4.3.2.2.2. Category 2.2.2: Negatively influences learning

Instant gratification and impulsive responses were noted by Participant 1 and 6 as negative influences on learning and both referred to this in Mathematics. Participant 1 said: *"So because it's on*

the screen, they just want to click the right answer. I want them to still grapple with the sum and have a whiteboard or a piece of paper and work stuff out. But they find that difficult because it's on the screen. So they just want to press the button. Instant answers, without thinking." (Participant 1, interview). Participant 6's reflection agreed with this.: *"Specifically, we did an online test was done and the feedback was... I miss click, I click accidentally click the wrong answer when I knew what the right answer was."* (Participant 6, interview).

Participant 3 provided additional information about how instant gratification negatively affects learning: *"I saw big gaps where they would just copy and paste information as much as you spoke about plagiarism, they didn't quite get it. They were looking for shortcuts or instant gratification. It also meant they weren't always learning or really understanding the concepts.* (Participant 3, interview).

Further challenges to learning concisely stated by Participant 4: *"I think the distractions that they can access are big."* (Participant 4, interview). Participant 2 noted that distractions could be related to things like: *"So they spending more time selecting what songs they want to listen to them actually engaging with the work that they should be doing."* (Participant 2, interview). As well: *"... they sometimes get hooked into the aesthetic of the presentation, rather than the content of the presentation."* (Participant 2, interview).

Negative influences related to social aspects were noted by Participants 3 and 4. Participant 3 stated: *"...children would use technology to bully or be mean to others. Either online, or unplugging each other's devices at the end of the day so that they couldn't use it the next day. Then the children would have to sit at the power station to work."* (Participant 3, interview). This concern was echoed by Participant 4: *"...the bullying has become increasingly cyberbullying. And I am very, very fearful of what happens to the more vulnerable child in cyberbullying because it's silent. And you don't see it happening. And unless the child feels safe enough to tell you or at least go home and tell their parents if nothing else, you're not even aware of it happening."* (Participant 4, interview).

4.3.2.3. Subtheme 2.3: Teachers' reflective practices

This subtheme provides more information about the research objective of identifying the reflective practices used by teachers when integrating digital technology into their lessons. The reflections speak to the skills of a reflective practitioner discussed in Chapter 2 (find numbering). The teachers' responses showed two main categories. The first is about how teachers plan the lessons and tasks involving digital technology, while the second category focuses on their reflections about staff collaboration and testing different approaches.

4.3.2.3.1. Category 2.2.1: Method of planning lessons

The participants reflected on the ways in which they planned to incorporate digital technology into their lessons. Several of them spoke to an intentional method of doing this, as expressed by Participant 5: *"I think that at the moment, and maybe for me specifically have to be intentional about technology lesson about using technology in the lesson."* (Participant 5, interview). Agreement for having an intentional plan and structure when using digital technology was also expressed by Participant 6. When asked what influences their decision to incorporate digital technology, they responded: *"So if it's definitely related to the task. If I have planned something, I think that's really important to not just allow children to go wild using technology and to have more structure because otherwise, you can go off on a tangent or end up in places where you shouldn't be ending up. So I think, if the lesson calls for it if I've planned for it, and then also how the atmosphere in the classes that day."* (Participant 6, interview).

Moreover, when asked directly how they plan to use digital technology, Participant 1 motivated for an intentional approach by saying: *"I think it's got to be intentional. So, you're using of devices needs to be intentional. It can't just become in and open your device and keep you busy sort of stuff. It's got it. And the kids have got to see the sort of reason they're using it."* (Participant 1, interview). They continued to provide examples of intentional planning regarding the purpose of using a specific device in tasks and connected it with the SAMR model, which was discussed earlier in this theme: *"So now I've sort of swayed more towards using the iPads for the creation and the augmentation of knowledge rather. So if*

you look at the SAMR model, the upper part of the SAMR model rather than just the stuff at the bottom..." (Participant 1, interview).

Interestingly, Participant 2 provided insight into the questions asked when planning to incorporate digital technology intentionally and critically. This also provides an additional perspective on their reflective thought regarding planning: *"Well it's how to include it and how to structures as well. I think about how to use those various things... So right from Classroom as a tool to then the individual apps beyond that... How are you going to use it? And it's, you know, you're asked the question about my map example. You know, why not do it on paper? At times, it's, maybe you want to do it on paper? At times, maybe you don't, maybe you want to do it in a digital format. But I don't think it should be doing it in a digital format because digital formats exist. Does it work? Is it necessary?"* (Participant 2, interview). Participant 4 also provided their viewpoint on the types of reflective questions they used when planning to incorporate digital technology: *"What parts of that lesson would be integrated with a whole class and you're doing some teacher talk and class discussion and class integration as the learning part of the lesson? And then you would decide on the practice part. Would they be doing it entirely with that technology? Individually or in pairs?"* (Participant 4, interview).

In contrast to this intentional approach in planning to incorporate digital technology, Participant 1 and 4 noted there are times that it is not always incorporated in this way. The decision to include or not to include digital technology is sometimes influenced in the moment by spontaneous factors in the classroom. Participant 1 explains: *"Often the whim things are the ones that just work at the moment. But yeah, more sort of the feeling or also you can get a group of kids to walk into your class, and they've had four tests in a week. And you were going to do it a specific way. And you go, Okay, now let's change it up." And "... sometimes it goes on according to what I feel like marking as well. So sometimes I might not feel like sitting in front of my laptop and marking 60 slideshows, you know, and then or at what I think, you know, we've had a lot of tech-based stuff in the last two weeks, let's rather find the balance and do something on paper, or whatever. So it's, it's not planned, per se."* (Participant 1, interview). Participant 1 concludes this comment with an interesting statement that speaks to the use of past

experience, wisdom, and intuition in planning- and decision-making. *“It’s more of a - I’ve been in the business for 20 years; this is my teacher feeling about how it should go.”* (Participant 1, interview).

Participant 4 also explained that the incorporation of digital technology often is not always according to the best practices: *“...sometimes the technology came out of desperation of how to complete something that we had run out of time for in class. And it wasn’t maybe the best technology or the best way of doing it ... we don’t have time we have to have this mark is just find a quicker way of doing this, then you will have to do that. So not everything technological was the best either. Sometimes it was just helpful.”* (Participant 4, interview).

4.3.2.3.2. Category 2.2.2: Collaboration

The participants discussed additional competencies for reflective practice. They mentioned the importance of collaboration and support from other staff members. Participant 4 explained that they had a weekly designated planning time with colleagues which made a big difference as this allowed time and space for intentional planning and critical reflection with others: *“We also reviewed at the end of a week, what had happened in that week. And if something hadn’t worked, and sometimes it did not. We there and then discussed how we should change that for the following year and made notes of it. That if we didn’t repeat the same mistakes from one year to the next if it didn’t work, it didn’t work.”* (Participant 4, interview). The majority of participants also reported on communication, sharing ideas, and collaboration. Benefits for this were shared by Participant 6: *“Some teachers have skills that others don’t have, like, we all have our own unique skill... And this teacher might know exactly where to research, this teacher might be good with this aspect of it. So, to really collaborate...”* (Participant 6, interview). They further described this process by saying that: *“So almost coming together within content areas, or subject areas sitting together and saying, Oh, but I found this, and this is useful. And this website and this technology, and this is how I taught this lesson, and really collaborating.”* (Participant 6, interview). Participant 3 observed that collaboration increased during the COVID-19 lockdown: *“wonderful how we all helped each other. If you were stuck, you know.”* (Participant 3, interview). Moreover, while Participant 2 was explaining that they are reducing external training, they added that: *“I think we’ve actually got*

very, very competent staff members who, who can assist and guide and help others develop these skills internally." (Participant 2, interview). This was echoed by Participant 3, who works at the same school: *"And then if there's anything new you needed to learn, they would have to do workshops at school, where the staff member who knows what was going on would teach you."* (Participant 3, interview).

4.3.2.3.3. Category 2.2.3: Teachers' readiness to learn

Participants 1, 2 and 3 discussed a teacher's disposition to learn new things with digital technology in the classroom. Participant 3 explained that they did a great deal in learning to use digital technology by immersing themselves in the process and learning via 'trial-and-error'. They reiterated the need to try new things or get first-hand experience by saying: *"I think basically, the teacher needs to know ... they need to be confident in what the work they're giving, that they can do it. They've got to have tried it themselves and make sure it works."* (Participant 3, interview). Confidence and experience in using technology were also highlighted by Participant 2: *"... depending on how tech-savvy they were, and, you know, how open to new ideas."* (Participant 2, interview). This participant even connected this learning disposition to age a few times in the discussion: *"And I think younger teachers, who are clearly more tech-savvy, they've grown up with all of the technology and all the different social media platforms and whatever else that exists. They tend to dive into it."* (Participant 2, interview). Participant 1 insisted that teachers must have an *"adventurous spirit"* and need to be willing to actively put in the effort when working with digital technology. They added that the benefit of this is: *"...the boys respect that as well, they realise that you don't have everything figured out yourself. And then they're also willing to try it, you know?"* (Participant 1, interview). They even remarked on how they learnt from their learners: *"So I'm quite keen to give stuff a try... And I'm with the boys, they know that I don't know everything. But if they want to know how to do so if you will, let's Google it together. And then and then we'll learn together. You know, when I taught on the iPads, there were often boys who knew more than I did, and you make them the master teacher, and you present their iPads... So that's how I've learned a lot."* (Participant 1, interview).

4.3.3. *Theme 3: Teachers suggested improvements to the implementation of relevant digital technologies in the classroom*

Several participants noted ways in which the use of digital technology in the classroom can be improved. This final theme was identified in the individual interviews and serves to provide a response to the final research objective which is: *“To generate suggestions to improve the implementation of relevant digital technologies in the classroom.”* The first subtheme emphasises the importance of explicitly focusing on the soft skills required to work effectively with technology as a learner or teacher. The second subtheme speaks to the broader school and contextual factors which, if addressed, could improve the use of digital technologies in the classroom. The final subtheme includes reflections on how training can improve teachers’ perspectives and the effective use of digital technology in the classroom. The description and definitions used in developing the subthemes are outlined in Table 4.5.

Table 4.5: Graphic descriptions of findings within Theme 3

Theme 3: Teachers suggested improvements to the implementation of relevant digital technologies in the classroom	
Subtheme	Categories & Description
Emphasis on soft skills	Skills needed for learners to ethically and responsibly use digital technology in their learning to ensure its purpose and function are appropriate to the goal.
School-contextual structures	<ul style="list-style-type: none"> • Access to devices - Limited access to the same devices/ any devices. • A clear school approach - There needs to be a structured, driven approach to incorporating technology into technology.
Training of teachers	Amount and quality of training had on the use of technology. The attitudes of teachers on the approach of using technology in the classroom, their willingness to research further

4.3.3.1. Subtheme 3.1: Emphasis on soft skills

Participants discussed the competencies needed to use digital technology in teaching and learning processes. Participant 1 referred to these skills required for “*digital citizenship*” and noted that learners must be explicitly taught the “*etiquette*” when using digital technology, specifically when presenting information on a Google Slide. They continue to say: “*...it’s no good putting a device in front of a child and say, go wild, you know, so, um, constantly digging my heels in about having to teach the soft skills, because I think the soft skills empower you to do all this other stuff.*” (Participant 1, interview).

Participant 5 shared similar sentiments and explained that it is good to expose learners to using digital technology in class. However, they highlighted that the use of technology should come with some form of user responsibility: “*I think the bigger lesson with technology is how children use it, not when we use it, you know, it’s got to teach them to be responsible on the internet and to manage the well being and the mental health with social media.*” (Participant 5, interview). Additionally, the responsibility for teachers was encouraged by Participant 6: “*But our role changes in where we need to teach children how to use this effectively and to their benefit. So I definitely think it can enhance teaching. We just need to maybe make a mind shift.*” (Participant 6, interview).

Another skill to improve the use of digital technology in the classroom was noted by several participants. It pertained to encouraging critical evaluation and discernment of information which learners receive online. Participant 6 highlighted that there is a wealth of information that learners have access to, but they need to be taught how to use their discernment and critically reflect on the information they find. They emphasised the importance of teaching learners to decipher if the information or sources are true and accurate. Continuing this thought, Participant 4 reflected that if learners simply copy and paste information then they have not fully processed what they are meant to learn. Rather, teachers must ensure that learners gain certain skills: “*...teachers have to teach children properly, how to research, how to find keywords and main points, how to put things into their own words, how to summarise.*” (Participant 4, interview). In further discussions, Participant 4 also raised the importance of learners explicitly being taught about plagiarism and correctly acknowledging sources.

4.3.3.2. Subtheme 3.2: School-contextual structures

In this subtheme, participants discussed how the use of digital technologies in the classroom can be improved through broader school and contextual factors. The specific categories regarding access, having a clear structure, and providing digital technology support are outlined.

4.3.3.2.1. Category 3.2.1: Limited access

Contextual factors, such as load-shedding, were noted to impact the effective use of digital technology in teaching and learning practices. Participants indicated that they often feel stranded when they experience power disruptions, such as the WiFi being down. Participant 4 suggested improvement to being able to access digital technology continuously: *“A critical thing that improved the functioning of our school was buying a generator in 2022, which kept the Wi-Fi router working. So during load-shedding, the classroom would have no lights, and no smartboard and no computer in the classroom desktop computer, but the Chromebooks, because they simply need to connect to the Wi-Fi, continue to work.”* (Participant 4, interview). The second enhancement Participant 4 referred to was that an IT administration team should offer technical support to teachers and learners. They noted that without this: *“...if there are disasters, but no Wi-Fi. If there are courses, introducing lots of exciting things, but no access to that, the teachers will become frustrated and negative and angry...”* (Participant 4, interview).

Participant 4 continued to discuss additional improvements concerning access. These centred specifically around having access to online platforms: *“...things are free with limitations, and you don't get access to the full benefit of the programme without paying a fee.”* (Participant 4, interview). They explained that: *“unless you are a premium user paying a fee, you can't access those things are not access other people's lessons, which I'm sure are very good, I can't even see them. And they can't see mine. I can't share mine with my colleagues.”* (Participant 4, interview). They further suggested that schools need to be able to provide financial access to be able to make use of rich online resources. In this context, they remarked that schools need to consider what resources are shared with teachers and what the school can and cannot provide.

4.3.3.2.2. Category 3.2.2: A clear school approach

Participant 1 emphasised the importance of having a clear and consistent approach throughout the school. They shared an example of the learners' experiences when this is not the case: *"But say, in grade three, they only use the devices for Google Docs, right? And then I get to grade four, and the grade four teachers are keen on devices, and they want the kids to really delve deep into something and use them, but the kids don't have the skills because they've only used Google Docs, you know... so they're one step behind to get. But then in grade four, they've had this rich experience, and they get to grade five, and the teachers only do pen and paper and maybe use the device to search up the word of the week, once a week."* (Participant 1, interview). They summarised that: *"Otherwise, you get this up and down and up and down. And, you know, you get exponential growth when everybody's on the same page, whereas moving two steps backwards, if not."* (Participant 1, interview).

Regarding having a uniform and structured approach, Participant 2 emphasised that this also needs to follow through to the delivery of online material. They explained that there is always a need for improvement in this regard, and: *"...due to parental concerns, we had to go to a teacher and ask them to actually put some formal structure into the Google Classroom so that kids and parents could manage to find information that Google Classroom..."* (Participant 2, interview).

Furthermore, Participant 2 and 4 noted the challenges of being overwhelmed with numerous platforms and online education programmes. Participant 4 explained that this created difficulty with the IT administrators: *"They couldn't cope with all the different platforms, it was just overwhelming. And there were security issues depending on what platform you had the major security issues in terms of connecting to the Wi-Fi and what you could do and not do."* (Participant 4, interview). Participant 2 also noted the importance of having a clear structure in the efforts of addressing these similar challenges: *"...we've got to actually draw the line in the sand and say this is, this is our basic framework."* and *"...what we've already got in place to make sure we're using that effectively. Before we add to it... So it's a case of also knowing when to put the brakes on all these newfangled ideas."* (Participant 2, interview).

4.3.3.3. Subtheme 3.3: Training of teachers

Several participants spoke about the importance of teachers' training to enhance their use of digital technology in the classroom for their teaching practices and to improve learner experiences. Participant 2 specifically noted that teacher training is vital to fully use their current digital technology resources effectively: *"...we're looking to maximize the use of what we've got. And to do that we've got to improve, you know, each teacher skill set."* (Participant 2, interview).

Participants also connected that teacher training can enhance teacher empowerment which in turn may influence learners in a positive manner. Participant 6 describes: *"If teachers know how to use them, they feel confident, then they're able to relate that to their students and a confident teacher will breed confident students as well."* (Participant 6, interview). Participant 1 reflects on their wishes to be able to offer workshops to other teachers: *"...And I would love to get our teachers more empowered to use the devices. You know, because the kids are ready for it, the kids will go with whatever you want. But I think it's up to teachers to use them in the right way."* (Participant 1, interview).

Moreover, Participant 3 raised that this training needs to be effective: *"Well, I think that if training is done well, it's done with engaged teachers, and the teachers are fully engaged. I think. They feel that they really learned something they're going to want to pass it on to the kids. So, I think the training, effective training will certainly be carried through to the children."* (Participant 3, interview). Participant 4 noted that for training to be effective, it must also be relevant and practical to their classroom: *"...because they were education orientated, people had huge buy-in... And a lot of us did that. Because it was connected with what we were learning and using."* (Participant 4, interview). These points were reiterated by Participant 2, as they pointed out a particular training's *"failing"* was that it didn't offer *"this is how you use it in a classroom. You know, this is how you can use it as a teaching tool."* (Participant 2, interview).

4.4. Conclusion

In this chapter, the main themes and subthemes that arose from analysing the data collected from six participants using reflexive thematic analysis were explored. Close attention was paid to the participants' words and reflections to provide a deeper understanding of their views and assist in portraying the themes. The themes included how teachers use digital technology, teachers' reflections and reflective practices of digital technology, as well as their suggestions for improving digital technology use and implementation in the classroom. In the next chapter, further comparisons are made between the research results and the literature to present findings and insights. The main research question was addressed and any limitations, contributions, and recommendations were discussed.

CHAPTER 5

DISCUSSION OF FINDINGS AND RECOMMENDATIONS

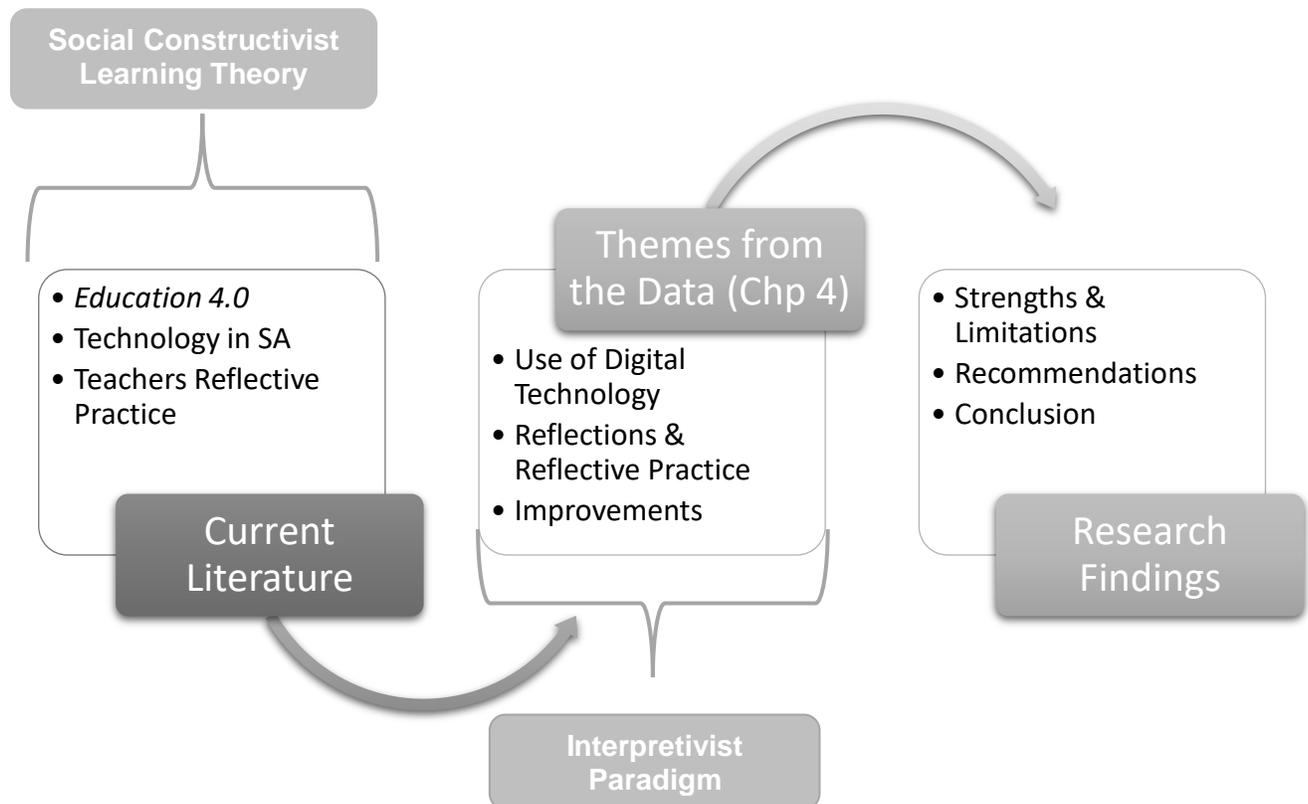


Figure 5.1: Conceptualisation of Chapter 5

5.1. Introduction

The primary purpose of this research study was to explore teachers' reflective pedagogies and practices when incorporating digital technology into their classrooms. The intention was first to uncover how teachers used digital technology in their teaching and learning processes. The second overarching objective was to investigate what reflective practices they used in their pedagogical decision-making. This objective intended to understand how they rationalised and evaluated the use of digital technology. Finally, the study aimed to explore teachers' reflections on how the integration of digital technology can be improved in classrooms. Data was gathered using an interpretivist research paradigm with a social constructivist theoretical learning framework to attain these research goals. This chapter discusses the findings from the data and draws connections to the literature which was discussed in Chapter 2. Finally, before the closing remarks, the limitations of the study and future recommendations for teachers using digital technology in the classroom are presented.

The research question was formulated as follows: *What reflective pedagogical approaches and practices do primary school teachers employ when integrating digital technology into their classrooms?*

Research objectives stemming from this question include the following:

1. To determine the pedagogical approach (how) employed when digital technology is used for teaching and learning in the classroom.
2. To investigate the reflective practices or processes educators employ when they incorporate digital technology into their teaching.
 - a. Investigate how educators rationalise including digital technology in their teaching and learning.
 - b. Explore the educators' evaluation of the effectiveness of making this inclusion.
3. To generate suggestions to improve the implementation of relevant digital technologies in the classroom.

5.2. Correlation between Themes and Current Literature

5.2.1. ***Research Question: What reflective pedagogical approaches and practices do primary school teachers employ when integrating digital technology into their classrooms?***

5.2.1.1. *Research objective 1: To determine the pedagogical approach (how) employed when digital technology is used for teaching and learning in the classroom*

The first research objective was addressed in the trends that emerged from Theme 1. This theme provided specific insight into how the six participants use digital technology in their teaching and learning practices. Within the subthemes, teachers reflected on the types of digital technologies used in the classroom and how it was used during the COVID-19 lockdown and the impacts this had on teaching and learning. This section will address the first research objective and draw connections from the data to the literature. Table 5.1 collates the findings within Theme 1 and provides general links to the literature. For a more detailed table, refer to Addendum I.

Table 5.1: Association of Theme 1 to the relevant literature

THE USE OF DIGITAL TECHNOLOGY BY TEACHERS AND HOW IT IS IMPLEMENTED IN THE CLASSROOM		
Subtheme 1.1: Types of digital technology used		
Categories	Study Findings	Relevant literature
Types of devices, media, applications and platforms used Depends on Task- goals	<p>The type of digital technology used depended on the task or the learning objective.</p> <ul style="list-style-type: none"> • Noting that certain devices were better for specific ages • Type of device – ease of use and learning • Not effective in the scaffolding of problem-solving skills in Mathematics 	<ul style="list-style-type: none"> • Wang's (2008) generic model <ul style="list-style-type: none"> ○ Pedagogical & Technology component. • Kirschner et al. (2004) conceptualisation of usefulness <ul style="list-style-type: none"> ○ Consideration of the educational and technological affordances • Bransford et al. (2000) - focusing on how people learn - see technology as a tool.
Subtheme 1.2: Use of digital technology during COVID-19 lockdown		
Categories	Study Findings	Connection to literature
Technology used for teaching Limitations and difficulties	<p>During COVID-19</p> <ul style="list-style-type: none"> • A need to enhance staff competencies - unfamiliar with what they have done before. • Access difficulties- learners & teachers 	<ul style="list-style-type: none"> • Hlatshwayo (2022) - Countries Infrastructure impacting access • Schleicher (2020) & Statistics South Africa (2020). <ul style="list-style-type: none"> ○ South Africa was unprepared- training before the lockdown. • SA- behind in meeting 4IR goals <ul style="list-style-type: none"> ○ Training and widening of the inequalities
Subtheme 1.3: Implementation method -SAMR Model		
Categories	Study Findings	Connection to literature
Modification-Redefinition Substitution-Augment Project-based learning	<ul style="list-style-type: none"> • Some evidence of using higher levels of SAMR <ul style="list-style-type: none"> ○ Project-based learning • Many teachers only use the lower levels of SAMR due to their lack of understanding of its capabilities 	<ul style="list-style-type: none"> • Lessons not explicitly planned with SAMR <ul style="list-style-type: none"> ○ Planned with pedagogical design (generic model) • Wang (2008) - effectivity of the device = teachers' understanding of its usefulness • The benefits of modification and redefinition <ul style="list-style-type: none"> ○ Relevant to real life and contextualisation ○ Added engagement and motivation ○ Promoted collaborative learning - constructivist

Participants in this study reported a wide range of devices, online platforms, and applications that they incorporated into their teaching methods. Several participants indicated that they had gone through reflection processes to ascertain the motives for selecting a specific form of digital media. These motives correlated with the Generic Model which Wang (2008) outlined. Participant 1 touched on Wang's 'ease of learning' consideration when they explained that specific devices and their capabilities (iPads) created better learning experiences. This corresponds to the pedagogical component of their model, which emphasises how the use of digital media can influence the scaffolding of learning (Wang, 2008). Furthermore, Participant 1 and 5 explained that specific activities would be more accessible on laptops versus cellphones, highlighting the 'ease of use' consideration that Wang (2008) integrates into the model's technology component.

Moreover, these aforementioned factors correspond to the social constructivist theory in Bransford et al.'s (2000) work. They promote that the first consideration should be how children learn before being overwhelmed by the 'cacophony' of delivery methods (Bransford et al., 2000). Evidence of this was identified in similar reports by Participant 1 and 5. Both participants reflected that they would avoid using digital technology as an instructional tool when focusing on developing the skill of Mathematical problem-solving as it detracted from how learners learned. In addition, participants applied Kirschner et al.'s (2004) model of usefulness when reflecting on their own experiences of the effectiveness of digital technology. Participants reported that the technology did not meet the usability criteria - in that the functionalities impacted their usage – and the utility criteria, as the inherent instant gratification interfered with the learners' ability to accomplish their educational goals (showing their ability to problem-solve).

Participants from the two schools accounted for similar experiences before and during the COVID-19 lockdown. Both schools had initiated intensive training and implemented a roll-out of Chromebooks for each learner before the pandemic started. A number of participants from each school acknowledged that they were in a very fortunate position to transition to online learning, with a pre-existing operation system and some familiarity among both teachers and learners. However, participants still experienced limitations as not all families at their schools could afford numerous devices - limiting the learners'

access. Furthermore, as Participant 4 noted, teachers also experienced difficulty in affording an appropriate internet connection to provide uninterrupted online learning experiences. Several participants in both schools noted an additional challenge related to expertise and training during this time. Participant 2 and 4 referenced the vast amount of time it took to adapt to digital resources and to familiarise themselves with a range of online learning tools.

The findings mentioned above connect to the more considerable challenges that South Africa faces, not only during the COVID-19 lockdown but also prior to the pandemic. Hlatshwayo (2022) provides a broader understanding of these challenges regarding the delays in meeting educational goals and the different industrial revolutions. The government is yet to reach their envisioned goals of responding to *Education 4.0*, namely the Draft White Paper on e-Education (Department of Education, 2003) and the e-Learning Game Changer (Department of the Premier, 2017). Furthermore, the country's instability in electricity and limited delivery of digital technology services has influenced their attainment of the 2IR and 3IR standards Hlatshwayo (2022). This broader context has a resounding impact on schools, for example, a teacher's ability to access affordable and stable internet connection. In addition, Schleicher's (2020) report highlighted that not all teachers received equal training before the pandemic. Although the two schools in this study did, it is still evident that even their exposure to digital technology has not provided adequate skills and efficiency to ensure a smooth transition to an online platform. This point is further discussed further in the training subtheme.

Although the specific levels of the SAMR model were only explicitly referred to by one participant regarding the training and experience in using it, participants provided several examples of activities and lessons that matched each level of the model. Participant 1 referred to the model when discussing lessons they had designed and observed lessons from other teachers in the school. They noted that many colleagues remain in the lower enhancement levels instead of using their full transformational capabilities. This was linked to their belief that teachers did not fully comprehend the digital devices' power and capabilities. Verenikina (2010) highlighted this fact by saying that digital technology can only significantly impact teaching and learning tasks (transformation) when there is a more profound

comprehension of what it could be used for. This reiterates the importance of considering the pedagogical component and usefulness discussed earlier. Transformational examples of the SAMR model highlight the numerous educational, technological, and social affordances that digital technology can provide. These include the ability for learners to virtually explore unseen environments which they may never experience without digital technology and engage remotely with an expert in a specific field. In addition, increased opportunities for collaboration and rich real-life cases enhanced the relevance and contextualisation of their understanding while increasing factors like engagement and motivation (Brown et al., 1986; Uribe et al., 2003; Verenikina, 2010). The participants noted a difference in their learner's motivation when tasks were situated in relation to their context, this was particularly evident in their discussions regarding project-based learning.

However, as Hamilton (2016) noted, even the first level of *Substitution* does not always produce benefits to learning. In this and subsequent themes, participants highlight that using digital technology in the classroom can have negative influences on the teaching and learning. Complexities and challenges exist in the classroom, which include difficulties with access and learner management. Therefore, being mindful of the complexities within a classroom is essential when considering integrating digital technology. These complexities are noted in several reference literature, which emphasises that a linear or technical rational approach in education is not always the best fit (Hamilton et al., 2016; Schön, 1995; Wallner & Wagner, 2016).

5.2.1.2. Research objective 2: To investigate the reflective practices or processes educators employ when they incorporate digital technology into their teaching.

The second research objective sought to delve into the reflective practices and pedagogies employed by primary school teachers when integrating digital technology into their instructional strategies. The emergence of the second theme during data analysis sheds light on this objective, revealing the teachers' rationalisations and evaluations of the effectiveness of incorporating digital technology. Moreover, this insight played a significant role in addressing the central research question, which was further enhanced through a thorough analysis of the multifaceted dimensions inherent to this

theme. Table 5.2 unpacks these connections to the central research question, objective two, while also establishing meaningful links to the existing literature. For a more detailed table, refer to Addendum I.

Table 5.2: Association of Theme 2 to the relevant literature

TEACHERS' REFLECTIONS AND REFLECTIVE PRACTICES ON THE USE OF DIGITAL TECHNOLOGY IN TEACHING AND LEARNING PRACTICES		
Subtheme 2.1: Positive impacts on teaching and learning		
Categories	Study Findings	Relevant literature
Increased accessibility	<ul style="list-style-type: none"> Ease of access to administration, marking, organisation and saves time to mark. 	<ul style="list-style-type: none"> Schwab (2016) - 4IR- distorting boundaries of the physical and digital sphere <ul style="list-style-type: none"> More flexibility in time and space (Oke & Fernandes, 2020) Teachers & learners- greater personalisation and buy-in Arfstrom (2021) – flipped classroom.
Greater learner engagement	<ul style="list-style-type: none"> Gamification – creative and challenging ZPD More engagement – more willing and open to learning – comfortable at ease. Group work – more motivated Mention of different learning styles and media appeals to this. 	<ul style="list-style-type: none"> Gamification – opens the ZPD- challenge. <ul style="list-style-type: none"> Contemporary skills (Wallner & Wagner, 2016) Making the curriculum more relevant (Williams, 2005). Social affordance – a more comfortable environment for learning. Personalised & ownership- meeting their learning need and sensor preferences.
Increased variety of teaching and learning methods	<ul style="list-style-type: none"> Various forms of delivering or introducing a topic. - Help is to gain their attention. Decentralises the teacher. More flexibility with what they can present. AI and new revolutions in teaching 	<ul style="list-style-type: none"> Brown and Reeve's (1985)- learner-focused and driving process. Arfstrom (2021) – flipped classroom. Enhancing skills needed for the 4IR world of work - Wallner and Wagner (2016) <ul style="list-style-type: none"> Being adaptable and able to apply skills instead of just repeating facts.
Promotion of 21st Century skills	<ul style="list-style-type: none"> Creativity - allowing for innovative possibilities. 	<ul style="list-style-type: none"> <i>Education 4.0</i> - promoting flexible thinking. PBL- a collaboration of skills from various subjects applied to a real-life example-

	<ul style="list-style-type: none"> • Digital tech - wider variety for problem-solving and applying to real life. • Critical thinking and being discerning of information (digital citizen). • Collaboration and fostering social-emotional skills. • PBL – use of it across both schools with deep incorporation of digital technology.
	<ul style="list-style-type: none"> • Fisk (2017) & Barron et al. (1998) <ul style="list-style-type: none"> ○ 4 principles of PBL ○ Different ways of assessing ○ Ability to interpret and infer data- not just applying skills to silos of subjects. ○ All skills needed in an ever-changing world of work.

Subtheme 2.2: Negative impacts on teaching and learning

Categories	Study Findings	Connection to literature
Negative influence on teaching-teachers	<ul style="list-style-type: none"> • Control issues for teachers and school • Teachers too reliant on technology <ul style="list-style-type: none"> ○ Reports that it is used to keep them busy and not fully used to deepen learning. • Need to make use of physical skills (handwriting, drawing, planning) and interacting with others. • Heavy reliance during lockdown 	<ul style="list-style-type: none"> • Teachers maintain their control and role as facilitators of knowledge. <ul style="list-style-type: none"> ○ Teachers must remain in control of interactivity and not allow it to be solely driven through a device (Verenikina, 2010; Wang, 2008). ○ Need to ensure deep learning opportunities are given – implications by Bransford et al. (2000). ○ Situated learning (Lave & Wenger, 1991). • If too relied on too heavily can influence learning - (Verenikina, 2010; Wang, 2008). <ul style="list-style-type: none"> ○ Technology is not used in the most effective way to enhance learning (Moss et al, 2007). ○ Bransford et al (2000) - acquiring skills is only possible when there is relevance to them and their prior knowledge. • Teachers must provide structured learning – Doolittle (1995). • Awareness of environmental changes/ social dynamics – to encourage learning (Brown & Reeves, 1985). • Tasks that are too static or superficial can give a poor measure of a learner’s true potential (Bransford et al., 2000).
Negatively influences learning	<ul style="list-style-type: none"> • Instant gratification/gamification- <ul style="list-style-type: none"> ○ In Mathematics ○ Distractions- can’t resist temptations to click on a video. • Information overload- pupils or teachers, not refining, analysing, or working through information. • Physical/spatial skills are needed in some learning. • Pupils’ responsible habits & use • It can cause social and emotional concerns. • Responsible behaviour- digital citizen, evaluating info, plagiarism, research. More accountable. 	

Subtheme 2.3: Teachers' reflective practices		
Categories	Study Findings	Connection to literature
Method of planning lessons	<ul style="list-style-type: none"> • Methods of planning <ul style="list-style-type: none"> ○ Intentional - Look to the purpose of the tasks and what they need to learn. ○ Organic - may need to respond to factors in the classroom. <ul style="list-style-type: none"> ▪ Past experience, wisdom and intuition. 	<ul style="list-style-type: none"> • Teacher training – constructivist teachers must ensure learning is deeper and ascertain prior knowledge. <ul style="list-style-type: none"> ○ Training teachers - “intensely curious about factors which enhanced or obstructed their professional development.” (Drever & Cope, 1999, p.100). ○ An in-depth understanding of the subject area (Bransford et al., 2000) ○ A need to deepen their understanding of the functionality of the pedagogical tool. ○ Teachers need their own growth and development in the ZPD and exploration of cooperative learning (Doolittle, 1995)
Collaboration	<ul style="list-style-type: none"> • Collaboration <ul style="list-style-type: none"> ○ Sharing experiences and ideas. ○ Gaining skills from other more knowledgeable/experienced 	
Teacher's readiness to learn	<ul style="list-style-type: none"> • Teachers' readiness <ul style="list-style-type: none"> ○ Self-discovery and trial and error. ○ Confidence and experience ○ The more open to learning and familiar – the better they adjust to using it. 	<ul style="list-style-type: none"> • Methods of planning – using internal intuition in action and responding to events or stimuli as they occur (Drever & Cope, 1999) <ul style="list-style-type: none"> ○ Teachers need to become comfortable with recognising ambiguity and be flexible in finding solutions.

When asked about the benefits of digital technology, the majority of participants highlighted the increased accessibility for both their learners and themselves. For example, Participant 3 and 4 referenced their ability to complete administration work without having to physically be at their school. This benefit was also reported for their learners, who can access the content outside of the classroom and continue their independent or group-based learning from home. Various literature notes that a big trend in *Education 4.0* is the distortion of the barriers between the physical, digital, and temporal spheres (Fisk, 2017; Oke & Fernandes, 2020; Schwab, 2016). In this context, teachers and learners can personalise or direct their learning or teaching experiences to suit their needs - enhancing their buy-in and engagement (Brown & Reeve, 1985; Fisk, 2017). Participants also reported the ability to automate their marking in some tasks and that the marking capabilities of some platforms provide opportunities for a deeper analysis of their learners' progress. This feature allows a constructivist teacher to continue monitoring and facilitating their learners' progress and provides stimulus for more reflections on their practices (Doolittle, 1995; Schön, 1995).

Participants' responses within the second subtheme relate to the perceived benefit of increased learner engagement. A common category that emerged among participants included the functionality of gamification. This inherent attribute of many online platforms and digital applications provides teachers with technological and educational affordances (Kirschner et al., 2004). Furthermore, it is often used to challenge learners' abilities, as Participant 5 noted when discussing the *Mathletics* programme, which may spur them on to the potential zone of development (Vygotsky, 1978). In addition, Williams (2005) referenced the use of games to assist in the goal of making a curriculum more connected to real-life experiences. Several participants referred to this, for example, by providing learners with the augmented reality simulation in exploring the pyramids (Participant 6). Both the participants and researchers, Chang and Wills (2013), noted that when learners become more engaged in lessons, their performance and enjoyment increase. Increased enjoyment and performance also correlate to digital technologies' social affordances (Kirschner et al., 2004). Therefore, as the participants often use cooperative learning when incorporating digital technology, it provides learners with the benefit of reducing the pressure of being solely responsible for the learning task and subsequently, providing a more pleasant learning experience

(Doolittle, 1995). In addition, the trend of increased free choice, personalised learning, and increased ownership of learning is relevant to these findings (Fisk, 2017). As noted by participants, digital technology can provide learners with alternative learning styles that may better suit their sensory or processing preferences. This educational affordance would increase their ability to receive personalised learning, which they would be more motivated to take ownership of and potentially enjoy.

In reference to the third subtheme of increased variety of teaching and learning methods, there was a significant variance in the example provided in the findings. Participants reported that digital technology allows for delivering and introducing topics in various ways that enhance the quality of learning and increase learner engagement. Participant 6 pointedly highlighted that the use of digital technology in the classroom decentralised the focus from the teacher and empowers learners to direct and deepen their own learning. This finding overtly links to the work of Brown and Reeve (1985) and Arfstrom (2021), which discussed a learner-centred and flipped classroom model. When learners drive and steer their learning, it further motivates them and enhances their participation, ensuring a deeper learning experience (Schweisfurth, 2013). Finally, participants noted the innovative potential that *Education 4.0* entails when regarding the impacts of recent developments in Artificial Intelligence (AI). They illuminated the endless possibilities AI has in education, as well as the influences it already has on several careers. This recent development and how it impacts teaching and learning may better prepare learners and expose them to different 21st-century skills needed in the working world (Wallner & Wagner, 2016).

Promoting the 21st-century skills subtheme was a continual trend in all participant interviews. Several participants explicitly mentioned that their teaching needs to be directed to meet these needs. This overt educational goal of these schools aligns with the goals and trends noted in the *Education 4.0* literature which states that education needs to provide more opportunities for the personalisation and contextualisation of information which empowers students to take ownership of their learning (Almeida & Simoes, 2019; Benešová & Tupa, 2017; Fisk, 2017; Wallner & Wagner, 2016). The participants referenced the ability of digital technology to provide opportunities for creativity, innovation, critical

thinking, and problem-solving skills. Participant 6 explained that in order for them to use digital technology responsibly in their learning, they needed to be able to use discernment and analysis when engaging with different sources. Their example relates to Fisk's (2017) sixth trend in *Education 4.0*, the ability to interpret and analyse data rather than simply reciting facts. Leadbeater (2000) also highlights this importance in the new revolution of education as these skills are considered applicable to the competencies required to be an employable candidate in the future.

Further, by assessing learners' skills in various ways (Participant 2's example of the production of a website), learners can apply their developed skills to a dynamic activity rather than a static summative assessment (Fisk, 2017). This allows teachers to better understand their true potential rather than their current level of development (Brown & Reeve, 1985). Several participants also highlighted a project-based learning (PBL) ability to foster and develop cooperation and social skills among learners. These criteria for PBL were discussed in Barron et al. (1998). They reinforced that PBL needs to promote the collaboration of individuals and encourage them to learn how to work constructively in a group (Barron et al., 1998). Additional principles for PBL, noted by Barron et al. (1998), such as the use of diverse cases and developing agency were touched on by participants. Participant 1 and 4 highlighted that PBL fosters the learner's independence as they become less reliant on the teacher to lead the learning sessions and have the confidence to make more choices. Additionally, participants provided examples of their PBL lessons, such as giving learners diverse cases, which is said to deepen their learning and extend their pre-conceived ideas about a topic (Barron et al., 1998). Finally, these PBL lessons provided opportunities to assess their understanding in alternative ways than the typical summative assessment.

Negative impacts on teaching and learning emerged as a significant subtheme in the data. One of the common negative factors that influenced teachers was their reduced control in their lessons. As Participant 1 reported, an inherent part of using technology in the classroom was to ensure that teachers resigned themselves to having less control over what their pupils were doing. As a result, a negative impact on learning was that digital technology provided more opportunities for distractions such as focusing on their music, watching a *YouTube* clip, or chatting silently with friends online during their

schooling. Furthermore, Participant 4 and 6 expressed a common concern that digital technology could enhance cyberbullying and exposure to inappropriate content while negatively impacting a learner's mental health. Brown and Reeves (1985) echo these concerns, highlighting that social and emotional factors in an environment can significantly impact learners' growth, learning, and development. Another negative impact noted was teachers' imbalanced use of digital technology in the classroom. Participant 1 and 6 observed that teachers can often rely too heavily on devices and only superficially utilise them. Participant 2 reported that this became more apparent after returning to school from remote teaching. These concerns reiterated the importance of a teacher's role in the learning process and indicated that they must maintain their control and role as facilitators of knowledge (Doolittle, 1995).

Moreover, participants observed that social engagement was often reduced when engaging in a digital classroom, resulting from an over-reliance on the learner-interface interactivity rather than the learner-people concept (Wang, 2008). Verenikina (2010) explained this further by saying that when teachers over-use digital technology as their teaching tool without comprehending their pedagogical purpose, learning and technology were only superficially explored. These examples provided by the participants reinforce that any pedagogical tool, including digital technology, must have purpose and relevance to the learning experience and the learner (Bransford et al., 2000). Therefore, tasks and activities using digital technology that merely keep learners busy, do not appropriately access their prior knowledge and are correlated to the 'basics' of that subject and provide an insufficient measure of learners' true potential (Bransford et al., 2000).

The last subtheme in this theme collated the teachers' reflective practices – such as how they planned lessons, their reference to colleagues for guidance, and their attitude and disposition to learning a new skill. These categories directly relate to Harrison's (2008) core competencies needed as a reflective practitioner which include: 1) *Observation* 2) *Communication*, 3) *Judgement*, 4) *Skills of decision making* and 5) *Team work*. Participants were asked to explicitly provide insight into the planning methods when incorporating digital technology into their lessons. Several participants highlighted an intentional approach, whereby they selected the digital media according to the lesson's purpose and

what they wanted their learners to learn. These constructivist considerations link to Bransford et al. (2000) recommendation to consider how children learn before a pedagogical tool is used. These connections were extensively covered in Theme 1's discussions. Participants also noted that they had to apply organic planning or reflection-in-action at crucial times. There were often times when ambiguity and complexity in the environment led to using a reflection-in-action approach to respond flexibly (Schön, 1995). Participant 1 explained that their experience and intuition justified their 'go with the flow' decision-making. Literature echoes this statement in saying that these decision-making methods are often not based on overt factors but instead occur in a teacher's mind (Drever & Cope, 1999; Schön, 1995). Schön defined this inconspicuous approach:

"...when they are asked to describe their methods of inquiry, they speak of experience, trial and error, intuition or muddling through. [When teachers]... operate in this vein, they tend to be afflicted with a nagging sense of inferiority in relation to those who present themselves as models of technical rigour." (Schön, 1995, p.28)

Participants further highlighted that collaboration with colleagues allowed for sharing knowledge and expertise. This was particularly important during the COVID-19 lockdown. The importance of collaboration for learners and teachers was noted by Doolittle (1995, p.15) "...teachers themselves are busy developing within their own zones of proximal development with the assistance of other adults and children." The powerful tool of collaboration in learning has been discussed in the previous subtheme; however, it can similarly be applied to teacher training. The final category of teacher readiness reflects the participants' view of how a teacher's attitude and disposition to learning can enhance their ability to gain new skills. Participant 3 referred to a trial-and-error approach, while Participant 1 noted that an 'adventurous spirit' assisted their ability to learn how to use digital technology in their classroom more effectively. Their ability to investigate and deepen their understanding of the concept connects to the constructivist self-directed learner mentioned in key literature (Bransford et al., 2000; Brown & Reeve, 1985; Vygotsky, 1978). These attributes of a teacher allow for deeper engagement as the knowledge and skills are directly related to their context. Drever and Cope (1999, p.100) state that training and

development are often more effective and valuable for teachers when they are “intensely curious about factors which enhanced or obstructed their professional development.” This observation is further discussed in Theme 3’s subtheme on teacher training.

5.2.1.3. Research objective 3: To generate suggestions to improve the implementation of relevant digital technologies in the classroom.

The final objective of the research was to generate suggestions to further improve the ways in which digital technology is incorporated into classrooms. The third theme contributes to this objective as it consolidates the suggested improvements that participants made to effectively incorporate digital technology into teaching and learning. Table 5.3 represents the findings and provides general links to the literature. For a more detailed table, refer to Addendum I.

Table 5.3: Association of Theme 3 to the relevant literature

Teachers suggested improvements to the implementation of relevant digital technologies in the classroom		
Subtheme 3.1: Emphasis on soft skills		
	Study Findings	Relevant literature
	<ul style="list-style-type: none"> • Digital citizen skills and online etiquette. • How to decipher quality sources of information. • Plagiarism and acknowledging sources. • Responsibility- safeguard well-being and mental health. 	<ul style="list-style-type: none"> • As the learners develop, so does the “basic repertoire of strategies” needed for a task (Shiffrin & Schneider, 1977). • When reminded – “a mature learner employs a variety of acquisition” (Brown et al., 1982, p.23)
Subtheme 3.2: School-contextual structures		
Categories	Study Findings	Connection to literature
Limited access	<ul style="list-style-type: none"> • Electricity and stable Wi-Fi connection • Commit financially 	<ul style="list-style-type: none"> • Verenikina (2010) provided a specific case of when ICT was not coordinated and uniformly introduced to the school.
A clear school approach	<ul style="list-style-type: none"> • A consistent digital journey through grades • A professional uniformed approach for parents. • An IT administrator based at the school to provide uniform directionality. 	<ul style="list-style-type: none"> ○ “...effective ICT integration requires a critical level of planning, coordination, and cultural adaptation.” (Verenikina, 2010. p.8)
4.3.3.3. Subtheme 3.3: Training of teachers		
	Study Findings	Connection to literature
	<ul style="list-style-type: none"> • Training to take full advantage of using digital technology effectively. • Setting the right tone for learners - embedded teaching and modelling of skills. • It empowers teachers – children already ready and willing to try these new things. • It is ineffective if not relevant 	<ul style="list-style-type: none"> • Teacher training – constructivist teachers must ensure learning is deeper and ascertain prior knowledge. ○ Training is effective if it is connected to solving real problems. ○ A need to deepen their understanding of the functionality of the pedagogical tool (Bransford et al., 2000)

The first subtheme provides a common thread that all participants expressed - learners should develop soft skills when utilising digital media in the classroom. Some participants spoke about these soft skills explicitly. Participant 1 and 5 reported teaching their learners about the responsible use of devices and how to become digital citizens. Other participants implicitly touched on these soft skills by expressing that learners must learn how to appropriately create compelling presentations and ensure they are discerning information when researching. Participant 3 specifically referenced teaching their learners about plagiarism and how to acknowledge different sources. All these concepts relate to vital abilities for learners in order to grasp the use of digital technology in an ethical and effective manner. According to Shiffrin and Schneider (1977), the constructivist learning process depends on strategic intervention and monitoring by teachers for the knowledge to be seamlessly assimilated. Brown et al. (1982) further emphasise that learning and retrieval for learners improve when they are taught explicit skills such as soft skills. Thus, teaching learners to engage with digital technology more ethically also relates to teachers' need to engage in critical reflection to ensure that the teaching tool does not have any negative impacts on learners and their experience (Helleve et al., 2020; Sellars, 2013).

The second subtheme collates the teachers' recommendations involving the broader context, the school, and the country. Many participants referred to the current infrastructure difficulties in South Africa and how this impacts access to utilising digital technology. Participant 4 remarked that it is difficult for schools and the broader education system to become proficient with digital technology as the infrastructure creates many barriers to this goal – such as power outages. When reflecting on a workshop they had attended, several teachers expressed frustration and anger towards the current conditions especially when exposed to advanced and innovative media. Another recommendation teachers made was to have a clear and transparent structure within their schools. Participant 1 and 2 noted that uniformity in how they used online platforms, such as *Google Classroom*, was prioritised at their school. They explained that to maintain professionalism and allow learners and parents greater ease of use, the school must ensure that all teachers have a consistent approach. This recommendation links to the consideration of technological affordances discussed earlier in this chapter (Kirschner et al., 2004).

Further, the majority of participants (from both schools) noted that it is vital that they have an IT administrator to take charge and refine the systems they use. Participant 1 added that this is vital to ensure they use the tools effectively and not become overwhelmed by the choices. Verenikina (2010) noted that effective integration of digital technology in a school requires critical planning and organisation. Lastly, participants suggested several improvements related to teachers' training. Some of these observations were discussed in the teacher reflections subtheme. Participant 6 highlighted that proper training on using digital media responsibly must be afforded to teachers they often set the tone for their learners. Similarly, other participants emphasised that it is vital for teachers to know how to use digital technology as learners model their teacher's engagement with the device. Therefore, it is noted that teachers have the immense power to influence learning as they provide embedded learning which relates to the possibility of watching and imitating others' behaviours or actions (Barron et al., 1998). Just as constructivists hope to promote a deeper comprehension of a concept for their learners, teachers must also develop a richer conceptualisation of digital technology skills due to their implicit role in the learning process (Bransford et al., 2000).

5.3. Conclusions for Discussion: *What reflective pedagogical approaches and practices do primary school teachers employ when integrating digital technology into their classrooms?*

Drawing from these threads of the research, it is evident that the reflective pedagogies and practices of primary school teachers utilising digital technology in their classrooms reveal a multifaceted landscape. In the process of exploring experience and frame of reference, the primary school teachers provided insight into how they incorporated digital technology into their classroom (pedagogy) and the thoughtful considerations they made along the way (reflective practices).

The study identified a connection between participants' choices and the social constructivist theory, emphasising the importance of understanding how children learn before delving into various delivery methods. The participants demonstrated a thoughtful approach by avoiding the use of digital technology when it could detract from specific skill development, such as mathematical problem-solving.

Additionally, the application of Kirschner et al.'s (2004) model underscored the importance of usability and utility criteria, showcasing participants' awareness of the impact of technology on their teaching practices. The participants reflected on the limitations and challenges that digital technology could introduce into their classroom, including reduced teacher control, distractions, and concerns about cyberbullying and mental health. Many participants incorporated this into their reflective practices when designing certain lessons. This reinforced the need for a balanced and purposeful use of digital technology, emphasising that technology should align with pedagogical goals and not merely keep learners busy.

The benefits of using digital technology in the classroom informed the participant's pedagogy and practices. A diverse range of devices and online platforms were available in the two settings, with participants actively engaging in reflective processes to select appropriate digital media. Many reported several factors that were considered for their pedagogy, such as increased accessibility for both teachers and learners, the ability to automate certain tasks, and the potential for a more personalised and engaging learning experience. The integration of gamification and varied teaching methods emerged as effective strategies to enhance learner engagement and foster 21st-century skills. Aligning with Wang's Generic Model (2008), considerations of ease of learning and ease of use were evident, emphasising the impact of digital media on scaffolding learning and the pedagogical choices made. An example of this was the valuable pedagogical approach of Project-based learning (PBL), which allowed learners to apply their skills in dynamic activities and promoted collaboration and social skills.

Moreover, the participants highlighted the importance of addressing the goals of Education 4.0, focusing on personalisation, contextualisation, and the development of critical thinking and problem-solving skills. However, the teachers noted several challenges they faced, especially during the COVID-19 lockdown, highlighting issues of limited access for both teachers and learners, difficulties in affording internet connectivity, and the time-consuming nature of adapting to digital resources. These challenges were contextualised within broader national issues in South Africa, including delays in meeting

educational goals and addressing the demands of Education 4.0, as well as disparities in teacher training.

The reflective practices of teachers, as illuminated in the findings, play a crucial role in navigating the complexities of incorporating digital technology. Core competencies, such as intentional planning, organic reflection-in-action, collaboration with colleagues, and a positive attitude towards learning new skills were identified by the participants as key components of effective teaching with digital technology. These practices align with the core competencies of a reflective practitioner.

In essence, the conclusion drawn from these findings underscores the dynamic nature of integrating digital technology in primary school classrooms. The pedagogies employed are influenced by the reflective practices and their development as a constructivist self-directed learner. Utilising digital technology in a classroom not only requires careful consideration of the pedagogical and technological aspects but also a continuous process of reflection, adaptation, and collaboration. As schools navigate the complexities of Education 4.0, addressing challenges, leveraging benefits, and promoting reflective teaching practices and individual professional development will be crucial in ensuring meaningful and effective integration of digital technology in primary education.

5.4. Limitations of the Study

Despite the rigorous methodology employed in this qualitative research study, several limitations pertaining to the generalisability and transferability of the findings should be considered when interpreting the results.

5.4.1. *Sample size and selection bias*

The study relied on a small sample size of six educators from two independent schools in the Western Cape. Using purposive sampling may introduce selection bias as participants were selected based on specific characteristics of incorporating digital technology into teaching and learning. Furthermore, the school principals provided potential participants which may have skewed the representation from the data source. Therefore, the findings may not represent all educators in similar

settings or across different educational contexts in South Africa. It is essential to note that because of these specific features, the findings of this study are context-dependent and may not be easily replicated in different settings or with different participants.

5.4.2. Representation of diversity

Data was collected from two independent schools in the Western Cape which limits the generalisability of the findings to other regions or types of schools. As these schools are independent, typically serving the middle to upper social-economic groups, it does not represent South Africa's diverse learner and teacher population well. The specific context of these schools, including their access to digital resources and diverse communities, may have influenced the educators' perspectives and practices regarding digital technology integration.

5.4.3. Subjectivity and bias

As a researcher and educator, subjectivity may have been introduced regarding my experiences using digital technology in my teaching. These experiences may have influenced the data analysis and introduced some bias as I may have used my own experiences to interpret the participants' reflections. Despite efforts to maintain reflexivity and awareness of personal assumptions, these perspectives and experiences may have influenced the identification and interpretation of themes. Extensive research notes and memos were kept during the data analysis process to address this limitation. These allowed me to investigate any assumptions for potential biases. These limitations should be considered when interpreting this study's findings and should be considered when applying them to other educational contexts or making generalisations.

5.5. Recommendations

Future research should address the aforementioned limitations by expanding the sample size, considering a broader range of educational settings, and employing longitudinal designs to capture the dynamic nature of digital technology integration in teaching and learning processes.

At a broader contextual level, several recommendations for governing bodies, policies and infrastructure are apparent. There is a need for improved accessibility of resources in the South African context. The current challenges vary from the limited accessibility of the different technologies to the ability to have teachers and learners have stable and good internet connectivity. For these limitations to be addressed, one would also need a stable electricity grid to make learning with digital technology efficient and effective. Although the government has been focusing on improving access to digital media in schools, without stable infrastructure like electricity and internet, it offers little use.

Furthermore, the education department and governing bodies at independent schools need to ensure that the digital technology teacher training received can be replicated in their context. Participants reported that their training had little value as they had limited resources available to them at school. In addition, the rate at which teachers receive effective training is keeping up with the latest digital innovations.

In light of the discussions of the findings, recommendations for teaching using digital technology in their classroom emerge. In order to enhance teachers' reflective practices when planning and considering how to use digital technology in their classroom, a practical model should be used. As Hamilton et al. (2016) state, models like the SAMR Model are not always practical as they do not consider the complexities teachers face in their classrooms. The SAMR model, as seen in the findings, does allow for more critical or technical reflection by providing a hierarchy of best practices (Schön, 1995). However, as Schön (1983) stated it is not always practical to apply this technical rationality in more complex and messier environments, such as a typical classroom. Rather, teacher training and development should be the central focus to enhance the teachers-in-training ability to use "knowing-in-action" (Schön, 1983). This training must be effective and provide teachers with practical links to their teaching. Continued collaboration and teacher-to-teacher learning should be encouraged to enhance knowledge-sharing and expertise. Teachers should be able to develop their confidence and understanding of digital technology's implications to incorporate it at the best time effectively. As

Participant 1 pointedly stated, “With great power comes great responsibility”. Therefore, they must fully comprehend these instruments' potential.

Another recommendation for teachers is to use Wang's (2008) generic model for teachers' pedagogical planning and Kirschner et al.'s (2004) conceptualisation of usefulness. These considerations encourage teachers not simply to select a tool for its ease of use but rather to achieve a better balance in the educational, social, and technological affordance they provide (Kirschner et al., 2004). Furthermore, the teachers can plan their lessons to ensure a balance is achieved between the interaction of the content, people, and interaction to provide more profound learning opportunities (Wang, 2008). The final recommendation is to motivate the use of the SAMR model for strategic planning by the school's key role players. This model will provide an opportunity to reflect on their attainment of the goals of *Education 4.0* and ensure they are striving to advance their incorporation of digital technology in their school.

5.6. Final Conclusions

Motivations for conducting this research include my own experiences and observations as a teacher learning to use digital technology effectively in the classroom. This research was further sparked by experiencing the feeling of being lost in a sea of wonderful and exciting information about the potential that digital technology has in education. This drove my professional development and self-discovery to find more effective and innovative tools to use in my teaching. It was not until teaching learning support during COVID-19 that I realised its significant implications on learning, both good and bad. I was amazed to see how some learners excelled during online learning while others learning gaps were significantly widened as the medium did not provide adequate learning opportunities to suit their needs. Observations and trends noted during this research process have further emphasised the need for teachers, as I did, to be mindful of the implications technology can have on the teaching and learning processes. It provides numerous exciting possibilities in education, which should be explored to prepare our learners for their future better. However, we must not get swept up in this excitement and forget the educational theoretical principles needed to provide accomplished learning spaces.

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ADDENDUM A: INFORMED CONSENT FORM: PARTICIPANTS



UNIVERSITEIT • STELLENBOSCH • UNIVERSITY
jou kennisvennoot • your knowledge partner

STELLENBOSCH UNIVERSITY CONSENT TO PARTICIPATE IN RESEARCH

You are invited to take part in a research project. Please take some time to read the information below, which will explain the details of this research project.

Please feel free to contact the researchers about any part of this project that you do not fully understand. It is very important that you are completely satisfied that you clearly understand what this research is about and how you could be involved.

Your participation is completely voluntary, and you are free to decline to participate. In other words, you may choose to take part, or not. Saying no will not affect you negatively in any way whatsoever.

You are also free to withdraw from the study at any point, even if you do agree to take part initially. In such an event you may request for your information to be deleted and not used in the study.

The Research Ethics Committee: Social, Behavioural and Education Research at Stellenbosch University has approved this study (Project ID #: 22383]. We commit to conduct the study according to the ethical guidelines and principles of the South African Department of Health Ethics in Health Research: Principles, Processes and Studies (2015).

1. WHO IS CONDUCTING THIS STUDY?

This research study is conducted by Tamryn Saunders.

The researcher is from the Educational Psychology Department at Stellenbosch University.

2. WHY DO WE INVITE YOU TO PARTICIPATE?

You have been selected to be part of this study as you meet the criteria. The criteria for this study is an educator working at an independent primary school with digital technologies available to them and using them in their learning and teaching practices. The term digital technology refers to electronic devices and resources that can be used in the teaching and learning process, for example, tablets, computers, Smartboards and online platforms.

3. WHAT IS THIS RESEARCH PROJECT ABOUT?

This study aims to gain insight into educators' practices and personal reflections regarding the use of digital technology in their classrooms. Furthermore, it is to gain insight into the educator's perspectives of using digital technology in the classroom and experiences in incorporating it into their classrooms.

4. WHAT WILL BE ASKED OF ME?

If you agree to take part in this study, you will be asked to participate in an interview process that will take place at a suitable time for you. This interview can take place via MS Teams or a phone call. The discussion will focus on how you use digital technology in your teaching and your planning processes regarding these decisions.

Ideally, it will be one individual interview which may take up to an hour and a half. You will also be asked to keep an online journal or reflection on your typical practices regarding the use of digital technology in a week.

5. ARE THERE ANY RISKS IN MY TAKING PART IN THIS RESEARCH?

You may experience some inconvenience in accessing a suitable online platform and possible costs of data. The researcher will strive to choose an online platform that is most convenient, cost-effective and uses minimal data. You will also have the option of selecting an MS Teams or a phone call.

6. WILL I BENEFIT FROM TAKING PART IN THIS RESEARCH?

In taking part in this study, you will be contributing to a better understanding of the current educational landscape and may be able to highlight crucial practices while navigating the digital technologies revolution in education.

The hope is that this knowledge may help provide insight into the use of digital technology in education and generate suggestions to improve the implementation of relevant digital technologies in the classroom for the broader teaching community.

7. WILL I BE PAID TO TAKE PART IN THIS STUDY AND ARE THERE ANY COSTS INVOLVED?

Participants in this study will not receive any payments for taking part in this research. The researcher will strive to choose an online platform that is most convenient, cost-effective and uses no or minimal data. You will also have the option of selecting an MS Teams or a phone call.

In the case where any data costs may incur, you will be reimbursed with a data bundle from your network.

8. WHO WILL HAVE ACCESS TO MY INFORMATION?

Any information you share with me during this study that could possibly identify you as a participant will be protected. This will be done by ensuring that the information you share remains anonymous. A pseudonym will replace your name, and the collected data will be stored securely. The computer and the Microsoft Teams folder which will store your data will be encrypted, password protected and have two-factor verification. My supervisor and I will be the only ones to discuss the raw data.

Your biographical data and your school's name will not be published or appear in the final research report. The interview conducted will be audio-recorded to ensure the accuracy of the data. These recordings will be transcribed, and a copy will be made available to you. The raw data will be stored securely for ten years using MS Teams.

A copy of this research report will be made available to all participants and the school where the data is gathered. The final research report may be used in future for additional publication purposes.

9. HOW DO I MAKE CONTACT WITH THE RESEARCHERS?

If you have any questions or concerns about this study, please feel free to contact the researcher, **Tamryn Saunders**, at **XXXXXXXXXXXX** and/or the study supervisor **Dr Karlien Conradie** at **XXXXXXXXXXXX**.

10. RIGHTS OF RESEARCH PARTICIPANTS

If you have questions, concerns, or a complaint regarding your rights as a research participant in this research project, please contact Mrs Clarissa Robertson [cgraham@sun.ac.za; (+27) 021 808 9183] at the Division for Research Development.

DECLARATION OF CONSENT BY THE PARTICIPANT
--

As the participant, I declare that:

- I have read this information and consent form, or it was read to me, and it is written in a language in which I am fluent and with which I am comfortable.
- I have had a chance to ask questions and I am satisfied that all my questions have been answered
- I understand that taking part in this study is voluntary, and I have not been pressurised to take part.
- I may choose to leave the study at any time and nothing bad will come of it – I will not be penalised or prejudiced in any way.
- I agree that the interview with me can be audio-recorded.

By signing below, I _____ (*name of participant*) agree to take part in this research study, as conducted by Tamryn Saunders.

Signature of Participant

Date

DECLARATION BY THE RESEARCHER

As the **researcher**, I hereby declare that the information contained in this document has been thoroughly explained to the participant. I also declare that the participant has been encouraged (and has been given ample time) to ask any questions. In addition, I would like to select the following option:

	The conversation with the participant was conducted in a language in which the participant is fluent.
	I did/did not use an interpreter. (If an interpreter is used then the interpreter must sign the declaration below.)

 Signature of Principal Investigator

 Date

ADDENDUM B: GATEKEEPER RESEARCH INVITATION TEMPLATE

Dear [Gatekeeper Name]

My name is Tamryn Saunders, and I'm currently beginning a research project for my Educational Psychology thesis at Stellenbosch University.

Subject to approval by Stellenbosch University Research Ethics Committee, this study seeks to uncover teachers' reflective practice and pedagogy when using digital technology as a teaching method. This will be done using a basic qualitative design, using interviews and teachers' reflections.

I'm writing to ask your permission to be allowed access to approach your Grade four to seven teachers to participate in this research. The interviews should take no more than 2 hours and can be conducted at a convenient time and date, either online or in person.

All participants shall be given a clear description of the research, and informed consent will be obtained. Their right to privacy, anonymity, confidentiality, and refusal to participate will be respected. The data and recordings from interviews will be treated with respect and stored securely. The names of both participants and the schools will be removed to respect privacy and anonymity. A copy of the raw data and reports will be shared with participants and the school.

If this is possible, please e-mail me at xxxxxxxxxx to confirm that you are willing to allow access to your employees, provided they agree and are happy to participate.

Thank you for your time, and I hope to hear from you soon.

Yours sincerely

Tamryn Saunders

ADDENDUM C: ETHICAL CLEARANCE FROM THE REC



UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

CONFIRMATION OF RESEARCH ETHICS APPROVAL

REC: Social, Behavioural and Education Research (SBER) - Initial Application Form

14 November 2022

Project number: 22383

Project Title: Digital technology in the classroom: Primary school teachers' reflective pedagogies and practices

Dear Ms TJ Saunders

Identified supervisor(s) and/or co-investigator(s):

Dr K Conradie

Your REC: Social, Behavioural and Education Research (SBER) - Initial Application Form submitted on 20/10/2022 23:17 was reviewed and approved by the Social, Behavioural and Education Research Ethics Committee (REC: SBE).

Your research ethics approval is valid for the following period:

Protocol approval date (Humanities)	Protocol expiration date (Humanities)
5 October 2022	4 October 2025

GENERAL COMMENTS PERTAINING TO THIS PROJECT:

INVESTIGATOR RESPONSIBILITIES

1. Please take note of the General Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.
2. Your approval is based on the information you provided in your online research ethics application form. If you are required to make amendments to or deviate from the proposal approved by the REC, please contact the REC: SBE office for advice: applyethics@sun.ac.za
3. Always use this project ID number (22383) in all communications with the REC: SBE concerning your project.
4. Please note that the REC has the prerogative and authority to ask further questions, seek additional information, and monitor the conduct of your research and the consent process, where required.

RENEWAL OF RESEARCH BEYOND THE EXPIRATION DATE

You are required to submit a progress report to the REC: SBE before the project approval period expires if renewal of ethics approval is required.

If you have completed your research, you are required to submit a final report to the REC: SBE to close the active REC record for this project.

Project documents approved by the REC:

Document Type	File Name	Date	Version
Data collection tool	Interview Guide - Final- T. Saunders	12/06/2022	1
Data collection tool	Educators Reflections- Final- T.Saunders	12/06/2022	1
Default	ISASA email	12/06/2022	1
Research Protocol/Proposal	Proposed Chapter 1. T. Saunders Revision 14.08.2022	14/08/2022	3
Proof of permission	Letter of Consent - Weizmann	19/10/2022	1
Proof of permission	Saunders T - Letter of Consent	19/10/2022	1
Informed Consent Form	SU HUMANITIES Consent form Written- T.Saunders final (1)	20/10/2022	2

If you have any questions or need further help, please contact the REC office at applyethics@sun.ac.za

Sincerely,

Mrs Clarissa Robertson (cgraham@sun.ac.za)

Secretariat: Social, Behavioral and Education Research Ethics Committee (REC: SBE)

*National Health Research Ethics Committee (NHREC) registration number: REC-050411-032.
The Social, Behavioural and Education Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research. In addition, this committee abides by the ethical norms and principles for research established by the Declaration of Helsinki (2013) and the Department of Health Guidelines for Ethical Research: Principles Structures and Processes (2nd Ed.) 2015. Annually a number of projects may be selected randomly for an external audit.*

ADDENDUM C: INTERVIEW SCHEDULE

Thank you for taking time out of your day and agreeing to this interview with me. Before we start, do you have any questions regarding the consent form?

1. Demographic & background

Could you tell me a bit more about yourself and your academic and work background?

Enquire about background information covering the following:

- Age
- Occupation history
 - How long have you worked in this current position?
 - How long have you been at this school?
- Qualifications and training
 - What qualifications do you have?
 - What sort of training have you been on recently, if any? This could be related to teaching or digital technologies.

2. Educators' role and philosophy

Thank you for sharing that information. I'd like to ask a bit more about your roles and responsibilities at the school and get a sense of your teaching style.

- What grade/subjects do you teach?
 - How do you currently plan for these lessons?
- What are some of the other roles and responsibilities you have at the school? (ascertaining their activity and role in school functioning)
- How would you describe yourself as an educator?
 - What are some of the principles you value in your classroom?
 - Any specific learning theory (framework) you apply in your classroom?
 - Could you describe your classroom environment?
 - In light of your teaching and classroom atmosphere, what does a typical day in your classroom look like?

3. Digital technology

In this next section, I will be focusing on questions regarding digital technology and how you make use of it in your classroom.

- COVID-19 – how did it prompt the use of digital technology?
 - Did it change the way you teach?

- Do you still incorporate this?
- What would your understanding of digital technology be in the classroom? (advantages)
 - What sorts of technology do you have available to you at your school?
 - (If further prompting is needed) Do you have access to tablets, laptops/Chrome books, online learning platforms etc.?
 - How would you consider or plan to incorporate these resources into a lesson?
 - Which of these digital resources would you say you use most often?
 - How do you use these in your teaching and learning processes?
 - Why do you use this type of digital technology the most?
 - What types of lessons or tasks would you use this digital resource for?
 - Which of these would you say you use least often? And why?
- What do you believe the role of digital technology is in education?
 - Do you see any benefits to the teaching and learning process? If so, then what would they be?
 - Do you think there are any challenges or disadvantages? If so, what are these?
 - Have you seen any of these benefits or challenges in your classroom?
 - Could you provide examples?
- How would you integrate digital technology into your lessons?
 - Could you describe ways in which you may plan for this?
 - What factors influence the decision to include technology in your teaching and learning processes?
 - How would you evaluate the success of including technology in the lesson?
 - Do you have practices to reflect on the benefits/ challenges of incorporating technology?
- Do you think there are ways to improve the implementation of digital technology in education?
 - What would you think could be improved?
 - What do you believe is working well?
 - How does your current training promote or hinder the use of digital technology in your classroom?

Would you like to add anything else?

Thank you again for your time today. Would it be acceptable to reach out if I have any further questions?

ADDENDUM D: REFLECTIVE WRITING INSTRUCTIONS

Educator's Daily Reflections

It would be greatly appreciated if you could share some insight into your typical week in your classroom. These reflections do not have to be too long and could be done at the end of each day. Please document or record some considerations of how digital technology was used in your teaching and learning processes.

These daily entries can be done using a voice recording app or an electronic, written reflection. Your reflections will be stored securely. Please select an option that is most convenient for you.

Possible questions to answer may include:

- 1) What happened in my lesson today?
- 2) How did I use digital technology in the lessons?
 - a. How did I manage and/or structure this?
- 3) How did it possibly influence my teaching and support to learners?
 - a. Did it have a functional purpose?
 - b. Were there any significant differences in the tasks or lessons using digital technology?
 - c. What perceived differences were there in the quality of learning/ learner experiences?
- 4) What were my assumptions, feelings, thoughts, and evaluations?
- 5) What would I like to change/do differently next time?

ADDENDUM E: PORTION OF TRANSCRIPT: PARTICIPANT INTERVIEW

The complete sets of the interview transcripts and raw data are stored securely in the Microsoft Teams folder, which is encrypted, password protected and had two-factor verification.

Transcription of Interview with P1
Date 13/09/2022
I=Interviewer P1= Participant 1

L 17:24

Would you say you're more intuitive with creating your planning?

P1 17:30

Most things, I'll go with most things I'm more intuitive than then really planned. And though that sounds terrible, but yeah. Often, often the whim things are the ones that just work in the moment. But yeah, more ~~more~~ sort of the feeling or also you can a group of kids walk into your class, and they've had four tests in a week. And you ~~you~~ were going to do it a specific way. And you go, Okay, now let's change it up. Because you guys, if I tried to do this way, it's never ~~gonna~~ work. So let's throw a few things on the table and, and change it up. And then you get the buy in? Like I said, it's constantly just about getting the kids invested in something.

L 18:10

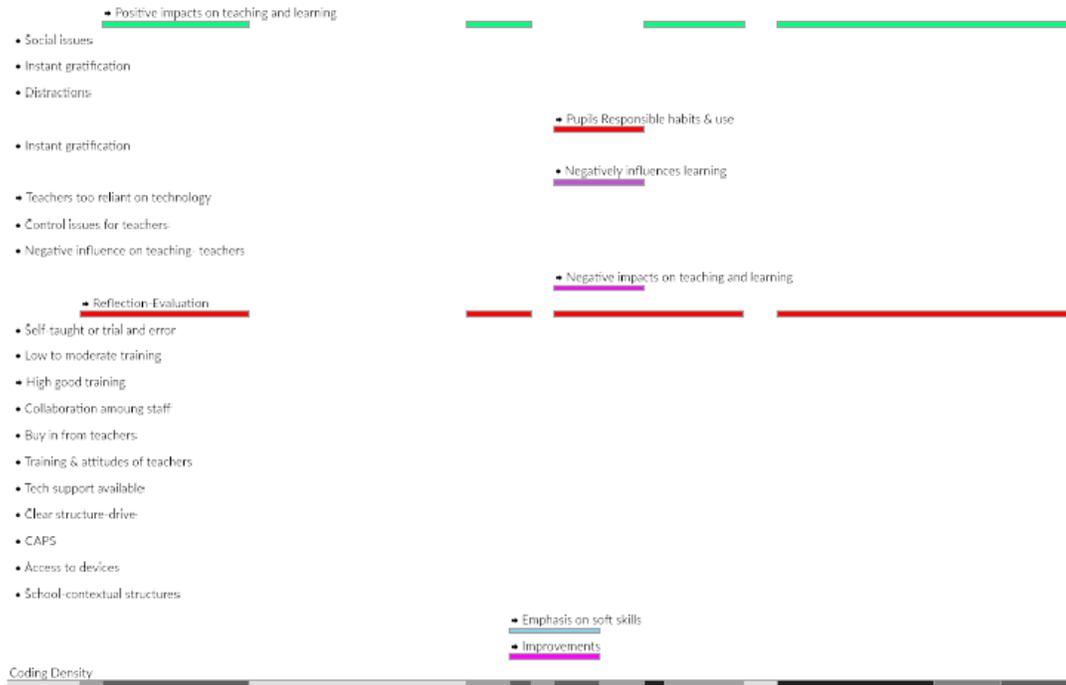
Yeah, thank you that's really valuable. In terms of I mean, I think this sort of speaks to the next question is, what would you say some of the advantages in using technology in the classroom? I think you mentioned some now,

P1 18:26

Yeah, so the advantage is that the research is at your fingertips, you know, the, the, the amount of knowledge that's out there is fantastic. And the fact that the kids can, can find what they're looking for. But it also teaches them to critically look at research, because often we find some dodgy sites that are saying things that are, are not what we're what we're going for. So for them to be able to learn that, at the same time is so important. You know, we teaching them to digital citizenship. So they're learning how to behave online. They're learning how to use their devices responsibly in the class. They're learning that if you're going to sit and play a sneaky game, when I can't see your screen, it's going to come back to back to you at some stage because you're going to fall behind. They're learning the how to collaborate with each other. I'm finding that there are kids who are stronger with IT, who are then empowered and are seen as the experts in the class and something that they might normally struggle with. You know, so they ~~they~~ gain kudos from their peers. There's ~~there's~~ a lot of benefits to it. (Bell went off)

I think the fact that's that there are lots of different opportunities for creativity online. I mean, if we're doing we're doing a project and we want to You create posters, the fact that boys can go onto a site like Canva and create posters I know in, in English at the moment, they're busy doing advertising, and they're all very excited to go on to Canva. And to create these really slick looking adverts, you know that that could be used in print media, you know, whereas if you're sitting with a piece of paper and you poky having to draw and, and make bubble letters, doesn't quite have the same effect. But then even within that I had a group come to me the other day because they wanted something on the poster and, and they wanted to remove the background behind the picture. And I'm like, how do we do that? So I was like, well, there's a site that does that for you. And I was able to

ADDENDUM F: PORTION OF A CODED TRANSCRIPT: PARTICIPANTS INTERVIEW



P1 17:30

Most things, I'll go with most things I'm more intuitive than then really planned. And though that sounds terrible, but yeah. Often, often the whim things are the ones that just work in the moment. But yeah, more more sort of the feeling or also you can a group of kids walk into your class, and they've had four tests in a week. And you were going to do it a specific way. And you go, Okay, now let's change it up. Because you guys, if I tried to do this way, it's never gonna work. So let's throw a few things on the table and, and change it up. And then you get the buy in? Like I said, it's constantly just about getting the kids invested in something.

I 18:10

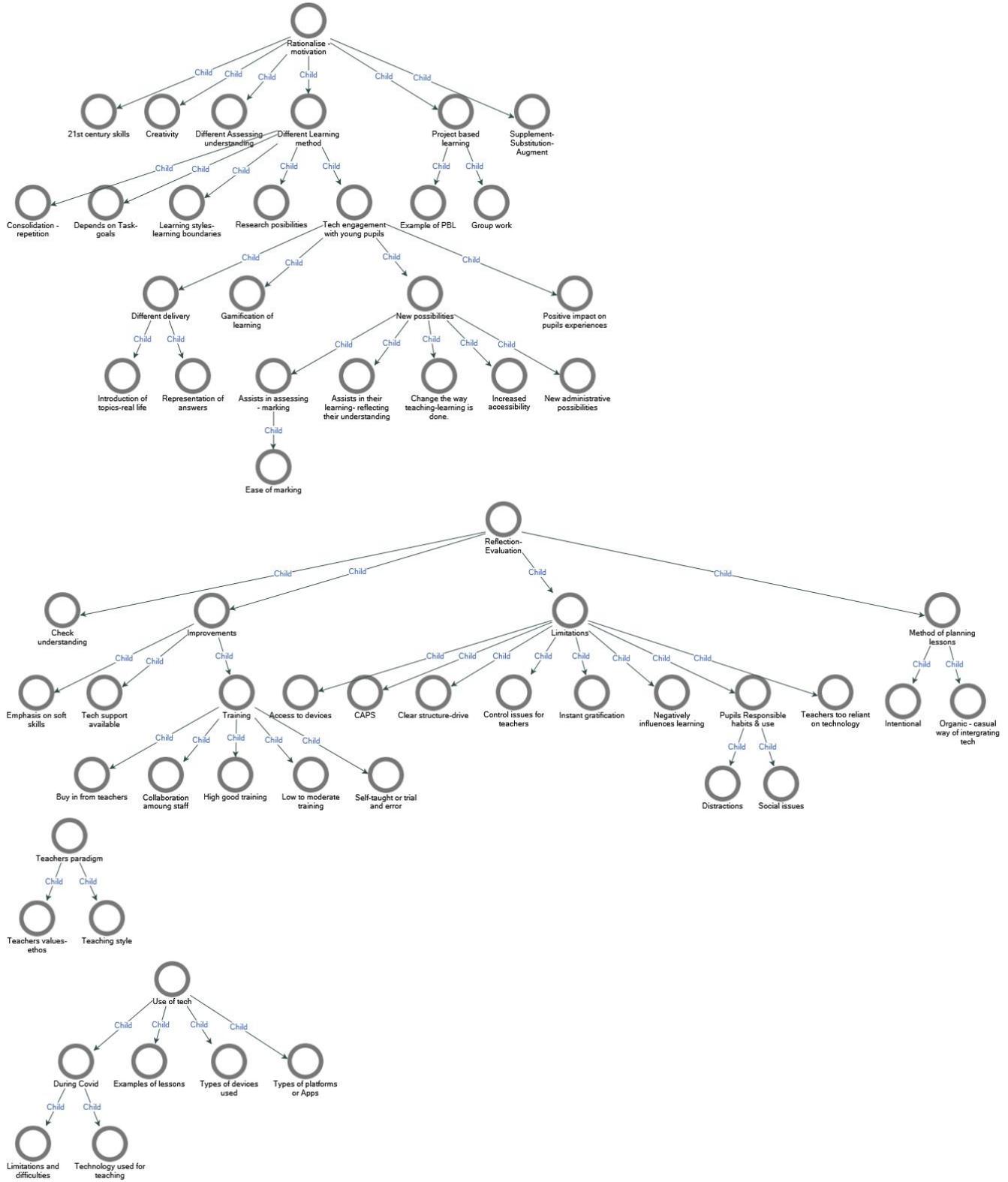
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P1 18:26

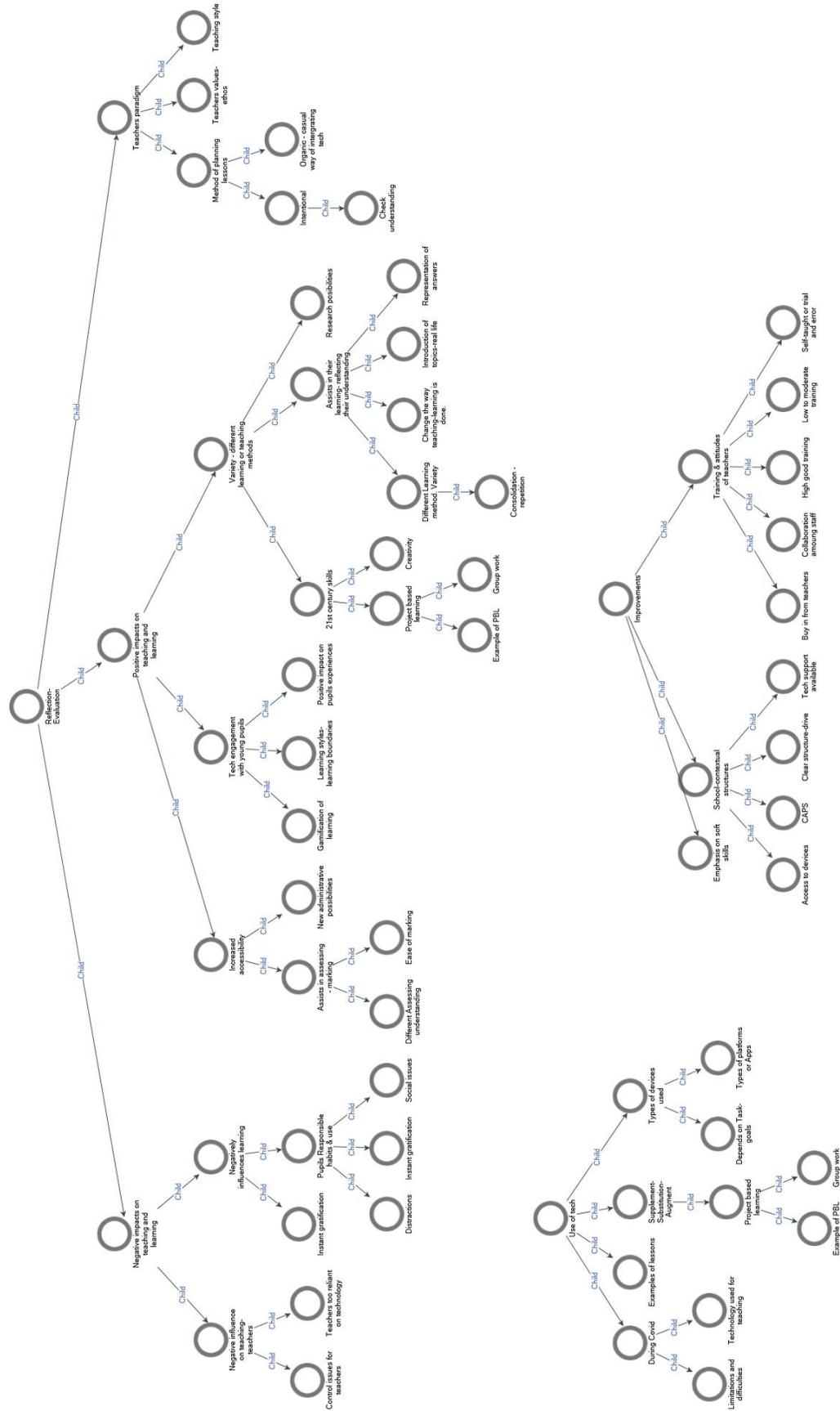
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ADDENDUM G: DATA ANALYSIS DEVELOPMENT: INITIAL THEMES



ADDENDUM H: DATA ANALYSIS DEVELOPMENT: THEME REFINEMENT



ADDENDUM I: THEMATIC OUTLINE

Table 5.1

Association of Theme 1 to the relevant literature

THE USE OF DIGITAL TECHNOLOGY BY TEACHERS AND HOW IT IS IMPLEMENTED IN THE CLASSROOM		
Subtheme 1.1: Types of digital technology used		
Categories	Study Findings	Relevant literature
Types of devices, media, applications and platforms used.	<p>Reports of the varied use of digital media. Several participants indicated occasions where the type of digital technology used depended on the task or the learning objective. Examples include:</p> <p>P1 & P2- Noting that certain devices were better for specific ages.</p> <p>P2 & P5- Chromebooks allowed – ease of use- typing vs a phone.</p>	<ul style="list-style-type: none"> • Wang's (2008) generic model <ul style="list-style-type: none"> ○ Pedagogical component. Considering how digital media could affect the scaffolding and the ease of learning. ○ Technology component. The importance of considering the ease of use • Kirschner et al. (2004) conceptualisation of usefulness <ul style="list-style-type: none"> ○ Consideration of the educational affordances ○ Consideration of the technological affordances • Bransford et al. (2000) Rather focusing on how people learn & seeing technology as a tool.
Depends on Task- goals.	<p>P1- iPads allowed ease of learning.</p> <p>P1 & P5 - Not effective in the scaffolding of problem-solving skills in Mathematics</p>	
Subtheme 1.2: Use of digital technology during COVID-19 lockdown		
Categories	Study Findings	Connection to literature
Technology used for teaching.	<p>Participants noted that during COVID-19, there was still a great need to enhance staff competencies.</p> <p>P2 & 4 – the amount of time to create resources was significant- so different and unfamiliar to what they have done before.</p>	<ul style="list-style-type: none"> • Hlatshwayo (2022) Countries Infrastructure impacting access • Schleicher (2020) & Statistics South Africa (2020). <ul style="list-style-type: none"> ○ South Africa was unprepared- teachers did not receive training before the lockdown.
Limitations and difficulties	<p>P3 - Also, families within this school still experienced access difficulties- limited devices.</p>	

	<p>P4 – teachers' access to stable and good Wi-Fi</p>	<ul style="list-style-type: none"> ○ Although this school was in the minority of those in SA offering online learning – it did not result in ease of delivery. ● SA- behind in meeting 4IR goals <ul style="list-style-type: none"> ○ Showing just how much training and knowledge is used to switch to a full e-learning basis. ○ Shows that even though training had occurred- there was not adequate training. ○ Hlatshwayo (2022) - Consideration of schools in less privileged circumstances and widening of the inequalities.
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Subtheme 1.3: Implementation method -SAMR Model

Categories	Study Findings	Connection to literature
<p>Modification-Redefinition</p> <p>Substitution-Augment</p> <p>Project-based learning</p>	<p>Some participants gave evidence of using higher levels of SAMR.</p> <ul style="list-style-type: none"> ● P1- had training on this and spoke to this explicitly. Augmented reality apps- explore rivers. ● P4 – deciding that students provide work via online videos. ● P4- Examples & cases rich and simulating- allowed them real-life experiences – exploring new places never visited before. <p>However, P1 also reported that many teachers only use the lower levels of SAMR due to their lack of understanding of its capabilities.</p>	<ul style="list-style-type: none"> ● Greater reflection using a generic model than SAMR. <ul style="list-style-type: none"> ○ Lessons not explicitly planned with SAMR in mind – instead, the lesson was planned regarding pedagogical design (generic model) ● Wang (2008) noted that the effectivity of the device is only as good as the teachers' understanding of its usefulness- the different affordances mentioned by Kirschner et al. (2004). ● The benefits of modification and redefinition of learning tasks allowed for <ul style="list-style-type: none"> ○ Relevant to real life and contextualised for the learner- added engagement and motivation. ○ Promoted collaborative learning – constructivist.

Table 5.2

Association of Theme 2 to the relevant literature

TEACHERS' REFLECTIONS AND REFLECTIVE PRACTICES ON THE USE OF DIGITAL TECHNOLOGY IN TEACHING AND LEARNING PRACTICES		
Subtheme 2.1: Positive impacts on teaching and learning		
Categories	Study Findings	Relevant literature
Increased accessibility	<p>Accessibility</p> <ul style="list-style-type: none"> • P4 ease of access to administration • P3 ease of marking- automated • P4 Saved time to mark. • P2 &4 – central location for students to access wherever they are. <ul style="list-style-type: none"> ○ Learning continues outside of the class. ○ Allowed group work possibilities. • Continued access to teachers' materials- teaching <p>Project base learning – use of it across both schools with deep incorporation of digital technology.</p>	<p>Accessibility</p> <ul style="list-style-type: none"> • Schwab (2016) - 4IR- distorting boundaries of the physical and digital sphere • Fisk (2016) echoes the trends. <ul style="list-style-type: none"> ○ More flexibility in time and space (Oke & Fernandes, 2020) ○ Teachers & learners- greater personalisation and buy-in • Arfstrom (2021) – flipped classroom. <ul style="list-style-type: none"> ○ Students access is not limited to the classroom (Brown & Reeve, 1985) • Allows teachers to monitor and analyse children's progress. <ul style="list-style-type: none"> ○ Reinforcing the social constructivist view of being a knowledge facilitator and providing stimulus triggers for more reflective practices (Doolittle, 1995; Schön, 1995).
Greater learner engagement	<ul style="list-style-type: none"> • Gamification – creative and challenging ZPD) • More engagement – more willing and open to learning – comfortable at ease. • Group work – more motivated • Mention of different learning styles and media appeals to this. 	<ul style="list-style-type: none"> • Chang and Wills (2013) noted a 15% enhanced performance and enjoyment, allowing for more free choices. • Gamification – opens the ZPD- challenge. <ul style="list-style-type: none"> ○ Contemporary skills – being flexible and adaptable (Wallner & Wagner, 2016) ○ Making the curriculum more relevant to the learners – reasons for incorporating games that provide real-life simulations (Williams, 2005).

		<ul style="list-style-type: none"> • Social affordance – a more comfortable environment for learning. <ul style="list-style-type: none"> ○ Reducing pressure on them to find the answers themselves (Doolittle, 1995). ○ Creating a safer learning environment - positive changes in learning (Brown & Reeve, 1985). • Personalised & ownership- meeting their learning need and sensor preferences.
<p>Increased variety of teaching and learning methods</p>	<ul style="list-style-type: none"> • P4- various forms of delivering or introducing a topic. • Help is to gain their attention. • P6 – noted that digital tech further decentralises the teacher and provides learners with unlimited information. <ul style="list-style-type: none"> ○ They can research and find more information that is relevant to them. • P1- notes that there is more flexibility with what they can present- more choice. • P5- AI and new revolutions in teaching – changes possible. 	<ul style="list-style-type: none"> • Brown and Reeve’s (1985)- learner-focused and driving process. • Arfstrom (2021) – flipped classroom. • Enhancing skills needed for the 4IR world of work - Wallner and Wagner (2016) <ul style="list-style-type: none"> ○ Being adaptable and able to apply skills instead of just repeating facts.
<p>Promotion of 21st Century skills</p>	<ul style="list-style-type: none"> • Creativity for learners and teachers noted- allowing for innovative possibilities. • Digital tech platforms provide a wider variety of problem-solving and application to real life. • Critical thinking and being discerning of information (digital citizen). <ul style="list-style-type: none"> ○ P6 – not simply regurgitating facts • P6 - Provides opportunities for collaboration and fostering social-emotional skills. 	<ul style="list-style-type: none"> • <i>Education 4.0</i>- promoting flexible thinking • PBL- a collaboration of skills from various subjects applied to a real-life example- • Fisk (2017) & <ul style="list-style-type: none"> ○ Barron et al. (1998) - 4 principles of PBL- provide deeper learning, start with a problem, various rich cases and examples (Cases – a stimulus to challenge and extend their thinking), embedded teaching, cooperation and agency. ○ Different ways of assessing & applying skills.

	<ul style="list-style-type: none"> ● Project base learning – use of it across both schools with deep incorporation of digital technology. <ul style="list-style-type: none"> ○ Examples & cases rich and simulating- allowed their real-life experiences. ○ Relevant to real life and contextualised for the learner- added engagement and motivation (add to engagement part) ○ Promoted collaborative learning – constructivist. ○ Team building and conflict resolution. ○ P1 – promoted independence and responsibility. ○ P4 – reduced teaching as focus and promoted learners to have free choice but use it responsibly. ○ P3- PBL caters for these skills, which are not explicitly taught in singular subjects. Relevance to the working world. 	<ul style="list-style-type: none"> ○ Fisk (2017)- Ability to interpret and infer data- not just applying skills to silos of subjects. ○ All skills needed in an ever-changing world of work.
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Subtheme 2.2: Negative impacts on teaching and learning

Categories	Study Findings	Connection to literature
Negative influence on teaching-teachers	<ul style="list-style-type: none"> ● Control issues for teachers ● Ability to control, and manage what pupils are doing, ensuring they are on task. ● Having less control over all aspects- ensure the school system is secure. ● Hybrid teaching- the ability to assist those in class & online. ● Teachers like to know what is happening- confident in practices, and not always planning tasks & activities well. ● Being intuitive- knowing class atmosphere and perceptive of pupil's behaviour 	<ul style="list-style-type: none"> ● Teachers to maintain their control and role as facilitators of knowledge. <ul style="list-style-type: none"> ○ Reduced interaction means the pedagogical design is too heavy with the learner interface – Wang (2008). Need to ensure intersubjectivity remains. ○ Need to ensure they provide deep conceptualisations – implications by Bransford et al. (2000). ○ Situated learning (Lave & Wenger, 1991).

	<ul style="list-style-type: none"> • Teachers too reliant on technology • Teachers are too reliant on using technology, P1 - Reports that it is used to keep them busy and not fully used to deepen learning. • P6 - they tend to not have a backup plan if there are technological issues. • Reports of a need for balance - to also make use of physical skills (handwriting, drawing, planning) and interacting with others. • P2 & P6 – Heavy reliance during lockdown, so teachers need to unlearn & find balance. Reduces interactions with peers and teachers- the teacher needs to be the facilitator of knowledge, not the device 	<ul style="list-style-type: none"> ○ Teachers must remain in control of interactivity and not allow it to be solely driven through a device (Verenikina, 2010). • If tools relied on too heavily can influence learning - Verenikina (2010) and Wang (2008) highlight the importance of being mindful of the pedagogical design and purpose for introducing tools- like digital tech. <ul style="list-style-type: none"> ○ When technology takes precedence over clear pedagogic purpose - technology is not used most effectively to enhance learning (Moss et al, 2007). ○ Bransford et al (2000) - acquiring skills is only possible when there is relevance to them - to their prior knowledge - if the task used to keep busy and not related to the core basics of the subject – not promote the acquisition of the skill and effective application of them.
<p>Negatively influences learning</p>	<ul style="list-style-type: none"> • Instant gratification/gamification- <ul style="list-style-type: none"> ○ P1 & 6 with regards to Maths - answer too quickly, guessing, not problem-solving. Not showing working out. ○ Distractions- can't resist temptations to click on video. • Information overload- pupils not refining, analysing or working through information. <ul style="list-style-type: none"> ○ P3 copy & paste/plagiarise—superficial engagement with learning. ○ P2 - Teachers not refining, editing or organising information. • Physical processes are needed in learning. Maths- problem-solving, drawing, P6 - planning, spatial awareness skills. <ul style="list-style-type: none"> ○ P2 - For studying- the use of physical notes could help. 	<ul style="list-style-type: none"> • Teachers must provide structured learning – Doolittle (1995). • Awareness of environmental changes- social dynamics – to encourage learning (Brown & Reeves, 1985). • Tasks that are too static or superficial in the learning – is a poor measure of the learner's true potential (Bransford et al., 2000).

	<ul style="list-style-type: none"> ○ P3 – planning of writing & structuring ideas – physical processes slow down - no shortcut. ● Pupils’ responsible habits & use <ul style="list-style-type: none"> ○ Distraction, games, videos, websites. Impact on their learning as they are not present. ○ Distracted when creating work, as there are so many elements -P1 font, images, information etc. ○ P3 Use it as an escape from the lesson but also socially - become more reclusive. ● It can cause social and emotional concerns. <ul style="list-style-type: none"> ○ Exposure to inappropriate content, ○ P4 & P6 increased cyberbullying and its impact on mental health. ○ Pupils were obsessive. ● Responsible behaviour- digital citizen, evaluating info, plagiarism, research. More accountable. 	
Subtheme 2.3: Teachers’ reflective practices		
Categories	Study Findings	Connection to literature
<p>Method of planning lessons</p> <p>Collaboration</p> <p>Teachers’ readiness to learn</p>	<ul style="list-style-type: none"> ● Methods of planning ● Intentional – P5 &6– one has to be intentional. <ul style="list-style-type: none"> ○ Look to the purpose of the tasks and what they need to learn. ○ P1 – needs to be planned to limit distractions and disruptions from the learners – they need to know reasons for using it. ● Organic 	<ul style="list-style-type: none"> ● Teacher training – constructivist teachers must ensure learning is deeper & ascertain prior knowledge. <ul style="list-style-type: none"> ○ If relevant to teachers’ development and solving real problems, training is effective. ○ Training teachers “intensely curious about factors which enhanced or obstructed their professional development.” (Drever & Cope, 1999, p.100).

- | | |
|---|---|
| <ul style="list-style-type: none"> ○ P1 & 4 noted that in a moment they may need to change a plan to respond to factors in the classroom. ○ P1 noted the use of past experience, wisdom and intuition. ○ P4 – emerged from a practical need. ● Collaboration <ul style="list-style-type: none"> ○ Allowed for sharing experiences and idea. ○ Gaining skills from other more knowledgeable/experienced – internal training P3 – during COVID-19. ● Teachers' readiness <ul style="list-style-type: none"> ○ Self-discover and trial and error- P3 learnt new skills. ○ Confidence and experience – P2 ○ The more open to learning and familiar – the better they adjust to using it. ○ P1 adventurous spirit – learning from students and teachers – try things. | <ul style="list-style-type: none"> ○ Teachers must have an in-depth understanding of the subject area (Bransford et al., 2000) ○ A need to deepen their understanding of the functionality of the pedagogical tool. ○ Teachers need their own growth and development in the ZPD and exploration of cooperative learning (Doolittle, 1995) ● Methods of planning – using internal intuition in action and responding to events or stimulus as they occur (Drever & Cope, 1999) <ul style="list-style-type: none"> ○ Teachers need to become comfortable with recognise the ambiguity and be flexible in finding solutions. ○ "...when they are asked to describe their methods of inquiry, they speak of experience, trial and error, intuition or muddling through. When teacher ... operate in this vein, they tend to be afflicted with a nagging sense of inferiority in relation to those who present themselves as models of technical rigor." (Schon 1995, p.28) |
|---|---|

Table 5.3*Association of Theme 3 to the relevant literature*

Teachers suggested improvements to the implementation of relevant digital technologies in the classroom		
Subtheme 3.1: Emphasis on soft skills		
	Study Findings	Relevant literature
	<ul style="list-style-type: none"> • P1 refers to digital citizen skills and hopes to build their etiquette. • P2 - how to display info in a slide, how to decipher quality sources of information. • Plagiarism and acknowledging sources. • Responsibility– safeguard well-being and mental health. • Soft skills- taught explicitly – learning and retrieval improves. 	<ul style="list-style-type: none"> • As the learners develop, so do the “basic repertoire of strategies” needed for a task (Shiffrin & Schneider, 1977). <ul style="list-style-type: none"> ◦ These skills evolve but need support from teachers to become automatic and unconscious. • When reminded – “a mature learner employs a variety of acquisition” (Brown et al., 1982, p.23)
Subtheme 3.2: School-contextual structures		
Categories	Study Findings	Connection to literature
Limited access	<ul style="list-style-type: none"> • P4 - Electricity and stable Wi-Fi connection. • P4- schools need to commit to financial access to be able to make use of rich online resources 	Covered in previous sections – not the infrastructure challenges
A clear school approach	<ul style="list-style-type: none"> • P1 noted that it is vital to develop a consistent journey - digital skills can be scaffolded each year. • P2- Present a professional uniformed approach also for parents. • Vital to have an IT administrator - provide uniformed directionality. 	<ul style="list-style-type: none"> • Verenikina (2010) provided a specific case of when ICT was not coordinated and uniformly introduced to the school. <ul style="list-style-type: none"> ◦ “...effective ICT integration requires a critical level of planning, coordination, and cultural adaptation.” (Verenikina, 2010. p.8)
4.3.3.3. Subtheme 3.3: Training of teachers		
	Study Findings	Connection to literature
	<ul style="list-style-type: none"> • P2 – need to be trained to make full usage of the power of digital tech. • P6 – setting the right tone for learners- embedded teaching & modelling of skills. 	<ul style="list-style-type: none"> • Teacher training – constructivist teachers must ensure learning is deeper & ascertain prior knowledge.

- P3 – training empowers teachers – children already ready and willing to try these new things.
 - P2 – training is ineffective if it didn't make it relevant to the ways teachers can use it as a tool.
- Training is effective if it is connected to solving real problems.
 - A need to deepen their understanding of the functionality of the pedagogical tool (Bransford et al., 2000)

ADDENDUM J: LETTER OF CERTIFICATE FOR COPY EDITING



Certificate of Editing

This serves to confirm that copy-editing and proofreading services were rendered to **Tamryn Jade Saunders** for **DIGITAL TECHNOLOGY IN THE CLASSROOM: PRIMARY SCHOOL TEACHERS' REFLECTIVE PEDAGOGIES AND PRACTICES** on **12 August 2023**

I am a member of the Professional Editors' Guild (member number ELS002) and commit to the following codes of practice (among others):

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- Checking citation style is correct, punctuating as needed and flagging missing or incorrect references
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- Returning the document with track changes for the author to accept

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To whom it may concern,

I, **Lounette Els**, confirm that I have met the above standards of editing and professional ethical practice as set out by the Professional Editors' Guild (PEG) of South Africa. The content of the work edited remains that of the student.

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